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[Additional counsel listed on signature page]

UNITED STATES DISTRICT COURT

NORTHERN DISTRICT OF CALIFORNIA

NEETA THAKUR, KEN ALEX, NELL GREEN NYLEN, ROBERT HIRST, CHRISTINE PHILLIOU, and JEDDA FOREMAN, on behalf of themselves and all others similarly situated,

Plaintiffs,

v.

DONALD J. TRUMP, in his official capacity as President of the United States; DEPARTMENT OF GOVERNMENT EFFICIENCY ("DOGE"); AMY GLEASON, in her official capacity as Acting Administrator of the Department of Government Efficiency; NATIONAL SCIENCE FOUNDATION;

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Case No. 3:25-cv-04737-RL

DECLARATION OF NEETA THAKUR

The Honorable Rita F. Lin

BRIAN STONE, in his official capacity as Acting Director of the National Science Foundation;
NATIONAL ENDOWMENT FOR THE HUMANITIES;
MICHAEL MCDONALD, in his official capacity as Acting Chairman of the National Endowment for the Humanities;
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY;
LEE ZELDIN, in his official capacity as Administrator of the U.S. Environmental Protection Agency;
UNITED STATES DEPARTMENT OF AGRICULTURE;
BROOKE ROLLINS, in her official capacity as Secretary of the U.S. Department of Agriculture;
AMERICORPS (a.k.a. the CORPORATION FOR NATIONAL AND COMMUNITY SERVICE);
JENNIFER BASTRESS TAHMASEBI, in her official capacity as Interim Agency Head of AmeriCorps;
UNITED STATES DEPARTMENT OF DEFENSE;
PETE HEGSETH, in his official capacity as Secretary of the U.S. Department of Defense;
UNITED STATES DEPARTMENT OF EDUCATION;
LINDA MCMAHON, in her official capacity as Secretary of the U.S. Department of Education;
UNITED STATES DEPARTMENT OF ENERGY;
CHRIS WRIGHT, in his official capacity as Secretary of Energy;
UNITED STATES DEPARTMENT OF HEALTH AND HUMAN SERVICES;
ROBERT F. KENNEDY, JR., in his official capacity as Secretary of the U.S. Department of Health and Human Services;
UNITED STATES CENTERS FOR DISEASE CONTROL;
MATTHEW BUZZELLI, in his official capacity as Acting Director of the Centers for Disease Control;
UNITED STATES FOOD AND DRUG ADMINISTRATION;
MARTIN A. MAKARY, in his official capacity as Commissioner of the Food and Drug Administration;
UNITED STATES NATIONAL INSTITUTES OF HEALTH;
JAYANTA BHATTACHARYA, in his official capacity as Director of the National Institutes of

Health;
INSTITUTE OF MUSEUM AND LIBRARY SERVICES;
KEITH SONDERLING, in his official capacity as Acting Director of the Institute of Museum and Library Services;
UNITED STATES DEPARTMENT OF THE INTERIOR;
DOUG BURGUM, in his official capacity as Secretary of the Interior;
UNITED STATES DEPARTMENT OF STATE;
MARCO RUBIO, in his official capacity as Secretary of the U.S. Department of State;
DEPARTMENT OF TRANSPORTATION;
SEAN DUFFY, in his official capacity as Secretary for the U.S. Department of Transportation,

Defendants.

DECLARATION OF NEETA THAKUR

I, Neeta Thakur, declare as follows:

1. I have personal knowledge of the facts contained in this declaration and, if called as a witness, could and would testify competently to those facts.

2. I am a pulmonary and critical care specialist at the University of California, San Francisco (UCSF) who examines the role of social and environmental stressors on asthma and COPD in historically marginalized communities. I currently serve as Medical Director of the Zuckerberg San Francisco General Hospital Chest Clinic. I am also an associate professor of medicine and pulmonary and critical care at UCSF.

3. I completed dual degrees in public health and medicine at the University of Arizona, where I earned MPH and MD degrees in 2007. I came to UCSF for a residency in Internal Medicine (2007-10) and stayed to complete a Pulmonary and Critical Care Medicine fellowship (2010-13). From 2013 to 2015, I was a clinical instructor at UCSF and joined faculty in 2015. Since then, I have worked at UCSF as a clinician, professor, and academic researcher.

4. My research focuses on (1) defining obstructive lung disease phenotypes that exist in racially and ethnically diverse communities and how these are shaped by social and environmental stressors; (2) identifying community-specific drivers that place individuals at high risk for poor outcomes; and (3) co-developing place-based and targeted interventions aimed at social and environmental stressors to improve respiratory outcomes in historically marginalized populations. My research is transdisciplinary and employs community-engaged approaches that enable community stakeholders to help shape research questions and propose locally relevant interventions to promote public health.

5. Articles illustrative of my focus on social determinants of pulmonary health include (among many others) an article on *Early life air pollution and asthma risk in minority children* published in the American Journal of Respiratory and Critical Care Medicine 188 (3), 309-318 (2013); and an article on *Associations between historical residential redlining and current age-adjusted rates of emergency department visits due to asthma across eight cities in California,* published in The Lancet Planetary Health 4 (1), e24-e31 (2020).

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6. My research, which frequently involves collaboration with other universities and community based organizations, has been supported by state grants, federal grants from the National Institutes of Health (NIH) and Environmental Protection Agency (EPA), foundation grants, and other sources.

7. In recognition of my research leadership, I was this year (2025) selected as the faculty director of Clinical Research Operations for the Clinical Trials Operations Unit at UCSF's Clinical & Translational Science Institute after a competitive search process.

8. A true and correct copy of my curriculum vitae is attached as Exhibit A.

Grant Application to EPA

9. In November 2021, I submitted a grant application to EPA in response to its announcement of funding opportunity EPA-G2021-STAR-H1. This opportunity, made available through the agency's Science to Achieve Results (STAR) program, focused on "Cumulative Health Impacts at the Intersection of Climate Change, Environmental Justice, and Vulnerable Populations/Lifestages: Community-Based Research for Solutions."

10. My research team's Grant Application, titled "Partnering for Resilient Opportunities To Eliminate Toxic (PROTECT) Health Effects from Wildfire $PM_{2.5}$ in Environmental Justice Communities," addressed the potential to intervene to prevent adverse health effects to environmental justice (EJ) communities from the fine particulate matter (PM) characteristic of wildfire smoke. Due to their small size (2.5 microns), $PM_{2.5}$ particles can penetrate deeply into human lung tissue and do considerable damage. A true and correct copy of our Grant Application is attached as Exhibit B.

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11. The premise of our grant research was that the increase in wildfire smoke in California has had a widespread and cascading impact on EJ communities, because environmental pollution and the social adversity that magnifies adverse health outcomes are concentrated in communities of color and low-income communities. Our proposal aimed to (1) estimate the health effects of sub-daily exposure to wildfire-specific $PM_{2.5}$ in California, including across social vulnerability factors, with particular focus on effects within EJ communities: (2) understand community recovery from short-term health effects following exposure; (3) understand indoor infiltration of wildfire smoke and the mitigating effect of housing quality and behaviors on health effects; and (4) identify acceptable, community-relevant interventions to mitigate exposure.

12. Our grant proposal, on which I was Principal Investigator, encompassed nine investigators spanning three institutions: UCSF, UC Berkeley, and California's Office of Environmental Health Hazard Assessment. Our team's expertise spanned exposure and building science, environmental engineering, atmospheric modeling, epidemiology, implementation science, and community-based participatory research.

13. Our proposal also contemplated work with community-based organizations and local government partners in the intended study areas of Fresno, Richmond, and San Francisco, and remuneration to community participants for same.

14. The Grant Application requested funding commensurate with our cumulative 3-year budget of $1,330,536 to support our multi-campus, multi-agency, multi-nonprofit research collaboration.

EPA's Grant Award

15. On November 22, 2022, an EPA Senior Grants Management Specialist, Jennifer Brooks, transmitted to me a Notice of EPA Award and the Grant Agreement. The Agreement indicated that our team was authorized to proceed for Project Period 12/01/2022-11/30/2025, and that EPA would make an initial grant of $690,000 (i.e., approximately half of project costs).

16. A true and correct copy of the 2022 Notice and Grant Agreement are attached as Exhibits C and D respectively.

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17. On June 21, 2023, an EPA Senior Grants Management Specialist, Jennifer Brooks, transmitted to me a second Notice of EPA Award and an Assistance Amendment. The Amendment likewise indicated that our team was authorized to proceed for Project Period 12/01/2022-11/30/2025. It stated that EPA was awarding $640,536, bringing our total federal funding award to $1,330, 536.

18. A true and correct copy of the 2023 Notice and Grant Agreement are attached as Exhibit E and F respectively.

19. To date, we have subcontracted $297,487 to UC Berkeley and $40,000 to our nonprofit partner Central California Asthma Collaborative.

EPA's Grant Termination

20. On April 28, 2025, EPA sent to the UC Regents a document styled as an "Assistance Amendment." A true and correct copy of the Assistance Amendment is attached as Exhibit G.

21. The Amendment instructed our research team to "stop work; terminate the [grant] agreement; reduce performance period duration; [and] curtail scope of work," while waiving certain reporting requirements. *Id*. at 1. It stated that "(EPA) hereby awards $0.00" towards any unfunded, as-yet-unincurred costs of the previously awarded $1,330,536. *Ibid.*

22. The Assistance Amendment stated: "The Agency is asserting its right under 2 C.F.R. 200.340 and the Termination General Term [stet] and Condition of this agreement to unilaterally terminate this award." *Id*. at 4.

23. The Amendment was accompanied by memorandum from EPA to the Director of Contracts and Awards at UCSF titled "Termination of EPA Assistance Agreement RD 84048101 under 2 CFR 200.340." A true and correct copy of this memo is attached as Exhibit H.

24. The memo stated that EPA terminated our grant for the following reasons:

> [T]he award no longer effectuates the program goals or agency priorities. The objectives of the award are no long consistent with EPA funding priorities.

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> The EPA Administrator has determined that, per the Agency's obligations to the constitutional and statutory law of the United States, this priority includes ensuring that the Agency's grants do not conflict with the Agency's policy of prioritizing merit, fairness, and excellence in performing our statutory functions. In additional to complying with the law, it is vital that the Agency assess whether all grant payments are free from fraud, abuse, waste, and duplication, as well as to assess whether current grants are in the best interests of the United States.
>
> The grant specified above provides funding for programs that promote initiatives that conflict with the Agency's policy of prioritizing merit, fairness, and excellence in performing our statutory functions; that are not free from fraud, abuse, waste, or duplication; or that otherwise fail to serve the best interests of the United States. The grant is inconsistent with, and no longer effectuates, Agency priorities.

Id. at 1.

Harm from EPA's Grant Termination

25. I and my project team have suffered immediate harm as a result of the cancellation of the grant. Specifically:

a) I have been unable to complete the health analyses with our UC Berkeley colleagues as well as identify promising health-protecting strategies to help protect communities across California during wildfire smoke events. Instead, I have had to spend significant time seeking alternate funding sources. This includes unexpected grant writing, and reaching out to other funding sources, including philanthropy groups. In addition, to support staff and avoid layoff of two individuals, I needed to use my own discretionary funds to support team members.

b) As my own time was also financially supported by this grant, I also needed to find new funding sources to fill this unexpected funding gap.

c) The abrupt loss of funding has additionally impacted the overall training environment for my research team, which has had to endure a funding gap for a post-doctoral fellow, the letting go of a student intern with our team, and uncertainty over whether we can accept new trainees on our team.

d) The UCSF and UC Berkeley researchers on this grant have been unable to complete the proposed analyses of the health impacts of wildfire smoke events across the state of California. This is after considerable work by UCB researchers to develop an unprecedented, highly temporally spatially resolute map of wildfire smoke at the hourly level. As a consequence, at least three research publications will go unpublished that have the potential for high impact both for science and public health.

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e) The now-terminated grant also supported new collaborations as well as early career investigators at UC Berkeley. The loss of this funding has impacted the pay plan for a recently hired graduate student at UC Berkeley, support for a post-doctoral fellow, and productivity for an early career investigator.

f) Lastly, the unrealized objectives of this transdisciplinary grant have important public health impacts that include:

- Generation of a temporally and geographically resolute map of wildfire smoke PM2.5 for the time period 2017 to 2022. This unprecedented modeling approach of using ground-level measures over an extended time period was to be used to provide more accurate estimates of exposure during future wildfire smoke events.

- Improved understanding of the health impacts of wildfire smoke, and specifically, how long after an event we expect health harms and for what health conditions. This has direct clinical and public health relevance.

- Identification of relevant thresholds for public health guidance during wildfire events. To our team's knowledge, all studies to date on the health effects of wildfire smoke use daily exposure averages. However, this is not how individuals experience adverse air quality: there are time periods where smoke exposure may be very high, and this is not reflected in the daily mean exposure. With our team's hourly exposure measurements, we are uniquely able to identify relevant thresholds for public health guidance during wildfire events.

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g) Grant termination has compromised the trust-building necessary for community-engaged participatory action research. It has taken years for effort for me to develop relationships with the community based organizations and community-engaged individuals who wrote letters in support of our grant application. They did so notwithstanding their scare time and resources, with the expectation that our project would deliver tangible benefits to their low income communities in the form of improved respiratory health. Through this EPA grant we were able to build partnerships with fifteen community based organizations and the work with these groups was abruptly stopped due to this termination. This is after significant efforts by these partners to co-design a survey, and also after my team had made a commitment to better understand how health impacts were being experienced in their communities and barriers to health protective resources during wildfire smoke events. The EPA's termination of this grant will make it more difficult for me to partner with organizations such as the Central California Asthma Collaborative in Fresno and Brightline in San Francisco, and with a community-trusted scientist in Richmond (Dr. Omoniyi Omotoso).

h) Additionally, even if we were eventually to find replacement funding for this project (a difficult proposition given the sums at stake), they would no longer be adequate to cover our expenses. This includes costs of staff, finding and training post-doctoral fellows to carry out proposed analyses, and re-establishing partnerships.

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i) These personal and financial harms are ongoing.

j) These harms are in addition to the loss of value to the public from my research team's inability to complete work on studying health risks from the fine particulate matter associated with wildfire, and inability to design health-protective interventions for three of California's most health-vulnerable communities.

Appeal of Grant Termination

26. The EPA memo regarding grant termination provided that UCSF could submit a "Dispute" to a named Disputes Decision Official at EPA within 30 days from the date EPA transmitted the termination notice.

27. UCSF is currently preparing such a Dispute.

28. The Award of Grant Funding will remain unavailable to our project pending the outcome of the appeal.

Role of Class Representative

29. I am ready to assume the responsibilities of serving as a class representative. I understand that I must stay informed regarding developments in the lawsuit, communicate regularly with my attorneys, and act in the best interests of the class. I have no conflicts that would prevent me from assuming this responsibility.

30. I have been in communication with other UC researchers, who would be members of the class, who have suffered the same general type of harm as I describe above, from the abrupt termination of their previously approved research grants. This harm is widespread and I believe it will only increase in scope and impact if classwide relief is not granted.

I declare under penalty of perjury under the laws of the State of California and the United States that the foregoing is true and correct.

Executed this 28 day of May, 2025.

DocuSigned by:
F643A791A203416...

Neeta Thakur

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EXHIBIT A

Prepared: May 10, 2025

University of California, San Francisco

CURRICULUM VITAE

Name: Neeta Thakur, MD, MPH

Position: Associate Professor In Residence, Step 3
Medicine
School of Medicine

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San Francisco, CA 94143
Voice: 415 378-6594
Pager Number: 415 443-9259
Email: Neeta.Thakur@ucsf.edu

EDUCATION

1998 - 2002	University of Arizona, Tucson, AZ	B.S.	Physiological Sciences, Magna Cum Laude
2002 - 2007	University of Arizona, Tucson, AZ	M.D./M.P.H.	
2007 - 2008	University of California, San Francisco	Intern	Medicine
2008 - 2010	University of California, San Francisco	Resident	Medicine
2010 - 2013	University of California, San Francisco	Fellow	Pulmonary and Critical Care Medicine
2012 - 2013	University of California, San Francisco	Certificate	Advance Training in Clinical Research
2012 - 2015	University of California, San Francisco	Fellow	Clinical Pharmacology
2015 - 2019	University of California, San Francisco	Certificate	Implementation Sciences
2019 - 2019	Zuckerberg San Francisco General Hospital, UCSF	Program	ZSFG Clinical Leaders Professional Development Program

LICENSES, CERTIFICATION

2009	California Medical Licensure A107658

2010	Internal Medicine Board Certification
2013	Pulmonary Medicine Board Certification
2015	Critical Care Medicine Board Certification

PRINCIPAL POSITIONS HELD

2004 - 2005	Arizona AIDS Education and Training Center, Tucson, AZ	Research Assistant	
2005 - 2005	California STD/HIV Prevention Training Center, Oakland, CA	Program Assistant	
2013 - 2015	University of California, San Francisco, CA	Clinical Instructor	Medicine
2015 - 2017	University of California, San Francisco, CA	Assistant Adjunct Professor	Medicine
2017 - 2021	University of California, San Francisco, CA	Assistant Professor in Residence	Medicine
2021 - present	University of California, San Francisco, CA	Associate Professor in Residence	Medicine

OTHER POSITIONS HELD CONCURRENTLY

2013 - 2014	Health and Environmental Resource Center, San Francisco, CA	Medical Director	
2017 - present	Zuckerberg San Francisco General Hospital	Medical Director of the Chest Clinic	Medicine
2020 - 2022	Zuckerberg San Francisco General Hospital	Founder, Medical Director of the Critical Illness Recovery Clinic	Medicine
2020 - 2022	UCSF Partnership for Research in Implementation Science for Equity (PRISE) Center	Program Director for Sub-specialty Care	Epidemiology and Biostatistics and Medicine
2021 - 2022	EPA Clean Air Scientific Advisory Committee Particulate Matter	Committee Member	
2021 - present	Zuckerberg San Francisco General Hospital	Director of Diversity and Social Justice	Division of Pulmonary and Critical Care Medicine

2022 - present	NHLBI National Asthma Education and Prevention Program Coordinating Committee	Committee Member	
2023 - present	Health Effects Institute	Research Committee Member	
2023 - present	UCSF PRISE Center	Co-Diector	Epidemiology and Biostatistics and Medicine
2024 - 2024	EPA Clean Air Scientific Advisory Committee NOx	Committee Member	
2024 - present	UC Center for Climate, Health and Equity	Interim Co-Chair of Research	UC-wide position
2025 - present	Clinical Research Operations/Clinical Trials Operation	Faculty Director	Office of the Associate Vice Chancellor for Clinical Research (AVC-CR) Clinical and Translational Science Institute (CTSI)

HONORS AND AWARDS

2002	Magna Cum Laude	University of Arizona
2009	Clinical and Translational Science Institute Resident Research Funding Award	UCSF CTSI
2010	Clinical and Translational Science Institute Travel Award	UCSF CTSI
2010	Environmental and Occupational Health Travel Award	American Thoracic Society
2012	Walter Travel Fund	Breathe California
2012	Social and Behavioral Health Sciences Travel Award	American Thoracic Society
2013	Social and Behavioral Health Sciences Travel Award	American Thoracic Society
2013	2nd Place for oral presentation, The Ninth Annual Respiratory Disease Young Investigators' Forum.	Respiratory Disease Young Investigators' Forum

2014	Podell Hewett Fellowship in Airways Disease Research, 2014-15	UCSF Division of Pulmonary and Critical Care Medicine Fellowship Program
2014	Social and Behavioral Health Sciences Travel Award	American Thoracic Society
2014	American Thoracic Society Recognition Award for Early Career Investigators	American Thoracic Society
2015	Parker B. Francis Fellow	Parker B. Francis Fellowship Program
2017	Nina Ireland Program for Lung Health Faculty	UCSF Division of Pulmonary and Critical Care Medicine
2018	Selected American Thoracic Society Representative for the 23rd Congress of the Asian Pacific Society of Respirology	American Thoracic Society
2019	Michael S. Stulbarg Outstanding Teaching Award	UCSF Division of Pulmonary and Critical Care Medicine Fellowship Program
2019	PEARLS tool recommended for ACEs screening in pediatric primary care. Only pediatric screening tool to be financially reimbursed by Medicaid.	California Department of Health Care Services
2020	Haile T. Debas Academy of Medical Educators Excellence in Teaching Award	UCSF
2021	Assembly on Behavioral Science and Health Services Research Early Career Achievement Award	American Thoracic Society
2021	V. Courtney Broaddus Service Award	UCSF Division of Pulmonary and Critical Care Medicine
2022	The Outstanding Mentor Award	UCSF Division of Pulmonary and Critical Care Medicine
2024	John Murray Humanitarian Award	UCSF ZSFG Department of Medicine

KEYWORDS/AREAS OF INTEREST

Social determinants of health, environmental justice, implementation sciences, health disparities, racism, asthma, COPD, acculturation, race/ethnicity, adverse childhood experiences, biomarkers, systems of care, pulmonary rehabilitation, representation in research

CLINICAL ACTIVITIES

CLINICAL ACTIVITIES SUMMARY

I work in both the outpatient and inpatient clinical settings at Zuckerberg San Francisco General Hospital (ZSFG). Since 2017, I have served as the Medical Director of the Chest Clinic. In this role, I have significantly expanded access to key treatments and services for our vulnerable patient population. This include establishing a shot clinic for our severe asthma patients to receive biologic therapies such as omalizumab and mepolizumab, developing and implementing a pipeline to access special pharmacies for anti-fibrotic therapies for our interstitial lung disease patients, and developing and piloting a community-based pulmonary rehabilitation program for symptomatic patients with COPD that is accessible for all patients within the SF Community Health Network - now a R01 trial to test for effectiveness. For each of these services, I had to develop good understanding of current health system barriers and reimbursement processes while also addressing important patient barriers (health literacy and numeracy, costs, and care access/transportation issues) prior to implementation. Programs were iteratively developed with cross-disciplinary input to ensure seamless integration into clinical flow. I have also developed relationship with investigators across campuses to gain critical access to pulmonary research trials, including those for asthma, pulmonary fibrosis, MAC treatment, COPD, and pulmonary rehabilitation.

In my role as Medical Director, I have worked to significantly enhance the clinical and educational experience for our six pulmonary fellows in our ACGME training program. This includes developing a case series of outpatient pulmonary cases, curating relevant ACGME board exam questions, organizing a weekly didactic series of high yield pulmonary topics, and precepting with fellows in our outpatient Chest clinic. Our ZSFG Chest Clinic is now the highest-rated clinic among our fellows and considered a high-yield learning opportunity by residents. In addition to my role as Medical Director, I see my own patients one half-day per week in the outpatient clinic. These clinical experiences (both in the inpatient and outpatient settings) at ZSFG gives me first-hand insight on how social and environmental stress negatively affect outcomes in patients with obstructive lung disease.

I also attend for three weeks on the pulmonary consult service and for three weeks in the Medical Intensive Care Unit (MICU). In these settings, I work with different trainee levels ranging from medical students to fellows and with trainees from different disciplines.

CLINICAL SERVICES

2013 - 2016	Parnassus Chest Faculty Practice Preceptor	Half a day per month
2014 - 2015	Parnassus Critical Care Attending	6 weeks per year
2013 - present	ZSFG Chest Clinic Provider and Preceptor	Half a day per week
2015 - present	ZSFG Medical Intensive Care Attending	3 weeks per year
2015 - present	ZSFG Pulmonary Consult Attending	3 weeks per year

Prepared: May 10, 2025

PROFESSIONAL ACTIVITIES

MEMBERSHIPS

2010 - present American Thoracic Society

2022 - present International Society for Environmental Epidemiology

SERVICE TO PROFESSIONAL ORGANIZATIONS

2014 - 2023	American Thoracic Society	Health Equity and Diversity Committee Member
2014 - 2018	American Thoracic Society	Environmental, Occupational and Population Health Assembly s Early Faculty and Fellows' Working Group Member
2017 - 2020	American Thoracic Society	Behavioral Science and health Service Research Program Committee Member
2018 - 2019	American Thoracic Society	Health Equality and Diversity Committee, Vice Chair
2019 - 2022	American Thoracic Society	Health Equality and Diversity Committee, Chair
2023 - present	American Thoracic Society	Ethnic, Conflicts of Interest Committee Member

SERVICE TO PROFESSIONAL PUBLICATIONS

2015 - present American Journal of Respiratory Critical Care Medicine, ad hoc reviewer (4-5 manuscripts per year)

2016 - present Plos One, ad hoc reviewer (1-2 manuscripts per year)

2016 - present Pediatrics, ad hoc reviewer (1-2 manuscripts per year)

2019 - present Thoracic, ad hoc reviewer (0-1 manuscripts per year)

2019 - present Journal of Allergy and Clinical Immunology, ad hoc reviewer (2-3 manuscripts per year)

2021 - present AJPH, ad hoc reviewer (0-1 manuscripts per year)

2021 - present	Lancet, ad hoc reviewer (0-1 manuscripts per year)
2022 - present	JAMA Network, ad hoc reviewer (2-3 manuscripts per year)

INVITED PRESENTATIONS - INTERNATIONAL

2013	American Thoracic Society International Conference "The Impact of Socioeconomic Status On Asthma Outcomes Among Black Youth", Philadelphia, PA.	Abstract, Podium
2013	American Thoracic Society International Conference "Decreased Asthma Diagnosis, Report of Symptoms and Medication Use Among Children of Mothers with Low Language Acculturation", Philadelphia, PA.	Abstract, Podium
2014	American Thoracic Society International Conference "Asthma and Discrimination The GALA II And SAGE II Studies", San Diego, CA.	Abstract, Podium
2015	American Thoracic Society International Conference "Diversity of the Healthcare Workforce," Denver, CO.	Invited Speaker, Podium
2017	American Thoracic Society International Conference "Racial Discrimination Affects Drug Response in African American Youth with Asthma," Washington, DC.	Abstract, Podium
2018	American Thoracic Society International Conference "Expanding Care Coordination to Outside the Health Care System:Addressing Unmet Social Needs," San Diego, CA.	Speaker and organizer of session
2018	23rd Congress of the Asian Pacific Society of Respirology "A Multi-level Approach to Asthma Health Disparities: from Biomarkers to Geocoded Data," Taipei, Taiwan. (Award)	Abstract, Podium
2019	American Thoracic Society International Conference "Adverse Childhood Experiences are Associated with Pediatric Asthma," Dallas, TX.	Abstract, Podium
2019	American Thoracic Society International Conference "Clinical Year in Review: Health Disparities," Dallas, TX.	Invited Speaker, Podium
2019	American Thoracic Society International Conference "Climate Change and Respiratory Health: Widening US Disparities," Dallas, TX.	Organizer of session
2021	American Thoracic Society International Conference "Removing barriers to clinical research" Virtual presentation.	Invited Speaker
2021	American Thoracic Society International Conference "Disparities Across Grantee Populations", Post-graduate course. Virtual presentation.	Invited Speaker

2021	Society for Prevention Research "Use of biological and context data to inform prevention: Opportunities, challenges and future directions", Virtual presentation.	Invited Speaker, Plenary Session
2021	26th Congress of the Asian Pacific Society of Respirology "Respiratory Health Inequities and the Compounding Impact of Climate Change" Virtual presentation.	Invited Speaker
2022	American Thoracic Society International Conference "Improving Representation in Clinical Studies" San Francisco, CA.	Invited Speaker
	American Thoracic Society International Conference "How to Build a Diverse Pipeline of PCCM Clinicians Going Forward?" San Francisco, CA.	Invited Speaker
2022	American Thoracic Society International Conference "The Role of Psychosocial, Neighborhood, and Contextual Factors as Environmental Stressors on Asthma Exacerbations" San Francisco, CA.	Invited Speaker
2022	International Society of Environmental Epidemiology "Bridging Implementation Science and Health Equity to Mitigate Climate Change Impacts" Session speaker. Athens, Greece.	Invited Speaker
2023	American Thoracic Society International Conference "Improving Representation in Biomedical Studies" Washington DC.	Invited Speaker
2023	American Thoracic Society International Conference "Utilizing a Community Based Participatory Approach in Environmental Justice Research" Washington DC.	Invited Speaker
2024	Pediatric Academic Societies Meeting "Moving Beyond PEARLS: Towards Sustainable Models for Addressing Early Life Adversity" Toronto, CA.	Invited Speaker
2024	American Thoracic Society International Conference. NHLBI Workshop, "Inclusive Practices in Clinical Trial Recruitment". San Diego, CA.	Invited Speaker

INVITED PRESENTATIONS - NATIONAL

2015	California Asthma Summit, "The Impact of Adversities on the Development and Management of Asthma", Los Angeles, CA.	Invited Speaker, Podium
2016	University of Arizona, College of Medicine, "A Multilevel Approach to Understanding Asthma Health Disparities", Tucson, AZ.	Invited Speaker, Podium

2016	ACEs Conference and Symposium: Pediatrics Symposium."ACEs and Asthma", San Francisco, CA.	Invited Speaker, Podium
2017	University of Illinois, Chicago, Medicine Grand Rounds. "What's Race Got to do with it? A Multilevel Approach to Examining Health Disparities", Chicago, IL	Invited Speaker, Podium
2017	University of Illinois, Chicago, Pulmonary Conference. "A Multi-Level Approach to Understanding and Improving Outcomes in Obstructive Lung Disease", Chicago, IL	Invited Speaker, Podium
2019	State of the Science: A National Research Meeting on Medical and Social Care Integration. "Should there be a common health outcome metric for social care intervention research? Use of biomarkers", SIREN UCSF Network, Portland, OR	Invited Speaker, Podium
2020	Mount Sinai, Division of Pulmonary and Critical Care Medicine Grand Rounds. "A Multi-Level Approach to Understanding the Role of Racism in Asthma" New York, New York. (virtual)	Invited Speaker, virtual presentation
2021	Mount Sinai, Department of Medicine T32 Virtual Retreat. "Issues of health equity in research and ways to reduce barriers to engagement by addressing SDOH" New York, New York. (virtual)	Invited Speaker, virtual presentation
2021	Thomas Jefferson University, World Asthma Day. "Addressing Asthma Health Disparities in 2021". Pittsburg, PA.(virtual)	Keynote Speaker, virtual presentation
2022	University of Washington, Pulmonary Grand Rounds. "Implementation Science in Action: Rehabilitation in Safety Net Environments (RISE) COPD", Virtual presentation	Invited Speaker
2022	Beth Israel, Pulmonary Grand Rounds. "Implementation Science in Action: Rehabilitation in Safety Net Environments (RISE) COPD", Virtual presentation.	Invited Speaker
2023	Children's Hospital of Philadelphia (CHOP) Center for Health Equity "CBPR Workshop", Virtual workshop.	Invited Speaker and Workshop organizer
2023	Regional Asthma Management & Prevention (RAMP) and the National Center for Healthy Housing (NCHH). "Racism, Housing, and Asthma: A Conversation" Webinar.	Panel Discussant
2024	ACEs Aware. "Pediatric ACES and Related Life Events Screener (PEARLS) and Health in a Safety-net Practice". Webinar.	Invited Speaker
2024	University of California, Irvine Medical Grand Rounds. "Engaging Community: Identifying & Prioritizing Place-based Interventions for Asthma". Virtual Presentation	Invited Speaker

2024	UIC ReCOVery Long COVID Summit, "Barriers to Long COVID Care for Minoritized Populations" Panel Discussion. Chicago, Illinois	Invited Panelist
2024	U Colorado Excellence in Respiratory and Critical Care Seminar Series, "Engaging Community: Identifying & Prioritizing Place-based Interventions for Asthma". Invited Professorship. Denver, Colorado	Invited Speaker

INVITED PRESENTATIONS - REGIONAL AND OTHER INVITED PRESENTATIONS

2010	Internal Medicine R3 Talk "The Economics of Tobacco: the business and political strategy", University of California, San Francisco	Presenter
2010	Pulmonary Grand Rounds "UPDATE: Factors associated with exacerbations in COPD", University of California, San Francisco	Invited Speaker, Podium
2012	Critical Care Medicine Grand Rounds "'I survived, but am I living?' Long-term Outcomes of ICU Hospitalizations", University of California, San Francisco	Invited Speaker, Podium
2013	Annual Pulmonary Research Retreat "Socioeconomic Status and Asthma Susceptibility: The GALAII and SAGE II Studies", University of California, San Francisco. Abstract selected for oral presentation	Abstract, Podium
2014	UCSF MTPCCR "The Social Determinants and Asthma: How chronic stress affects asthma in minority youth." San Francisco, CA	Guest Lecturer
2014	Health Disparities Research Symposium, UCSF "Increased Asthma Risk with Perceived Discrimination", San Francisco, CA	Abstract, Podium
2015	Annual School Symposium on Asthma, SEHAC. "The Impact of Adversities on the Development and Management of Chronic Illnesses". Oakland, CA.	Invited Speaker, Podium (Community Event)
2015	San Francisco State University, Fall Colloquial. "The heterogeneity of Asthma: What is the role of Poverty?" San Francisco, CA	Invited Speaker, Podium
2016	Medicine Grand Rounds. "What's Race Got to do with it? A Multilevel Approach to Examining Health Disparities", University of California, San Francisco. San Francisco General Hospital.	Invited Speaker, Podium
2016	Stanislaus County Asthma Coalition. "The Impact of Adversities on the Development and Management of Asthma", Modesto, CA.	Invited Speaker, Podium (Community Event)

2016	Medicine Grand Rounds. "The heterogeneity of Asthma: What is the role of Poverty?" University of California, San Francisco. Parnassus Campus.	Invited Speaker, Podium
2016	SF Build Dialogue. "The heterogeneity of Asthma: What is the role of the environment?" San Francisco State University. San Francisco, CA.	Invited Speaker, Podium and Panelist
2016	White Coats for Black Lives. "Exploring Race-based Medicine." University of California, San Francisco. Parnassus Campus.	Invited Speaker, Podium and Panelist
2016	Asthma Forum. "Asthma Phenotypes", Kaiser Permanente, San Francisco, CA.	Invited Speaker, Podium (Community Event)
2017	Medicine Grand Rounds. "COPD Update: Identifying Patients and Optimizing Treatment in Vulnerable Populations", University of California, San Francisco. San Francisco General Hospital.	Invited Speaker, Podium
2017	Asthma Forum. "Discrimination, Psycho-Social Stress and the Relationship to Non-Atopic Neutrophilic Asthma and Other Asthma Phenotypes", Kaiser Permanente, San Francisco, CA.	Invited Speaker, Podium and Panelist (Community Event)
2017	Koret Institute for Precision Prevention. "A Multilevel Approach to Understanding Asthma Health Disparities", UC Berkeley. Berkeley, CA.	Invited Speaker, Podium
2017	CME Care of the Vulnerable Patient. "Approach to an Underserved Patient with COPD", Zuckerberg San Francisco General, UCSF. San Francisco, CA.	Invited Speaker, Podium
2018	American Lung Association. "State of the Air 2018 and New Research" UCSF Mission Bay Campus. San Francisco, CA.	Invited Speaker, Podium (Community Event)
2018	CME UCSF 46th Annual Advances in Internal Medicine. "Asthma Updates", UCSF, San Francisco, CA.	Invited Speaker, Podium
2019	Asthma Summit. "Asthma and the Indoor Environment: The Who, What, and How (we can help). Sacramento, CA	Invited Speaker, Podium and Panelist
2019	Annual Tri-hospital Pulmonary Retreat. "A Multi-level Approach to Examining and Addressing Asthma Health Disparities". Presidio. San Francisco, CA.	Invited Speaker, Podium
2019	UCSF School of Medicine: Adverse Childhood Experiences Speaker Series. "Stress and ACEs: risk factors for poor health . San Francisco, CA.	Invited Speaker, Podium

2021	UCSF School of Medicine. Racism and Race: The Use of Race in Medicine and Implications for Health Equity Event Series, Session 2: Case Studies: Race, Racial Categorization, and Racism in Medicine Today. San Francisco, CA	Panelist, virtual presentation
2022	UCSF Department of Pediatrics Grand Rounds. PEARLS: Screening for Social Adversity in Primary Care: the Why & How. San Francisco, CA.	Invited Speaker, virtual presentation
2022	California Thoracic Society Meeting. "Wildfires and Effects on Obstructive Airways Disease". Carmel, CA	Invited Speaker
2022	CME UCSF 27th Annual Management of the Hospitalized Patient. "Management of Hospitalized Patient with Asthma and COPD". San Francisco, CA	Invited Speaker
2023	AIM Youth Mental Health Conference. "Research Findings from the Pediatric Adverse Childhood Experiences ACEs Study" Monterrey, CA	Invited Speaker and Panel Discussant
2023	California Department of Public Health Research Updates. "Historical Redlining and COVID-19 cases and deaths in California", Virtual Presentation	Invited Speaker

GOVERNMENT AND OTHER PROFESSIONAL SERVICE

2019 - present	SFDPH Climate Change Coordinating Committee	Member
2021 - 2022	Environmental Protection Agency (EPA) Clean Air Scientific Advisory Committee for PM2.5	Committee Member
2022 - present	NHLBI National Asthma Education and Prevention Program Coordinating Committee	Committee Member
2024 - present	Environmental Protection Agency (EPA) Clean Air Scientific Advisory Committee for NOx	Committee Member

UNIVERSITY AND PUBLIC SERVICE

SERVICE ACTIVITIES SUMMARY

Division Service: I play an active role in the UCSF Division of Pulmonary and Critical Care Medicine and serve on several division-specific committees and have served on several search committees for faculty and leadership positions within our division. On the Clinical Competency Committee, I evaluate the progression of our clinical fellows and ensure they are meeting core competencies. In my position on the Fellowship Selection Committee, I review applications, interview prospective fellows, and participate in the final selection meeting. I value this position as it provides an opportunity to ensure our fellows represent diverse interest and are from diverse backgrounds.

I also serve on the Nina Ireland Program for Lung Health (NIPLH) Executive Advisory Board in the Division of Pulmonary and Critical Care Medicine. This program was established in 2010

after a large gift and provides an endowment to support pulmonary medicine. One main area of focus is the unrestricted grant program which awards over $500,000/year of pilot funding to pulmonary and critical care medicine focused projects. The NIPLH Executive Advisory Board sets the research agenda for the granting program and reviews and provides recommendations for funding of applications. As a member, I have expanded the scope of the research program to include health disparities and implementation sciences as priority areas. I am also working with Dr. Golden (Director of the NIPLH) to develop a community-academic partnership grant program to promote and facilitate community-engaged research.

Lastly, I am the ZSFG Pulmonary Director of Diversity and Social Justice. In this role, I chaired the NI Scholars Pilot program from 2019-2022, which was intended to promote increased diversity within the pulmonary fellowship program, including recruitment of applicants from groups traditionally excluded from medicine. This program is targeted at applicants with a track record in scholarly activities, including clinical, translational, and basic science. In this role, I developed selection criteria and facilitated a group of six faculty members in selecting scholars for the last two fellowship applicant seasons. My other areas of focus are to increase the use of diversity supplements across the ZSFG Pulmonary Division (and the division as a whole) and to develop clinical equity markers across our clinical footprints at ZSFG extending from the outpatient to the ICU setting.

Department and Campus Service: I have served on several search committees for faculty and leadership positions across the School of Medicine, extending from the recruitment of basic scientists and epidemiologists to interventionists. At the start of 2024, I joined the CTSI Clinical Trials Advisory Committee (CTAC), which reviews and provides feedback on clinical research processes at UCSF. In addition, I recently joined the Academic Senate Committee on Equal Opportunity.

Service to Professional Societies: I chaired the American Thoracic Society (ATS) Health Equity and Diversity Committee from 2019-2022 and was a member of this committee since 2014 and rotated off in 2023 to join the Ethics and COI committee. The ATS is the leading professional association for pulmonary and critical care medicine and research with over 16,000 members worldwide. As chair, I oversaw several successes: expansion of a dedicated fellowship to 2 positions, establishment of an ALA-ATS-CHEST RWJF Harold Amos Fellow, partnering with the PFT committee to establish new guidelines removing the use of race from spirometry equations, providing scholarships to support URM medical students at the ATS conference, highlighting work on health disparities at the annual International ATS conference, and providing recommendations to the ATS leadership on diversifying committee representation.

Government Service: Over the past five years, I have increasingly served on several federal government expert panels, including the EPA Clean Air Scientific Advisory Committee PM and NOx Panel and the NHLBI National Asthma Education and Prevention Program Coordinating Committee. Locally, I am an active member of the SFDPF Climate Coordinating Committee, which discusses the health impacts of climate-related events across the city and county, how to leverage available resources in a coordinated fashion, and identify resource gaps.

Public Service: To increase awareness of respiratory health and provide disease supports and education, I started Asthma and COPD Health Days in San Francisco and Richmond, CA. These health fairs are directed at patients with lung disease receiving care within the SF Community Health Network and Lifelong Medical Care. These health fairs are supported through funding from the NIPHL, SF Department of Public Health, and research grants. At the

health fairs, participants received asthma inhaler teaching, information sheets and short Q&A sessions on environmental supports, learn how stress effects disease, and a tool kit which includes a spacer and environmental controls (e.g. dust mite pillow covers). In addition to these health fairs, I present at a variety of community events targeted at patients and Community Health Workers on asthma and COPD two to three times a year. Most recently, I am a member of the Technical Advisory Committee to the Bayview Hunters Point AB617 Community Steering Committee, which is developing a community emissions reduction plan to address traffic related pollution burden as well as climate change impact in Bayview Hunters Point.

UCSF CAMPUSWIDE

2024 - present	Clinical Trials Advisory Committee	Member
2024 - present	Committee on Equal Opportunity	Member

SCHOOL OF MEDICINE

2021 - 2022	Family and Community Medicine Faculty Search Committee	Committee Member
2022 - 2022	Epidemiology and Biostatistic Faculty Search Committee	Committee Member

DEPARTMENTAL SERVICE

2011 - 2015	Pulmonary and Critical Care Medicine Program Evaluation Committee	Fellow representative
2017 - 2018	Pulmonary Fellowship Program Director Search Committee	Member
2017 - 2018	Pulmonary Division Status of Women and UIM	Member
2014 - present	SFGH Chest Leadership Committee	Member
2015 - present	Nina Ireland Program for Lung Health Executive Advisory Board	Member
2016 - present	Pulmonary and Critical Care Medicine Fellowship Selection Committee	Member
2017 - present	Pulmonary and Critical Care Medicine Program Evaluation Committee	Member
2017 - 2019	Faculty Retreat Planning Committee	Member
2018 - 2020	Severe Asthma Clinical Trialist Search Committee	Member
2018 - present	Pulmonary and Critical Care Medicine Fellowship Clinical Competency Committee	Member
2020 - 2022	Nina Ireland Scholars Subcommittee	Chair
2022 - 2023	ZSFG Chief of Nephrology Search Committee	Member
2023 - present	Pulmonary and Critical Care Medicine Nina Ireland Endowed Chair Search Committee	Member

COMMUNITY AND PUBLIC SERVICE

1999 - 2002	Alternative Breaks - Service Learning organization, University of Arizona	Director
2000 - 2004	Fostering and Achieving Cultural Equity and Sensitivity (FACES) in Medicine, University of Arizona	President
2003 - 2004	Commitment to Underserved People (CUP) Program, University of Arizona College of Medicine	Referral Coordinator
2014 - present	Bay Area Research Consortium on Toxic Stress	Member
2014 - present	Present on topics related to asthma and COPD to community health workers and first line medical workers (e.g. school nurses, medial assistants)	Presenter
2016 - present	Asthma and COPD Day: Health Fair directed at patients with lung disease receiving care within the Community Health Network and ZSFG	Organizer
2018 - present	American Lung Association medical expert - provide testimony and meet with legislature regarding the negative impact of air pollution on lung health.	Medical Expert
2019 - present	National Consortium on Asthma and Toxic Stress	Member
2024 - present	AB617 Bayview Hunters Point Community Emissions Reduction Plan	Technical Advisor

CONTRIBUTIONS TO DIVERSITY

CONTRIBUTIONS TO DIVERSITY Contributions to Diversity, Equity & Inclusion Guidance

My research program, approach to mentoring, and the leadership positions I have elected to pursue are all tied to my commitment to diversity, equity, and inclusion. Over the last decade, my **research program** has contextualized how risk factors operate within and across communities (DOD, NHLBI K23) to contribute to health inequities, built upon these findings to create interventions with community perspectives and partnerships (EPA, PCORI), and, most recently, test these interventions through rigorous trial design in and with the communities they were co-designed (state-funded CAIPM, NHLBI R01). Through this work, we have taken steps to include community members as partners and ensure our research is representative of the populations most burdened by the disease or exposure of interest. As a result, all of our current studies have community partners as co-investigators, and greater than 70% of recruited study populations are composed of individuals historically excluded from research. Our work is purposeful in its design and constructs research questions that have clear community and policy targets for intervention.

I am dedicated to **supporting and mentoring** students, trainees, and early career faculty who identify as being from historically marginalized groups. This includes developing and supporting scholarship programs for trainees and junior faculty from marginalized backgrounds (ATS Health Equity and Diversity Fellowship, NI Scholar Program, YPAR Summer Intern Program), providing formal recommendations on diversifying the research field (Thakur

AJRCCM 2014, invited ATS presentations in 2015 and 2020, 2022, 2023), and providing support and mentorship in an inclusive, safe environment for trainees at every level (high school, undergraduate, graduate and medical school, and post-doctoral). The program that most exemplifies my commitment to students and trainees from marginalized backgrounds is our YPAR Summer Intern Program. In 2019, as part of my research program, we launched the Youth Participatory Action Research (YPAR) program targeted at teens from historically marginalized communities. In its first year, we hired six student interns (ages 14-17) from Richmond, CA. The paid internship program provided basic needs, such as meals, social support, and financial support, while also providing career development skills and fostering an interest in science. We have had promising results: supported 25 high school interns over the last five years, supported students to successfully obtain two grants (Community Art Mural and Community Air Monitoring Project), 100% retention in high school, and >97% of those eligible, attend college. In addition, by actively involving our pulmonary and post-doctoral fellows from marginalized groups as peer mentors, we have provided a setting where our high school students can see themselves in science while also enriching the training of our fellows.

Lastly, my **leadership** positions have been largely driven to address diversity, equity, and inclusion. Most exemplary was my role as Chair of the American Thoracic Society (ATS) Health Equality and Diversity Committee. The ATS is the leading professional association for pulmonary and critical care medicine and research with over 16,000 members worldwide. We have had several successes, including: dedicated fellowship, providing scholarships to support URM medical students at the ATS conference, highlighting work on health disparities at the annual International ATS conference, and providing recommendations to the ATS leadership on diversifying committee representation. In my role as chair: 1) I led a workshop, including researchers and individuals from the NHLBI, NIMHD, and FDA, to develop recommendations for increasing minority participation in clinical research. This work was published in the form of a Research Statement published in the American Journal of Respiratory and Critical Care Medicine (2020) and has resulted in several invited presentations Nationally; 2) hosted a Town Hall on Addressing Racism and Health Disparities with the leaders within ATS (inc. over 40 individuals) on how to shape and expand existing priorities of the ATS towards an equity lens. This has involved on-going meetings (2-3/months) with the executive leadership and committee leadership to ensure progress on set benchmarks and re-evaluation of guideline recommendations; and, 3) overseen the development of a mentoring and networking program for URM early career faculty and trainees in the ATS, including sponsoring URM students at the ATS conferences.

TEACHING AND MENTORING

TEACHING SUMMARY

My teaching experiences span the spectrum from bedside, clinical teaching to the development of educational programs. Examples include:
-As part of the K12 IMPACT Program, I developed the health system embedded experience for the K12 Scholars. This included working with key stakeholders at UCSF and ZSFG to determine alignment across training opportunities, identifying learning objectives based on aligned experiences across the two health systems, and regular biweekly check-ins with Scholars during their embedded experience.
-In 2019, I started the YPAR Summer Internship program. This program focuses on developing research and career development skills for teens from historically disadvantaged communities by employing a Youth Participatory Action Research (YPAR) curriculum (yparhub.berkeley.edu). Informed by their own experiences living in the community, coupled with introductory lectures of stress and the environment, the teens are encouraged to formulate

their own research question regarding neighborhood quality and determine the best way to answer the developed question. The summer experience cumulates with the students participating in the analysis of collected data and presenting their results to public officials in Richmond, including the District Supervisor, representatives from the City of Richmond, DPH, Air District, Food Banks, and other youth groups. In the past, their work was also submitted as an abstract to the Yes Conference, a research conference for high school students across the SF Bay Area focused on science and the environment and has resulted in two youth-led mini-grant applications to local organizations.
-As medical director of the Chest Clinic at ZSFG, I have transformed the educational curriculum for the pulmonary fellows assigned their longitudinal clinic at ZSFG. This includes designing the Outpatient curriculum, developing accompanying ACGME-board questions for lectures, and personally delivering several didactics on several topics including asthma, COPD, and addressing unmet social needs in practice.

In addition, I guest lecture 3-4 times per year in a variety of setting to discuss health disparities and asthma, including in the Schools of Pharmacy and Medicine, UC Berkeley School of Public Health, and San Francisco State University. Lastly, I teach informally as an attending in the ZSFG Chest Clinic weekly and on the Medical Critical Care and Pulmonary Consult service 6 weeks per year, where I work with fellows, residents, and medical students from multiple departments.

FORMAL TEACHING

	Academic Yr	Course No. & Title	Teaching Contribution	School	Class Size
	2015 - 2020	SF BUILD Scholars Program: NIH funded collaboration between SF State University and UCSF to diversify the biomedical sciences.	Guest Lecturer		10
	2016 - 2021	UCSF-UCB Joint Medical Program - Asthma Block	Guest Lecturer	Medicine	15
	2017 - 2021	ImS K12 Learner Health System Embedded Experience Program	Director	Grad	4
	2018 - 2019	PUMCH Designing Clinical Research	Section Leader	Grad	7
	2018 - present	UCB PH-270 Seminar Introduction to Environmental Health Sciences	Guest Lecturer	Grad	30

	Academic Yr	Course No. & Title	Teaching Contribution	School	Class Size
	2020 - 2021	ImS Individual Level Behavioral Interventions	Section Leader	Grad	10

INFORMAL TEACHING

2013 - present Teaching of pulmonary fellows on outpatient pulmonary medicine during chest clinic at ZSFG and Parnassus. Occurs weekly.

2014 - present Bedside teaching of critical care medicine to residents and critical care fellows during attending time in ICU

2015 - present Bedside teach of pulmonary medicine to medical students, residents, and pulmonary fellows during attending time on the pulmonary consult service at ZSFG

MENTORING SUMMARY

I provide mentorship for trainees extending from the undergraduate level to early career faculty. I am the primary mentor for 1 undergraduate student, 2 graduate/medical students, 2 post-doctoral/pulmonary fellows, and 4 early career faculty. My mentorship activities demonstrate my dedication to providing opportunities for students and trainees from groups underrepresented in medicine and science. My mentees have a track record of productivity and success, including 16 publications in peer-reviewed journals, and 7 research-related grants (including 4 career development awards and one R21). One of my mentees, Dr. de la Rosa, recipient of the California Presidential Post-Doctoral Fellow, successfully obtained a tenured faculty position at UC-Berkeley starting in July 2021.

For each of my mentees, I provide one-on-one teaching on the disparities relevant to our study population and on statistical methods, help mentees formulate their research question and plan, and provide oversight and input on statistical analyses and manuscript preparations. This is carried out through daily to weekly one-on-one meetings with each mentee. In addition, I help identify training gaps and opportunities for professional development. As I have personally benefited from having a team of mentors, I encourage my trainees to seek out other content experts and career mentors. In this vein, I mentor several pulmonary fellows and faculty who are interested in health disparities research, but in different pulmonary fields such as interstitial lung disease, transplant medicine, and critical care medicine.

Lastly, I started the KIPP Summer Internship program for teens from historically disadvantaged communities, which provides a structured environment for learning research methods while also cultivating personal development.

PREDOCTORAL STUDENTS SUPERVISED OR MENTORED

Dates	Name	Program or School	Mentor Type	Role	Current Position

Prepared: May 10, 2025

Dates	Name	Program or School	Mentor Type	Role	Current Position
2011 - 2011	Christine Jalluri	University of California, San Francisco ZSFG	Project Mentor	Supervised research	Physician, Sutter Health
2012 - 2012	Melissa Martin	University of California, San Francisco School of Medicine	Project Mentor	Supervised research	Pediatric Gastroenterologist, Sutter Health
2014 - 2016	Nicolas Barcelo	University of California, San Francisco, School of Medicine	Research/Scholarly Mentor,Project Mentor	Supervised research	National Clinical Scholars Fellow, UCLA Psychiatry
2015 - 2017	Sonia Carlson	University of California, San Francisco, School of Medicine	Research/Scholarly Mentor,Project Mentor,Career Mentor	Supervised research	Gynecologist, Cleveland Clinic, Weston, FL
2014 - 2019	Jessica An	University of California, Berkeley, School of Public Health	Research/Scholarly Mentor,Project Mentor,Career Mentor	Supervised research	Staff Researcher, Kaiser
2017 - 2018	Sonya Chalaka	University of California, San Francisco, Global Health	Project Mentor	Supervised research	Associate, Health & Senior Care Section at HansonBridgett
2016 - 2020	Emilia Patrick	University of California, San Francisco, School of Nursing	Research/Scholarly Mentor,Project Mentor,Career Mentor	Supervised research	Nurse Educator, ZSFG

Prepared: May 10, 2025

Dates	Name	Program or School	Mentor Type	Role	Current Position
2017 - present	Vedaja Surapaneni	University of California, Berkeley	Research/Scholarly Mentor,Project Mentor,Career Mentor	Supervised research	Medical Student, Emory Medical School (Class of 2024)
2017 - 2022	Anthony Nardone	University of California, San Francisco, School of Medicine	Research/Scholarly Mentor,Project Mentor,Career Mentor	Supervised research	Joint Medical Program Student
2018 - 2019	Andrea Munoz	San Francisco State University, SFBUILD	Project Mentor	Supervised research	Nursing Student, USF
2019 - present	Savannah Sturla	University of California, Berkeley/University of Michigan	Project Mentor	Supervised research	Doctoral Student
2020 - 2022	Michelle Williams	University of California, Berkeley	Research/Scholarly Mentor,Project Mentor	Supervised research	Master Student in Public Health and City Planning Program
2021 - 2022	Carlos Vera	University of California, Berkeley	Project Mentor	Supervised research	Data and Evaluation Specialist, Monterey County
2022 - present	Jocylene Arenalles	Contra Costa College	Research/Scholarly Mentor	Supervised research	Undergraduate student
2024 - present	Sara Alavi	University of California, San Francisco, School of Medicine	Research/Scholarly Mentor	Supervised research	Joint Medical Program

Prepared: May 10, 2025

POSTDOCTORAL FELLOWS AND RESIDENTS MENTORED

Dates	Name	Fellow	Mentor Role	Faculty Role	Current Position
2017 - 2019	Tyronda Elliot	Pulmonary Fellow	Career Mentor	Member of Research Committee and meet with fellow regular to discuss career and research opportunities	Intensivist, Highland Hospital
2018 - 2022	Bhavika Kaul	Pulmonary Fellow	Career Mentor	Member of Research Committee and meet with fellow regular to discuss career and research opportunities	Assistant Professor, Baylor
2019 - present	Katherine Sullivan	Chief Resident	Project Mentor,Career Mentor,Co-Mentor/Clinical Mentor	Co-mentor/Content Mentor	Pulmonary Fellow
2019 - present	Adali Martinez	Resident	Research/Scholarly Mentor,Project Mentor,Career Mentor	Primary mentor	Pulmonary Fellow
2020 - 2022	Nick Murphy	Resident	Project Mentor	Research mentor	Pulmonary Fellow
2021 - 2023	Ernesto Casillas	Pulmonary Fellow	Research/Scholarly Mentor,Project Mentor,Career Mentor	Primary mentor	Assistant Professor, UCSF
2023 - present	Rebecca Sugrue	Post-doctoral Fellow	Research/Scholarly Mentor,Project Mentor,Career Mentor	Primary mentor	Post-doctoral Fellow

FACULTY MENTORING

Dates	Name	Position while Mentored	Mentor Type	Mentoring Role	Current Position

Dates	Name	Position while Mentored	Mentor Type	Mentoring Role	Current Position
2019 - present	Rosemarie de la Rosa	Post-doctoral Fellow	Research/Scholarly Mentor,Project Mentor,Career Mentor	Primary mentor	Assistant Professor, UC Berkeley
2018 - present	Alison DeDent	Post-doctoral Fellow	Research/Scholarly Mentor,Project Mentor,Career Mentor	Primary Mentor	Assistant Professor, UCSF
2019 - present	Aaron Baugh	Post-doctoral Fellow	Research/Scholarly Mentor,Project Mentor,Career Mentor	Primary mentor	Assistant Professor, UCSF
2020 - present	Leslie Seijo	Post-doctoral Fellow	Research/Scholarly Mentor,Project Mentor,Career Mentor	Primary mentor	Assistant Professor, UCSF
2022 - present	Jamuna Krishnan	Assistant Professor	Research/Scholarly Mentor,Co-Mentor/Clinical Mentor	Co-mentor	Assistant Professor, Cornell
2022 - present	Marissa Boeck	Assistant Professor	Research/Scholarly Mentor,Co-Mentor/Clinical Mentor	Co-mentor	Assistant Professor

RESEARCH AND CREATIVE ACTIVITIES

RESEARCH AND CREATIVE ACTIVITIES SUMMARY

I am a physician-scientist with specialty training in pulmonary and critical care medicine and advanced training in clinical research methods, social epidemiology, and implementation sciences (MPH in Community Health, Certificate in Clinical Research and Implementation Sciences). From my time as an undergraduate student and now as faculty, I have been interested in the role of opportunity, or lack thereof, in health outcomes. Opportunity plays a large role in determining where people live, how individuals are treated, and their overall socioeconomic wealth; each of which is an important risk factor for developing lung disease and contributes to morbidity. This has informed my research program, which is dedicated to understanding and addressing the contributors to respiratory health disparities in populations disproportionately exposed to social stressors and environmental hazards. Over the past decade, I have developed a novel research agenda and my primary goals are directed towards

1) defining obstructive lung disease phenotypes that exist in racially and ethnically diverse communities and 2) identifying community-specific drivers that place individuals at high risk for poor outcomes and 3) co-developing place-based and targeted interventions aimed at social and environmental factors to improve respiratory outcomes in historically marginalized populations. To successfully achieve these goals, I employ community-engaged methods ranging from querying community stakeholders for input on scientific questions and study design to participatory action research through our Youth Participatory Action Research program and our environmental justice portfolio.

RESEARCH AWARDS - CURRENT

1. OPR20142 PI 15 % effort Thakur (PI)
   California Initiative to Advance Precision Medicine 09/16/2021 06/30/2025
   Collaborative approach to examining Adversity and building REsilience (CARE) $ 1,000,000 direct/yr 1 $ 3,000,000 total
   Under this award, we will build upon three studies and align efforts across Northern and Central California. Applying a Precision Medicine approach, we will expand upon the existing Pediatric ACEs and Resiliency Study (PEARLS) cohort (n=350) by adding a 3-year follow up biomarker testing and analysis point (Aim 1). This will allow us to identify early effects of adversity and pinpoint heterogeneity, including identifying factors that are protective or stress-buffering, which may allude to intervention. Under Aim 2, we have aligned three caregiver-child intervention studies and, using a randomized wait-list controlled trial design (n=300), will test effect of intervention on caregiver stress, behavioral and biologic outcomes. Under Aim 3, led by Futures Without Violence and informed by Aims 1 and 2, we will develop and pilot a community-vetted Resilience Toolkit for low-resourced primary care settings that is scalable and of value across California. The proposed activities under CARE will accelerate our understanding of how to best identify those at greatest risk, enhance protective factors, and intervene to bolster resilience across the care continuum.
   PI of grant

2. R01HL161049 PI 20 % effort Thakur (PI)
   NHLBI 12/31/2021 12/30/2026
   Rehabilitation in Safety-net Environments (RISE) to improve outcomes in vulnerable patients with COPD $ 499,000 direct/yr 1 $ 2,495,000 total
   The proposed study will directly test the benefit of the COPD Wellness and Plus+ Program relative to usual care and estimate the added benefit of the HA in COPD Wellness Plus+ to COPD Wellness alone in a three-arm, randomized waitlist-controlled trial (n=387) conducted in three geographically isolated urban primary care sites that provide care for some of the most socially vulnerable patient populations with COPD. In this Type 1 effectiveness-implementation hybrid design, we aim to 1) determine the effectiveness of COPD Wellness and Plus+ to improve functional and symptom outcomes; and, using a mixed-methods approach 2) to evaluate the implementation of COPD Wellness and Plus+ across study sites applying the RE-AIM and CFIR frameworks to identify additional barriers and enablers of intervention implementation and patient acceptance and adherence.
   PI of grant

3. Grant13504839 PI 15 % effort Thakur (PI)

EPA 12/30/2022 12/29/2025

Partnering for Resilient Opportunities To Eliminate Cumulative Toxic (PROTECT) Health Effects from Wildfire PM2.5 in Environmental Justice Communities $ 1,350,000 total

This proposal seeks to 1) estimate the health effects of sub-daily exposure to wildfire-specific PM2.5 in California, including across social vulnerability factors, with particular focus on effects within EJ communities; 2) understand community recovery from short-term health effects following exposure; 3) understand indoor infiltration of wildfire smoke and the mitigating effect of housing quality and behaviors on health effects; and, 4) identify acceptable community-relevant mitigation interventions.

PI of grant

4. U01HG013276 MPI 10% % effort Christensen/Thakur (PI)

NIH 07/01/2023 06/30/2028

EXposomic Profiling in Airway disease to uNravel Determinants of disease in Asthma (EXPAND-Asthma) Center $ 500,000 direct/yr 1 $ 2,500,000 total

Goals: To improve our understanding of heterogeneous asthma pathobiology associated with socio-environmental exposures, relevant to marginalized populations, allowing us to better discriminate individuals at high risk for poor outcomes and identify place-based targets for intervention.

MPI of grant to standardize social and environmental measures, oversee community-based research infrastructure, and lead community-engaged research partnerships.

5. 1R01MD019027 Co-I 10% % effort Best (PI)

NIMHD 09/24/2023 09/23/2028

Factors Influencing Pediatric Asthma into Adulthood (FIPA2)

Major Goals: To examine the complex interplay between social, environmental and immunological response to viral respiratory infections as contributory to asthma and asthma-related morbidity in American Indian (AI) populations with asthma. Specifically, we will test the hypothesis that AI children with asthma have alterations in immunological response to several viral respiratory infections as compared to those without asthma. We will also investigate whether social and environmental factors (SEF) significantly contribute to this disparity through stressed-induced modification of immune state. We will explore the role of viral respiratory infections (RSV, rhinovirus C, and influenza A and B) and SEF on asthma severity, including frequency of exacerbations, ER visits/hospitalizations, and use of asthma medications.

Asthma expertise as well as expertise on measuring social adversity measures, including ACEs.

6. R01ES035504 PI 15% % effort Thakur (PI)

NIEHS/NIH 08/01/2024 07/31/2029

Driving Environmental Justice: Community Monitoring of Diesel Truck Emissions and Impacts on Asthma Morbidity in Immigrant Communities. | $ 500,000 direct/yr 1 | $ 2,500,000 total

To increase our understanding of the short-term respiratory health effects of residing near diesel exhaust pollution sources, including frequented truck routes, for Latino/x/e children with asthma and to identifying and co-prioritizing mitigation strategies for adoption and policy change.

PI of grant (scored 8th Percentile, assigned for funding)

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7. R0S1716943471093 | Research Project PI | 10% % effort | Weiser (PI)

NIH/NIEHS | 09/01/2024 | 08/31/2029

Equity and Climate Opportunities for Health (ECO-Health) Center | $ 918,024 direct/yr 1 | $ 2,764,734 total

Major Goals: The proposed Equity and Climate Opportunities for Health (ECO-Health) Center at the University of California will generate rigorous scientific evidence about how climate change leads to poor health outcomes within communities that are heavily impacted by structural injustices. The Center will also partner with these communities to use this evidence to co-develop and co-implement climate adaptation interventions that improve health and reduce health inequities. Ultimately, the ECO-Health Center will help generate equitable solutions that build resilience to the health risks of climate change in California communities and beyond.

Research Project PI

RESEARCH AWARDS - SUBMITTED

1. Grant14259129 | PI | 10 % effort | Thakur (PI)

EPA | 01/01/2025 | 12/31/2027

Healthy Homes Through Every Door | $ 4,911,546 direct/yr 1 | $ 15,297,705 total

This collaborative project integrates decarbonization efforts with health-targeted programs, addressing the underutilization of these initiatives in disadvantaged communities, particularly communities of color and low-income households. Our proposal focuses on three San Francisco Bay Area counties (Alameda, San Francisco, and San Mateo), aiming to enhance local capacity and engagement with Healthy & Efficient Home Initiatives to improve health outcomes. This initiative aligns with climate and pollution reduction strategies by targeting energy-efficient housing, workforce development, and indoor air quality improvements, aiming to decarbonize low-income households and create green job opportunities. Our proposed action areas include: Action Area 1: Increase access and engagement by partnering with Community-Based Organizations (CBOs) to provide coordination services to 400 households and foster a community of practice. Action Area 2: Incorporate these initiatives into Asthma Home Visit programs, extending services to an additional 225 households. Action Area 3: Deliver comprehensive remediation services, including solar installation and green job training, to 150 households, with a subset receiving free solar installations.

PI of grant

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2. | UCSF Lead | 2.5% % effort | Preble (PI)

California Air Resource Board | 03/01/2025 | 02/28/2027

Reducing Exposure with Air Cleaners and Technology (REACT) in At-Risk Communities — $ 54,940 direct/yr 1 — $ 109,880 total

Communities with historical and persistent divestment face disproportionate air pollution and health burdens. This study aims to mitigate these exposures by evaluating the impact of air filtration devices on indoor fine particulate matter (PM2.5) and respiratory health using an interrupted time series design. Additionally, a multistage randomized control trial will assess how indicators from low-cost PM2.5 sensors and technical assistance can enhance the use and effectiveness of air cleaners. We will recruit 100 households in Bayview Hunters Points (BVHP) and monitor them for 90 days. The study will determine how air quality indicators, air cleaner usage, and targeted assistance improve indoor air quality and health outcomes, guiding future policy and advocacy to protect over-exposed communities. This collaborative effort involves UC Berkeley, UC San Francisco, and local environmental justice organizations, BVHP Community Advocates, and Brightline Defense.

UCSF Lead, will oversee recruitment with partnering community organizations and lead the health outcome analyses.

RESEARCH AWARDS - PAST

1. NIH/NHLBI 1K12 HL119997-01 — Career Development Award Recipient — 75 % effort — Burchard/Erle (PI)

   UCSF Career Development Program in Omics of Lung Diseases — 07/01/2015 — 12/31/2015

   The Use of High Dimensional Data to Identify Asthma Phenotypes Susceptible to Social Adversities — $ 86,500 direct/yr 1 — $ 259,500 total

   This proposal aims to identify asthma phenotypes in disadvantaged, minority populations and their interaction with social determinants using an omics approach. This will allow for the uncovering of relationships previously missed due to biases brought into analyses.

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2. Principal Investigator — 16.6 % effort — Thakur (PI)

   American Thoracic Society: Recognition Award for Outstanding Early Career Investigators — 11/01/2014 — 10/31/2015

   Allostatic Load and Asthma: Chronic Stress and Asthma in Minority Children — $ 40,000 direct/yr 1 — $ 40,000 total

   The goal of the Recognition Award is to fund researchers who had a Career Development Award that was near fundable level but not awarded from the National Institute of Health or an equivalent organization. This support will be used for ancillary supplies to measure cytokines in African American study participants to better elucidate the inflammatory response to social stressors.

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3. PR141896 — Principal Investigator — 20 % effort — Thakur (PI)

   Peer Reviewed Medical Research Program Discovery Award — 09/30/2015 — 3/31/2017

   Pathways to Disease: The Biological Consequences of Social Adversity on Asthma In Minority Youth — $ 130,000 direct/yr 1 — $ 200,000 total

The goal of this award is to better delineate the biological pathways of stress related to socioeconomic and environmental stress among urban, minority of youth with asthma. This study will examine 1) the immune and neuro-endocrine response and 2) the microbiome in response to chronic exposure to psychosocial stress.

4.	A125633	Principal Investigator	33 % effort	Thakur (PI)
	Francis Family Foundation: Parker B. Francis Fellowship Program		07/01/2015	06/30/2018
	Social Adversity and Asthma: A new Phenotype?		$ 50,000 direct/yr 1	$ 156,000 total

The goal of this award is to 1) identify risk factors for poor asthma outcomes in African American and Latino children that are related to social and environmental exposures, 2) test a limited set of inflammatory biomarkers to determine if they are elevated in the presence of specific stress exposures, and 3) Determine if there is an asthma phenotype susceptible to social and environmental stress.

5.			15 % effort	Thakur (PI)
	Nina Ireland Program in Lung Health		01/01/2017	12/31/2018
	Rehabilitation in Safety-Net Environments (RISE) for COPD		$ 50,000 direct/yr 1	$ 100,000 total

The goals of the project are to conduct a pilot study of 1) low-intensity pulmonary rehabilitation, COPD Wellness, for individuals with moderate-to-severe COPD seeking care through ZSFG; and determine if 2) adding a program that addresses unmet social needs improves adherence to the exercise program.

6.	A126349A	Principal Investigator	13 % effort	Thakur (PI)
	Tara Health/Center for Youth Wellness		09/1/2015	02/28/2020
	Pediatric ACEs and Resilience Study (PEARLS)		$ 151,000 direct/yr 1	$ 755,000 total

The goals of this award are to 1) develop and validate a screening tool for ACEs for use in pediatric primary care; 2) further understand the longitudinal relationship of ACEs and health in children; and 3) identify biologic markers that may help identify children at greater risk from poor health due to high ACEs exposure.

I am the Lead-PI for objectives 2 and 3 for this grant and the co-I for objective 1. Since 2019, I have served as the primary contact to the funder and have overseen all scientific inquiry and day-to-day operations for PEARLS. This includes finding additional funding to support the continuation of the PEARLS cohort.

7.	K23HL12551-01A1	Principal Investigator	75 % effort	Thakur (PI)
	NHLBI		01/01/2016	12/31/2020
	Social Adversities and Asthma: A New Phenotype		$ 165,000 direct/yr 1	$ 625,000 total

The goals of this project are to 1) identify individual- and community-level risk factors for asthma among disadvantage, minority youth; 2) define a profile of characteristics, which includes biomarker data, that will better identify individuals at high risk for poor asthma outcomes who are from communities burdened by social adversities; and 3) examine the asthma-related outcomes in individuals with the identified phenotype.

8.	Awarded	PI	15 % effort	Thakur (PI)
	TARA Health		02/28/2020	07/31/2021
	PEARLS Extension		$ 184,734 direct/yr 1	$ 184,734 total

Complete follow up, biomarker analysis, and analysis from PEARLS.

I lead the health outcomes and biomarker aim for this proposal. This includes overseeing and contributing to all analysis and manuscript preparations for the study, including examining for associations between ACEs and health, biological health, and intervention response.

9.		Project PI	3.5 % effort	Cohen (PI)
	Koret Foundation		09/01/2017	08/31/2022
	The Koret Institute for Precision Prevention at the Berkeley Global Campus			$ 614,246 total

This is a Center Grant to UC-Berkeley and includes an environmental, health, and training focus. UCSF is leading the Health Project of the Koret Institute for Precision Prevention (KIPP). The study will examine the social and environmental contributors to asthma in vulnerable populations.

I am the Project PI of this R01 equivalent award. I established the Richmond Environment and Asthma Community Health (REACH) Study to study the joint effect of psychosocial stressors and ambient air pollution on asthma morbidity in children from high-risk communities.

10.		PI	2.5% % effort	Thakur (PI)
	Genentech Corporate Giving		09/16/2020	09/15/2022
	ACES and Resilience from Biologic-Response to the Community (ARC)		$ 200,000 direct/yr 1	$ 400,000 total

To study the longitudinal effect of ACEs on pediatric health outcomes in children in PEARLS. This provides funding for an additional time point of collection.

I am the PI of the study and oversee all aspects of the study design, recruitment, methods of data collection, and data analysis.

11.		PI	10 % effort	Thakur (PI)
	Robert Wood Johnson Foundation		06/15/2020	06/30/2022
	Title: Social and Economic Barriers to Public Health and Clinical Interventions for COVID-19 in Vulnerable Populations			

To understand and address barriers to public health and clinical interventions for COVID-19 in vulnerable populations across ten sites in the US. Identifying key intervention targets will require detailed information regarding the drivers of barriers to both health care access and ability to self-isolate, with special attention to barriers to COVID-19 testing and treatment; telemedicine; and shelter in place regulation adherence.

I am the PI of this multi-center trial that includes 10 sites across the US. As PI, I have personally recruited each site to participate, determined the study design, and overseen recruitment, methods of data collection, and data analysis.

12. EACB-23028 PI 5 % effort Thakur (PI)
Patient Centered Outcomes Research Institute (PCORI) 12/21/2021 02/28/2024
Building Capacity for Research to Address Climate-Impacted Health Conditions $ 249,974 total

Extreme heat and wildfire smoke events have significant health impacts in communities with the least economic, social, or political resources to respond. This project will engage a diverse group of stakeholders in San Francisco to understand priority health conditions, identify relevant patient-centered outcomes affected by climate, and collect information on the barriers to existing migration strategies.

PEER REVIEWED PUBLICATIONS

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3. 2013 **Thakur N**, Oh SS, Nguyen EA, Martin M, Roth LA, Galanter J, Gignoux CR, Eng C, Davis A, Meade K, LeNoir MA, Avila PC, Farber HJ, Serebrisky D, Brigino-Buenaventura E, Rodriguez-Cintron W, Kumar R, Williams LK, Bibbins-Domingo K, Thyne S, Sen S, Rodriguez-Santana JR, Borrell LN, Burchard EG. Socioeconomic status and childhood asthma in urban minority youths. The GALA II and SAGE II studies. Am J Respir Crit Care Med. 2013 Nov 15; 188(10):1202-9. PMID: 24050698.

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5. 2014 **Thakur N**, McGarry ME, S Oh S, M Galanter J, Finn PW, Burchard EG. The lung corps' approach to reducing health disparities in respiratory disease. Ann Am Thorac Soc. 2014 May; 11(4):655-60. PMID: 24697756.

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7. 2015 ME McGarry, E Castellanos, **N Thakur,** SS Oh, C Eng, A Davis, K Meade, MA LeNoir, PC Avila, HJ Farber, D Serebrisky, E Brigino-Buenaventura, W Rodriguez-Cintron, R Kumar, K Bibbins-Domingo, SM Thyne, S Sen, JR Rodriguez-Santana, LN Borrell, EG Burchard. Obesity and Bronchodilator Response in African-American and Hispanic Children and Adolescents with Asthma. CHEST. 2015 Jun;147(6):1591-8 PMID 25742612. PMCID: PMC4451713

8. 2015 Oh SS, Galanter J, **Thakur N**, Pino-Yanes M, Barcelo NE, White MJ, de Bruin DM, Greenblatt RM, Bibbins-Domingo K, Wu AH, Borrell LN, Gunter C, Powe NR, Burchard EG. Diversity in Clinical and Biomedical Research: A Promise Yet to Be Fulfilled. PLoS Med. 2015 Dec; 12(12):e1001918. PMID: 26671224.

9. 2016 Neophytou AM, White MJ, Oh SS, **Thakur N**, Galanter JM, Nishimura KK, Pino-Yanes M, Torgerson DG, Gignoux CR, Eng C, Nguyen EA, Hu D, Mak AC, Kumar R, Seibold MA, Davis A, Farber HJ, Meade K, Avila PC, Serebrisky D, Lenoir MA, Brigino-Buenaventura E, Rodriguez-Cintron W, Bibbins-Domingo K, Thyne SM, Williams LK, Sen S, Gilliland FD, Gauderman WJ, Rodriguez-Santana JR, Lurmann F, Balmes JR, Eisen EA, Burchard EG. Air Pollution and Lung Function in Minority Youth with Asthma in the GALA II & SAGE II Studies. AJRCCM. 2016 Jun 1; 193(11):1271-80. PMID 26734713

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11. 2017 Galanter J M, Gignoux C R, Oh S S, Torgerson D G, Pino-Yanes M, **Thakur N**, Eng C, Hu D, Huntsman S, Farber HJ, Avila PC, Brigino-Buenaventura E, Lenoir M A, Meade K, Serebrisky D, Rodriguez-Cintron W, Kumar R, Rodriguez-Santana JR, Seibold M, Borrell LN, Burchard EG, Zaitlen. Methylation Analysis Reveals Fundamental Differences Between Ethnicity and Genetic Ancestry. E-Life. 2017 01 03;6. PMID: 28044981

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23. 2020 Magaña J, Contreras MG, Keys KL, Risse-Adams O, Goddard PC, Zeiger AM, Mak ACY, Elhawary JR, Samedy-Bates LA, Lee E, **Thakur N**, Hu D, Eng C, Salazar S, Huntsman S, Hu T, Burchard EG, White MJ. An epistatic interaction between pre-natal smoke exposure and socioeconomic status has a significant impact on bronchodilator drug response in African American youth with asthma. BioData Min. 2020; 13:7. PMID: 32636926. PMCID: PMC7333373

24. 2020 **Thakur N**, Lovinsky-Desir S, Bime C, Wisnivesky JP, Celedón JC. The Structural and Social Determinants of the Racial/Ethnic Disparities in the U.S. COVID-19 Pandemic: What's Our Role? Am J Respir Crit Care Med. 2020 Jul 17. PMID: 32677842. PMCID: PMC7528789

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BOOKS AND CHAPTERS

1. 2017 **Thakur N,** White MJ, Burchard EG. Race and Ethnicity. In Achieving Respiratory Health Equality 2017 (pp. 11-25). Springer International Publishing.

OTHER PUBLICATIONS

1. 2009 N. Thakur, S. McPhee. Outpatient Procedures: Pap Smear, Wet Mount, Shave Biopsy, Wart Removal. In: Chiovaro J, Durand K, Lai C., eds. UCSF Outpatient Medicine Pocket Preceptor. University of California San Francisco. November 2009.

2. 2019 Brian Block and Neeta Thakur. Cost-cutting jeopardizes many Americans access to lifesaving oxygen therapy. STAT News. June 14, 2019. https://www.statnews.com/2019/06/14/access-lifesaving-oxygen-therapy/

SIGNIFICANT PUBLICATIONS

1. 2013 **N Thakur**, Oh SS, Nguyen EA, Martin M, Roth LA, Galanter J, Gignoux CR, Eng C, Davis A, Meade K, Lenoir MA, Avila PC, Farber HJ, Serebrisky D, Brigino-Buenaventura E, Rodriguez-Cintron W, Kumar R, Williams LK, Bibbins-Domingo K, Thyne S, Sen S, Rodriguez-Santana JR, Borrell LN, Burchard EG. Socioeconomic Status and Childhood Asthma in Urban Minority Youths: The GALA II and SAGE II Studies. Am J Respir Crit Care Med. 2013 Nov 15; 188(10):1202-9. PMID: 24050698; PMCID: PMC3863734.

   Socioeconomic Status (SES) and Asthma: Individuals living in poverty are thought to be at higher risk for asthma as they have greater exposure to known risk factors to asthma. Yet, when we examine the role of socioeconomic status within each racial/ethnic group, the effects vary. With the GALA II and SAGE II studies, two parallel, case-control studies of asthma designed to examine the complex interplay of genetics and socio-environmental factors, we demonstrated that the risk factors for asthma differ among racial/ethnic groups: poverty increases the odds of asthma in African Americans, yet decreases it in Mexican Americans. This is the first study to demonstrate this different in effect and now has been replicated by other studies. Moreover, we were able to demonstrate that this risk held true across the SES gradient (i.e. not limited to high vs. low SES) regardless of race/ethnicity. Given the significance of these findings, this paper was selected for an editorial. The observed heterogeneity in exposure effect has also deeply informed my research program and formed the basis of my K23 award. For this specific manuscript, I developed the research question and analytic approach, performed all data analyses, interpreted the results, drafted and revised the final manuscript as published.

2. 2015 Pino-Yanes M, **Thakur N,** Gignoux C R, Galanter J M, Roth L A, Eng C, Nishimura K K, Oh S S, Hita Vora, Huntsman S, Nguyen E A, Hu D, Drake K A, Conti DV, Moreno A, Sandoval K, Winkler CA, Borrell LN, Lurmann F, Islam T S, Davis A, Farber H J, Meade K, Avila P C, Serebrisky D, Bibbins-Domingo K, Lenoir M A, Ford J G, Brigino-Buenaventura E, Rodriguez-Cintron W, Thyne S M, Sen S, Rodriguez-Santana J R, Bustamante C, Williams L K, Gilliland F D, Gauderman W J, Kumar R, Torgerson D G, Burchard E G. Genetic ancestry influences asthma susceptibility and lung function among Latinos. J Allergy Clin Immunol. 2015 Jan;135(1):228-35. PMID 25301036. PMCID: PMC4289103.

   Genetic Ancestry and Asthma: Asthma prevalence varies across Latino subgroups, which have varying levels of Native ancestry. Prior studies suggest that Native ancestry is protective. Here we show that Native ancestry is associated with reduced odds of asthma and improved pulmonary function. I critically reviewed and provided interpretation of the results, revised several iterations of the manuscript, and approved of the final version as published.

3. 2015 **N Thakur***, Barcelo N*, Oh SS, Nguyen EA, Eng C, Davis A, Meade K, Lenoir MA, Avila PC, Farber HJ, Serebrisky D, Brigino-Buenaventura E, Rodriguez-Cintron W, Kumar R, Bibbins-Domingo K, Thyne S, Sen S, Rodriguez-Santana JR, Borrell LN, Burchard EG. *These authors contributed equally to this work. Discrimination is predictive of asthma in some racial/ethnic groups: The GALA II and SAGE II Studies. Chest.2017;151(4):804-812. PMID 27916618

   Discrimination and Asthma: Psychosocial stress is an important predictor of poor health outcomes. In this work, we demonstrated that perceived racial discrimination is associated with asthma and worse morbidity among African American children. In Latinos, this association varied by socioeconomic status. For this manuscript, I conceived the research question, designed the analytical approach, and performed the analysis. I would with a medical student to draft the first and subsequent iterations of the manuscript, and approved of the final version as published.

4. S. Carlson, Borrell N, Eng C, Nguyen M, Thyne S, LeNoir MA, Burke-Harris N, Burchard EG*, **Thakur N***. *These authors contributed equally to this work. Self-reported racial/ethnic discrimination and bronchodilator response in African American youth with asthma. PLoS ONE 12(6): e0179091. PMID 28609485

   Discrimination and Asthma: Among children with asthma, we found that consideration of experiences of discrimination when examining asthma phenotypes helped improved our ability to identify children who may benefit from further asthma controller therapy in a group of children with an asthma types thought to be more drug resistant (TNF-alpha high asthma). These results support the need to screen for racial/ethnic discriminatory experiences among those with moderate-severe asthma as it may help to reclassify asthma type and identify more precise treatments for high-risk population. For this manuscript, I conceived the research question, worked with Dr. Carlson to develop the analytical approach, directly supervised the analysis and assisted with interpretation of results, and revised and approved the final manuscript. This project was supported by independent funding I obtained from the Department of Defense and represents the output of one of my first mentorship opportunities.

5. Koita K, Long D, Hessler D, Benson M, Daley K, Bucci M, **Thakur N**, Burke Harris N. Development and implementation of a pediatric adverse childhood experiences (ACEs) and other determinants of health questionnaire in the pediatric medical home: A pilot study. PLoS One. 2018; 13(12):e0208088. PMID: 30540843.

   Adverse Childhood Experiences: Early-life trauma and related adversities are prevalent and associated with negative childhood and adulthood health outcomes. These adverse childhood experiences (ACEs) are especially common in low-income communities. Early identification and targeted treatment of trauma in childhood is critical for reducing the long-term behavioral, mental, and physical health outcomes in children and adults. This manuscript is the output of our pilot study for to develop a questionnaire for screening for ACEs within pediatric primary care. This screener was selected by the California Department of Public Health for ACEs screening in pediatric primary care, the only tool to be available for financial reimbursement. For this pilot study, I co-designed the study and the semi-structured interview guide and reviewed the coded data and help interpret the results. I also participated in finalizing the questionnaire, revised several iterations of the manuscript, and approved of the final version as published.

CONFERENCE ABSTRACTS

2009 Blumenthal E, Kalanithi L, Keet K, Kern R, Kneeland P, Mikosz C, Neinstein A, Osterhoff R, Pierce R, Ponce P, Thakur N, and Yong C. Teaching Leadership and Quality Improvement: A Resident-Led Initiative to Improve Anticoagulation Safety at UCSF Medical Center. American Association of Medical Colleges: Integrating Quality Meeting, June 15-16, 2009.

2011 C. Jalluri, Thakur N, Seligman H. Average travel time to clinic in underserved patients with and without lung disease. Health Disparities Research Symposium V at UCSF 2011.

2012 N Thakur, EG Burchard, H Seligman. Risk Factors Associated With Missed Appointments Among Patients With Chronic Lung Disease In A Safety-Net System. Am. J. Respir. Crit. Care Med. 2012; 185: A5139.

2012 N Thakur, C Jalluri, EG Burchard, and H Seligman. Average Travel Time To Clinic In Patients With And Without Lung Disease Utilizing A Safety-Net Clinic. Am. J. Respir. Crit. Care Med. 2012; 185: A2865.

2018 V Surapaneni, J DeVore, EC Patrick, G Su, **N Thakur.** Barriers and Facilitators to Low-Intensity Pulmonary Rehabilitation in a 'Safety-Net' Setting. American Journal of Respiratory and Critical Care Medicine 2018;197:A2167

2019 M Ye, LN Borrell, S Oh, K Bibbins-Domingo, R Kumar, EG Burchard, **N Thakur**. Allergen Sensitization Patterns by Socioeconomic Class in Children with and Without Asthma. American Journal of Respiratory and Critical Care Medicine 2019;199:A7052. **Oral Presentation, Podium.**

2019 Munoz Vera A, Andrade A, Athavale P, Chalaka S, **Thakur N**. Barriers and Facilitators to ACEs Screening Tools in Low-income Community Health Facilities. Health Disparities Research Symposium at UCSF. 2019. San Francisco, CA.

2020 R de la Rosa, M Ye, D Zablotny, D Hessler, M Benson, R Gilgoff, K Koita, M Bucci, DLong, N Thakur. Unmet Social Needs Increases Emergency Department Visits And Exercise Wheeze In Children With Eosinophilic Asthma. 2020 International American Thoracic Society Meeting. Philadelphia, PA. **Rapid Oral Poster Presentation** (Deferred due to COVID-19 Pandemic).

2020 Ye M, Andrade A, Munoz Vera A, Obasi C, Guzman E, Gonzalez E, Rayon C, Madriz S, Hernandez J, De La Rosa R, Morello-Frosch R, Noth B, Hammond SK,; Smith MT, Balmes J1, Cohen R, **Thakur N**. Neighborhood Physical and Social Attributes by Systemic Social Observation and Asthma Emergency Department Visits. 2020 International American Thoracic Society Meeting. Philadelphia, PA (Deferred due to COVID-19 Pandemic).

2020 A Martinez, M Ye, R de la Rosa, D Hessler, M Benson, R Gilgoff, K Koita, M Bucci, DLong, **N Thakur.** Adverse Childhood Experiences Increases Severe Asthma Symptoms in Children Receiving Care within a Safety Net Setting. 2020 International American Thoracic Society Meeting. Philadelphia, PA **Oral Presentation, Podium.** (Deferred due to COVID-19 Pandemic).

ACADEMIC LEADERSHIP

At ZSFG, I am the Medical Director of the Chest Clinic, where I also serve and chair the ZSFG Chest Leadership Committee. This multidisciplinary committee is composed of nursing, respiratory therapy, and Chest providers, including a trainee representative, and meets quarterly to identify quality improvement projects for clinic (past projects include the biologic shot clinic for severe asthma and streamlining the oxygen prescribing process), reviews quality metrics for clinic, and ensures the clinic environment provides a well-rounded educational opportunity for the fellows. As an emerging Clinical Leader at ZSFG, in 2019 I was invited to participate in the inaugural ZSFG Clinical Leadership Professional Developmen Program, a six-month program that included content on ZSFG and Department of Medicine operations, personality type and leadership training, change management, and developing your people skill training.

EXHIBIT B

OMB Number: 4040-0004
Expiration Date: 12/31/2022

Application for Federal Assistance SF-424 G21H113504839

* 1. Type of Submission:
- [ ] Preapplication
- [x] Application
- [ ] Changed/Corrected Application

* 2. Type of Application:
- [x] New
- [ ] Continuation
- [ ] Revision

* If Revision, select appropriate letter(s):

* Other (Specify):

* 3. Date Received: 11/16/2021

4. Applicant Identifier:

5a. Federal Entity Identifier:

5b. Federal Award Identifier:

State Use Only:

6. Date Received by State:

7. State Application Identifier:

8. APPLICANT INFORMATION:

* a. Legal Name: The Regents of the University of California San Francisco

* b. Employer/Taxpayer Identification Number (EIN/TIN): 94-6036493

* c. Organizational DUNS: 0948783370000

d. Address:

* Street1: UCSF Office of Sponsored Research
Street2: 490 Illinois Street, 4th Floor
* City: San Francisco
County/Parish: San Francisco
* State: CA: California
Province:
* Country: USA: UNITED STATES
* Zip / Postal Code: 94143-0000

e. Organizational Unit:

Department Name: Medicine

Division Name: School of Medicine

f. Name and contact information of person to be contacted on matters involving this application:

Prefix:
* First Name: Sharon
Middle Name:
* Last Name: Hutchinson
Suffix:

Title: UCSF Contracts and Grants Officer

Organizational Affiliation:

* Telephone Number: 415-260-6443
Fax Number:

* Email: shutchinson@ucsf.edu

Application for Federal Assistance SF-424

*** 9. Type of Applicant 1: Select Applicant Type:**

H: Public/State Controlled Institution of Higher Education

Type of Applicant 2: Select Applicant Type:

Type of Applicant 3: Select Applicant Type:

* Other (specify):

*** 10. Name of Federal Agency:**

Environmental Protection Agency

11. Catalog of Federal Domestic Assistance Number:

66.509

CFDA Title:

Science To Achieve Results (STAR) Research Program

*** 12. Funding Opportunity Number:**

EPA-G2021-STAR-H1

* Title:

Cumulative Health Impacts at the Intersection of Climate Change, Environmental Justice, and Vulnerable Populations/Lifestages: Community-Based Research for Solutions

13. Competition Identification Number:

Title:

14. Areas Affected by Project (Cities, Counties, States, etc.):

1234-Areas_Affected.pdf | Add Attachment | Delete Attachment | View Attachment

*** 15. Descriptive Title of Applicant's Project:**

Partnering for Resilient Opportunities To Eliminate Cumulative Toxic (PROTECT) Health Effects from Wildfire PM2.5 in Environmental Justice Communities

Attach supporting documents as specified in agency instructions.

Add Attachments | Delete Attachments | View Attachments

Application for Federal Assistance SF-424

16. Congressional Districts Of:

* a. Applicant: CA-012 * b. Program/Project: CA-012

Attach an additional list of Program/Project Congressional Districts if needed.

1235-CongressionalDistricts.pdf | Add Attachment | Delete Attachment | View Attachment

17. Proposed Project:

* a. Start Date: 07/01/2022 * b. End Date: 06/30/2025

18. Estimated Funding ($):

* a. Federal	1,330,536.00
* b. Applicant	0.00
* c. State	0.00
* d. Local	0.00
* e. Other	0.00
* f. Program Income	0.00
* g. TOTAL	1,330,536.00

*** 19. Is Application Subject to Review By State Under Executive Order 12372 Process?**

☐ a. This application was made available to the State under the Executive Order 12372 Process for review on .

☐ b. Program is subject to E.O. 12372 but has not been selected by the State for review.

☒ c. Program is not covered by E.O. 12372.

*** 20. Is the Applicant Delinquent On Any Federal Debt? (If "Yes," provide explanation in attachment.)**

☐ Yes ☒ No

If "Yes", provide explanation and attach

Add Attachment | Delete Attachment | View Attachment

21. *By signing this application, I certify (1) to the statements contained in the list of certifications and (2) that the statements herein are true, complete and accurate to the best of my knowledge. I also provide the required assurances** and agree to comply with any resulting terms if I accept an award. I am aware that any false, fictitious, or fraudulent statements or claims may subject me to criminal, civil, or administrative penalties. (U.S. Code, Title 218, Section 1001)**

☒ ** I AGREE

** The list of certifications and assurances, or an internet site where you may obtain this list, is contained in the announcement or agency specific instructions.

Authorized Representative:

Prefix: | * First Name: Olive

Middle Name:

* Last Name: Giovannetti

Suffix:

* Title: UCSF Contracts and Grants Officer

* Telephone Number: (415) 260-5861 Fax Number:

* Email: olive.giovannetti@ucsf.edu

* Signature of Authorized Representative: Mae Moredo * Date Signed: 11/16/2021

OMB Number: 2030-0020
Expiration Date: 04/30/2021

EPA KEY CONTACTS FORM

Authorized Representative: *Original awards and amendments will be sent to this individual for review and acceptance, unless otherwise indicated.*

Name: Prefix: | First Name: Shelby | Middle Name:
Last Name: Mayoral | Suffix:
Title: Director, Contracts and Awards

Complete Address:

Street1: UCSF Office of Sponsored Research
Street2: 490 Illinois
City: San Francisco | State: CA: California
Zip / Postal Code: 94143-0000 | Country: USA: UNITED STATES
Phone Number: (628) 224-3730 | **Fax Number:**
E-mail Address: Shelby.Mayoral@ucsf.edu

Payee: *Individual authorized to accept payments.*

Name: Prefix: | First Name: Ellyn | Middle Name:
Last Name: McCaffrey | Suffix:
Title: Assistant Controller-Contracts and Grants

Complete Address:

Street1: 1855 Folsom Street, Suite 425
Street2:
City: San Francisco | State: CA: California
Zip / Postal Code: 94143-0000 | Country: USA: UNITED STATES
Phone Number: 415.476.0829 | **Fax Number:**
E-mail Address: Ellyn.McCaffrey@ucsf.edu

Administrative Contact: *Individual from Sponsored Programs Office to contact concerning administrative matters (i.e., indirect cost rate computation, rebudgeting requests etc).*

Name: Prefix: | First Name: Sharon | Middle Name:
Last Name: Hutchinson | Suffix:
Title: UCSF Contracts and Grants Officer

Complete Address:

Street1: Office of Sponsored Research
Street2: 490 Illinois, 4th Floor
City: San Francisco | State: CA: California
Zip / Postal Code: 94143-000 | Country: USA: UNITED STATES
Phone Number: 415-260-6443 | **Fax Number:**
E-mail Address: shutchinson@ucsf.edu

EPA Form 5700-54 (Rev 4-02)

EPA KEY CONTACTS FORM

Project Manager: *Individual responsible for the technical completion of the proposed work.*

Name: Prefix: | First Name: Neeta | Middle Name:

Last Name: Thakur | Suffix: M.D.

Title: UCSF Assistant Professor

Complete Address:

Street1: Zuckerberg San Francisco General Hospital

Street2: 1001 Potrero Avenue, 228

City: San Francisco | State: CA: California

Zip / Postal Code: 94143-0841 | Country: USA: UNITED STATES

Phone Number: (415) 476-0735 | **Fax Number:**

E-mail Address: Neeta.Thakur@ucsf.edu

EPA Form 5700-54 (Rev 4-02)

Table of Contents

Funding Opportunity: EPA-G2021-STAR-H1, Cumulative Health Impacts at the Intersection of Climate Change, Environmental Justice, and Vulnerable Populations/Lifestages: Community-Based Research for Solutions

Partnering for Resilient Opportunities To Eliminate Cumulative Toxic (PROTECT) Health Effects from Wildfire $PM_{2.5}$ in Environmental Justice Communities.

Abstract

Investigators: Thakur, Neeta; Balmes, John R.; Holm, Stephanie; Chow, Fontini (Tina); de la Rosa, Rosemarie; Noth, Betsey M.; Chan, Wanyu R.; Kirchstetter, Thomas W.; Basu, Rupa

Institution(s): University of California San Francisco, University of California Berkeley, Lawrence Berkeley National Laboratory, Office of Environmental Health Hazard Assessment

Project Period and Location: December 1, 2022 - November 30, 2025; Fresno, Richmond, and San Francisco Counties, California.

Project Cost: $1,349,532

Project Summary: Social adversity and environmental pollution are geospatially distributed and concentrated in communities of color and of low socioeconomic status, leading to worse health outcomes in these (Environmental Justice [EJ]) communities. In California, the increase in wildfire smoke events has likely had cascading and widespread impacts in EJ communities. There is a critical need to understand the impact of recurrent and prolonged wildfire smoke exposure on health and how this health risk is distributed across communities.

Objectives: This proposal seeks to 1) estimate the health effects of sub-daily exposure to wildfire-specific PM2.5 in California, including across social vulnerability factors, with particular focus on effects within EJ communities; 2) understand community recovery from short-term health effects following exposure; 3) understand indoor infiltration of wildfire smoke and the mitigating effect of housing quality and behaviors on health effects; and, 4) identify acceptable community-relevant mitigation interventions.

Approach: We will derive an hourly 3km wildfire-specific PM2.5 concentration grid by improving upon the NOAA HRRR Smoke Model with corrections from observation data. Exposure estimates will be assigned to geographic areas of interest. We will use a combination of air infiltration models using housing attributes and meteorological data as inputs combined with new observational studies of infiltration factors of $PM_{2.5}$ to estimate smoke infiltration.We will then examine for health effects of wildfire-specific $PM_{2.5}$ on respiratory, cardiovascular, and cerebrovascular-related emergency department visits and hospitalizations across zip codes (n~1300) in California, factoring for smoke infiltration. We will examine if health effects occur disproportionately across social vulnerability factors, including age, race/ethnicity, composite indices for socioeconomic status, and EJ community designation using CalEnvironScreen 4.0. Lastly, with our community partners, we will quantitatively survey (n=450) residents of EJ communities residing in Fresno, Richmond, and San Francisco about mitigation behaviors during wildfire events and qualitatively assess barriers to existing barriers. Together, these data will be used to co-develop implementation strategies to increase uptake of acceptable community-relevant mitigation interventions.

Expected Results: At the conclusion, we will have a HRRR Smoke model with more accurate estimates for wildfire-specific $PM_{2.5}$ and understanding of smoke infiltration for housing across California; estimated health risk of wildfire PM2.5 across different communities in California; improved understanding of behaviors during wildfire events, including barriers to mitigations; and, co-developed implementation strategies to increase uptake of acceptable interventions.

Supplemental Keywords: Wildfire Smoke, Environmental Justice, Health Effects

Funding Opportunity: EPA-G2021-STAR-H1, Cumulative Health Impacts at the Intersection of Climate Change, Environmental Justice, and Vulnerable Populations/ Lifestages: Community-Based Research for Solutions

Partnering for Resilient Opportunities To Eliminate Cumulative Toxic (PROTECT) Health Effects from Wildfire $PM_{2.5}$ in Environmental Justice Communities.

RESEARCH PLAN

1. Objectives

1.1 Background and Significance: Across the United States and in California, social adversity and environmental pollution are geospatially distributed and concentrated in communities of color and of low socioeconomic status (SES).[1] These environmental justice (EJ) communities carry a disproportionate burden of exposure that has a significant impact on health, including mortality.[2–4] For example, nationally, 1 in 12 children has asthma.[5] In EJ communities, this number is as high as 1 in 4.[5,6] African American and Latinx children have twice as many asthma hospitalizations[5] and are more likely to have severe or difficult-to-control asthma compared to non-Hispanic White children.[7,8] Similarly striking disparities are observed for cardiovascular and cerebrovascular disease.[9–13]

Traffic-related air pollution - a mixture of fine particulate matter ($PM_{2.5}$) and gases (especially nitrogen dioxide [NO_2]) and known contributors to respiratory,[14] cardiovascular,[15] and cerebrovascular[10,11] morbidity - is 37% higher in communities of color compared with predominantly white communities.[29] African American and Latinx populations are also twice as likely to live in poverty, more likely to live in poor housing conditions, and be exposed to violence and discrimination. These factors - all well-described risks[12,13,16] for respiratory, cardiovascular, and cerebrovascular disease - compound the effects of traffic-related air pollution, contributing to the disproportionate negative health effects in these communities. These conditions are relevant to EJ communities within San Francisco (Bayview-Hunters Point and Tenderloin), Richmond (North Richmond and Iron Triangle), and Fresno (South Central), CA. **Figure 1** demonstrates the disproportionate asthma burden in these EJ communities compared to California overall. Individuals within these communities also have limited control in changing personal environments to reduce exposure to these risk factors for poor health.[17–19] This is particularly relevant when considering the rising occurrence of extreme weather events due to climate change.[20]

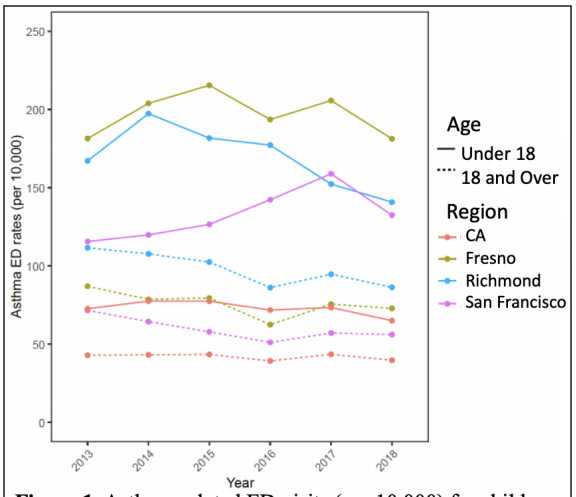


Figure 1. Asthma-related ED visits (per 10,000) for children (0-17) and adults (18+). Data from HCAI

In California, the increase in wildfire events has amounted to a 5-fold increase in annual burned area over the last three decades and increased frequency of wildfire smoke events.[21] For example, for a 4-week period in August-September 2020, San Francisco, Richmond, and Fresno all experienced extremely poor air quality due to $PM_{2.5}$ from wildfire smoke. These events have now become a yearly occurrence (**Figure 2**). This is concerning as major wildfire events have increasingly impacted the public health of urban communities.[22,23] While many urban communities are not directly affected by advancing fire lines, wildfire smoke travels hundreds of kilometers and is now responsible for 50% of annual $PM_{2.5}$ in the Western US.[24] This is alarming as there is mounting evidence associating wildfire smoke exposure

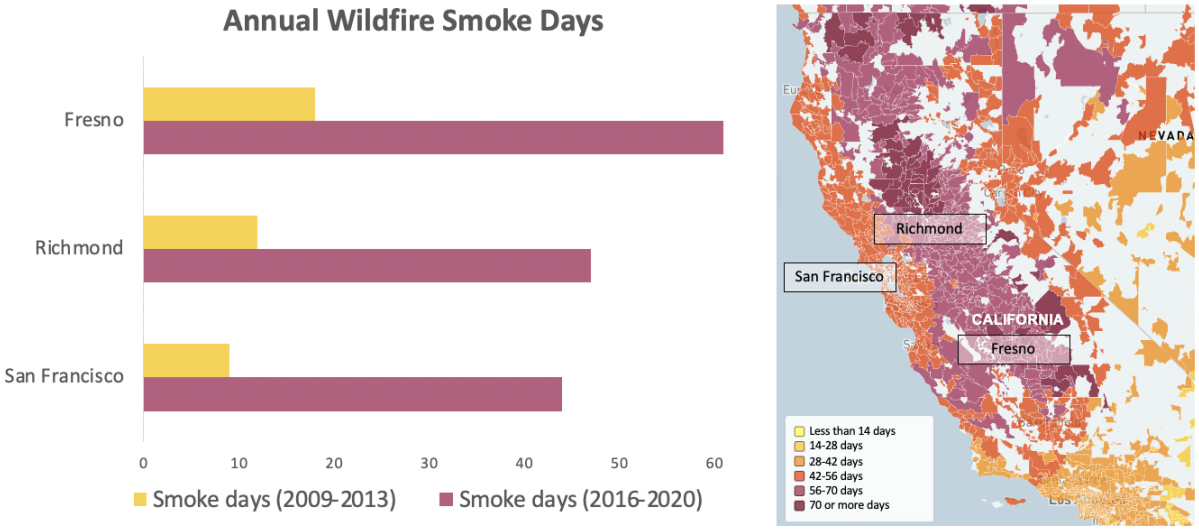


Figure 2. Increase in Wildfire Smoke Days Across California and in our three focal Study Areas [25]

with exacerbations of cardiovascular and respiratory disease,[26] including emergency department (ED) visits.[10,27,28] With increasing events, the impact of recurrent and prolonged wildfire smoke exposure on health needs to be better understood; simple single day or summative exposure studies are no longer sufficient to understand risk. A recent study examined the health effects of wildfire $PM_{2.5}$ exposures over the course of an extended event and found an increased risk of respiratory hospital admissions when smoke levels were extreme but not when smoke levels were lower.[29] Furthermore, research, including our own,[26,30–33] has found that the health impacts of wildfire events, are unevenly distributed, with greater risks for children and those in poor and socially marginalized communities.[3,4]

We are just beginning to understand the health effects of wildfire events in individuals living and working in the state of California. Given the increase in frequency and intensity of such events, there is a critical need to understand the effects of immediate (i.e., hours to days) and longer-term (weeks) exposure on health. There is an even greater need to determine the compounding effects of wildfire smoke in EJ communities. While all Californians are vulnerable to the health impacts of $PM_{2.5}$ emissions from wildfires, EJ communities are at increased risk due to their increased exposure (from being essential outdoor workers and/or living in older, substandard housing[34] with increased infiltration of outdoor air pollutants), increased sensitivity to climate change, and their decreased ability to adapt to climate change. Risk factors for climate-related morbidity and mortality are often classified as intrinsic (e.g., pre-existing medical conditions, disability, age) or extrinsic (housing that remains cool in high temperatures and has central ventilation, access to resilience center, transportation). EJ communities are disproportionately affected by *both* factors.[4] These communities are the most exposed, sensitive, and least likely to have the economic, social, or political resources necessary to prepare for or respond to wildfire events.

Health-protective guidance would improve if we better understood the exposure-response relationship for most short-term health outcomes of concern, including respiratory, cardiovascular, and cerebrovascular conditions. Critical data gaps include the effects of sub-daily exposures, understanding community recovery following exposure, understanding indoor infiltration of wildfire smoke, and quantifying the health effects across social vulnerability factors, with particular focus within EJ communities.

1.2 Objectives: To address these gaps, we propose to **estimate the sub-chronic effects of short-term exposures** (e.g., hourly or daily variations) over days to weeks **to wildfire-specific $PM_{2.5}$ on respiratory, cardiovascular, and cerebrovascular outcomes,** including ED visits and hospitalizations. Through this proposal (see Fig. 3), we aim to:

Objective 1: Quantify the wildfire-specific fine particulate matter ($PM_{2.5}$) exposures for the 2016-2020 fire seasons using a high-resolution atmospheric smoke model fused with dense networks of state-wide air quality monitoring data to provide inputs to exposure models.
Hypothesis 1: Integrated model-data products will show improved predictions of $PM_{2.5}$, and exposure to wildfire-specific $PM_{2.5}$ will vary more by geographic region than by vulnerability.

Objective 2: Estimate how housing attributes (e.g., structure type and condition, year built, presence of air conditioning) and human behaviors (e.g., window opening, use of mechanical ventilation and/or filtration system) modify the infiltration of wildfire-specific $PM_{2.5}$ into the indoor environment to provide novel insights that are vital when considering exposure risk and mitigation strategies. We will use a combination of air infiltration models using housing attributes and meteorological data as inputs combined with new observational studies of infiltration factors of $PM_{2.5}$ in California residences to estimate smoke infiltration.
Hypothesis 2: Census tracts within EJ communities will have a greater percentage of housing with attributes that increase the infiltration of wildfire-specific $PM_{2.5}$ compared with housing located in non-EJ communities.

Objective 3: Estimate the added burden of immediate (hours, days) and longer-term (weeks) exposure to wildfire-specific $PM_{2.5}$ on respiratory (COPD and asthma), cardiovascular (myocardial infarction and heart failure), and cerebrovascular (stroke and transient ischemic attack) emergency department (ED) visits and hospitalizations, and how these relationships are modified by social vulnerability factors (race and ethnicity, neighborhood deprivation, EJ community designation) across communities in California (represented by ~1300 zip codes).
Hypothesis 3a: The magnitude of the wildfire $PM_{2.5}$ effect on acute health outcomes will be largest for high sub-daily exposures and the magnitude of the effect for subchronic health outcomes will be largest for longer (daily to weekly) exposures.
Hypothesis 3b: The magnitude of the wildfire $PM_{2.5}$ effect on select health outcomes will be greatest in communities with highest vulnerability.

Objective 4. Engage closely with community groups to better understand current mitigation behaviors and to identify place-based mitigation strategies to reduce the short-term effects of wildfire-specific $PM_{2.5}$ while addressing the ongoing health risks that environmental pollution poses in Environmental Justice (EJ) communities.
Hypothesis 4a: EJ communities will have more barriers to adopting mitigation behaviors during wildfire events than non-EJ communities due to social and structural barriers.
Hypothesis 4b: Targeting of health-protective guidance and mitigation will be improved with more specific place-based data and stakeholder engagement.

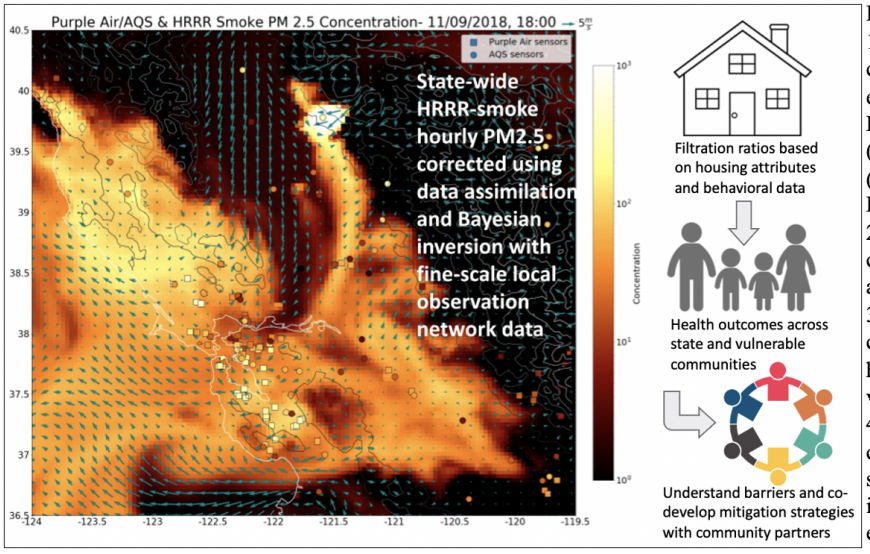


Figure 3. Project workflow:
1) HRRR-Smoke $PM_{2.5}$ concentration and wind vectors, enhanced by concentrations from Purple Air (squares) and AQS (circles) observations of $PM_{2.5}$ (shown here during the 2018 Camp Fire event),
2) Indoor/outdoor filtration ratios calculated based on housing attributes and behavior data,
3) Statewide respiratory, cardiovascular, and cerebrovascular health outcomes and across social vulnerability.
4) Engage EJ community partners to co-develop implementation strategies for adopting mitigation interventions during wildfire smoke events.

2. Approach/Activities

Overview: The PROTECT Health Effects project will address our 4 objectives by estimating the health effects of wildfire-specific $PM_{2.5}$ exposure (i.e., hourly and daily variations) across vulnerable communities in California. We will also examine how housing quality may reduce risk, as a promising intervention to limit wildfire $PM_{2.5}$ health effects and effects from on-going exposures to other pollutants. Lastly, we will engage with EJ communities to understand existing barriers to mitigation interventions and co-develop implementation strategies to increase uptake of acceptable community-relevant mitigation interventions.

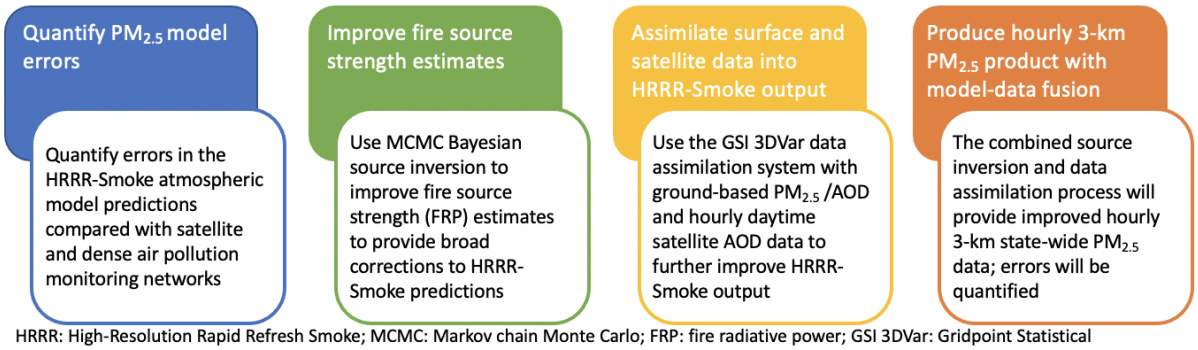
2.1 Objective 1: Quantify the wildfire-specific fine particulate matter ($PM_{2.5}$) exposures for the 2016-2020 fire seasons using a high-resolution atmospheric smoke model fused with dense networks of state-wide air quality monitoring data.

Background: High-resolution smoke forecasts are needed to provide reliable spatial and temporal information during extreme wildfire events. The National Oceanic & Atmospheric Administration (NOAA) High-Resolution Rapid Refresh Smoke (HRRR-Smoke) model provides a robust, straightforward dataset with hourly, nationwide smoke coverage, including vulnerable communities which typically lack dense observation data, from 2016-present.[35,36] At 3-km resolution, HRRR-Smoke is the highest resolution operational smoke model available.[37,38] HRRR-Smoke only includes wildfire smoke emissions (no background emissions), providing a way to isolate smoke contributions to sub-daily $PM_{2.5}$ exposures.

Preliminary Data: We have a wealth of experience using weather prediction models including the state-of-the-art HRRR-Smoke wildfire smoke model to generate $PM_{2.5}$ concentration fields; we will be supported directly by NOAA scientists in the proposed work (*see* Letter of Support). HRRR-Smoke is a three-dimensional atmospheric model for simulation of mesoscale flows and smoke dispersion over complex terrain.[39] HRRR-Smoke is based on the Weather Research and Forecasting (WRF) model, enhanced with rapid assimilation of observation data, making it a very robust numerical weather prediction model. Satellite fire detections of fire radiative power (FRP) are fed into the model to drive smoke transport in the boundary layer and aloft, at high spatial resolution over the entire continental US. HRRR-Smoke is unique in its ability to capture both meteorological and $PM_{2.5}$ fields; the model includes the effect of weather on smoke transport, and the effect of smoke on weather, and at 3-km resolution is able to capture spatial variations and transient patterns of smoke plumes due to complex terrain effects across California.[37]

Deriving a Statewide Concentration Grid: HRRR-Smoke predictions are highly sensitive to errors in the satellite FRP; $PM_{2.5}$ estimates are also influenced by errors in the driving meteorology, land-surface characterization, and contributions from sources in addition to wildfires. We will enhance the HRRR-Smoke using source inversion and data assimilation of large datasets of surface and satellite $PM_{2.5}$ observations to build a highly spatiotemporally resolved pollutant concentration time series that corresponds to the locations of the residences of the study population. This process will account for model errors in wind speed and direction and satellite fire detection when predicting smoke transport.

Proposed Model: To correct for errors in fire detection source strength, we will use Bayesian inference techniques[40,41] to adjust emissions. Further errors in model predictions will be reduced using standard data assimilation techniques (three-dimensional variational [3DVar] data assimilation) available with the HRRR model to incorporate sensor network data,[42,43] following guidance from data assimilation and other data fusion approaches.[44–46] Our goal is to use computationally efficient data science approaches that can be incorporated into real-time forecasts. Thus, we focus on algorithms which can be executed in a time frame on the order of minutes to provide hourly 3-km data for the 2016-2020 period, without requiring new HRRR-Smoke simulations. We summarize the process in **Figure 4**.



HRRR: High-Resolution Rapid Refresh Smoke; MCMC: Markov chain Monte Carlo; FRP: fire radiative power; GSI 3DVar: Gridpoint Statistical Interpretation three-dimensional variational data assimilation; AOD: aerosol optical depth; HMS: Hazard Mapping System

Figure 4. Overview of steps to develop a wildfire-specific $PM_{2.5}$ 3-km statewide surface grid.

Data Sources: The corrections referenced in **Figure 4** will leverage dense observation networks described below to improve the statewide $PM_{2.5}$ concentrations provided by HRRR-Smoke. These networks include:

- ***Statewide regulatory monitoring stations.*** Data are available from EPA's Air Quality System (AQS) database and include hourly $PM_{2.5}$ and other pollutants.
- ***Purple Air $PM_{2.5}$ data.*** There are 8,700 community-installed Purple Air sensors in California. In Figure 2, we compare a sample of Purple Air data to HRRR-Smoke. In the San Francisco Bay Area alone, the number of sensors grew to 5,615 by 2021, with 38% of them indoors, providing overall excellent temporal and spatial coverage. These low-cost sensors are not as accurate as AQS sensors, but can be easily adjusted using newly established correction factors to capture spatial and temporal trends.[47–49]
- ***Berkeley Atmospheric CO_2 Observation Network (BEACO$_2$N).*** A 70-sensor network in the SF Bay Area (2 km apart), measuring 5 sec concentrations of NO, NO_2, O_3, CO, CO_2, size resolved particle number from 100 nm to 10 microns, and boundary layer height.
- ***Satellite aerosol optical depth (AOD) data.*** Hourly daytime AOD data from GOES-16/17 can be compared to vertically integrated smoke predictions from HRRR-Smoke and incorporated into the integrated model-data product to constrain wildfire emissions. Smoke emitted from intense wildfires is often extremely thick and satellite algorithms label the smoke plume as a `cloud' which leads to missing FRP data (which will be the target of the source inversion approach described above) and also missing AOD data (which will be complemented by analogous data sources and/or gap filling measures).
- ***NASA AERONET (AErosol RObotic NETwork).*** In addition to the satellite AOD data, ground based hourly AOD measurements are available. All AOD data are for daytime only and may be limited due to cloudiness, but can serve as additional constraints in the data assimilation process.
- ***Assembly Bill (AB) 617 Surface Monitoring Data.*** AB617 mandates that community air monitoring and emission reduction plans be developed for designated EJ communities. North Richmond and South Central Fresno, CA are CARB-designated AB617 communities (https://ww2.arb.ca.gov/capp-communities).

Deriving Area Exposure Estimates: We will use the hourly 3-km grid of wildfire-specific $PM_{2.5}$ generated from the HRRR-Smoke model to assign residential outdoor wildfire-specific $PM_{2.5}$ exposures for all census tracts and zip codes in California. Census tract and zip code geographical extent data is available for each year from 2016-2020 from the US Census website. This information will be overlaid on the hourly 3-km grid. We will use tools within ArcGIS to spatially average or extract the wildfire-specific $PM_{2.5}$, depending on the size of the census tract and zip code. Once the hourly spatial average exposure is derived, we can aggregate the data into sub-daily exposure periods (e.g., daytime, night time) for each geographical area. We will also derive the number of daily exceedance hours and the time of

day at which the peak exposure occurred. The daily exceedance hours will be defined as the number of hours that the hourly average of wildfire PM2.5 was greater than 55.4 micrograms per cubic meter, the level at which the Air Quality Index (AQI) deems $PM_{2.5}$ to be 'unhealthy.'

Differences across geographical areas and communities (e.g., Bayview-Hunters' Point vs. all of San Francisco) will be quantitatively assessed by comparison of annual average daily wildfire-specific $PM_{2.5}$ µg/m3, daily exceedance hours, and timing of peak hours of exposure.

Expected Outcome: This will create an wildfire-specific $PM_{2.5}$ exposure estimate for every census tract and zip code in California between 2016-2020, for each day, with detailed sub-daily exposures and aggregated exposures up to multi-year averages, as needed.

2.2 Objective 2: Estimate how housing attributes and human behaviors modify the infiltration of wildfire-specific $PM_{2.5}$ into the indoor environment.

Background: Another novel element of our proposal is estimating exposure by accounting for indoor concentration differences. During major wildfires, people are advised to shelter indoors to reduce their exposure to outdoor smoke. However, the ability to keep windows closed during wildfires depends on outdoor conditions, and if thermal comfort can be maintained in homes with windows closed. The ability to remove infiltrated wildfire-specific $PM_{2.5}$ using filtration also varies depending on the use and effectiveness of portable air cleaners and furnace air filters (if present). The infiltration of wildfire-specific $PM_{2.5}$ depends on housing characteristics, outdoor conditions, and occupant behaviors, but pin-pointing the effects of these influencing factors is challenging.[50] New assessments of infiltration factors of wildfire $PM_{2.5}$ using crowdsourced data in California found substantial variability that can be partially explained by building and behavioral factors.[20,51,52] However, there is an absence of data on the infiltration factors in EJ communities.

Preliminary Data: Dr. Chan has compiled the largest US residential air leakage database to date,[53] and has published work[54] to estimate the population exposure to outdoor air pollutants while sheltering in homes. She has led field teams to measure indoor PM in a large number of homes, and has developed mechanistic and statistical approaches to estimate the contribution of exposure from indoor sources and from PM of outdoor origin.

Proposed Model: The wildfire $PM_{2.5}$ infiltration factor will be calculated at the census-tract level using this model: $(AER*P)/(AER+k)$. The penetration coefficient of infiltrating particles P and loss rate k of indoor particles by surface deposition and other mechanisms will be sampled from published distributions.[55] Empirical and physics-based models relate to the air infiltration portion of the air exchange rate (AER) which will be computed using meteorology and building attributes for single-family homes.[56] AER of multi-family dwellings will be estimated based on California datasets.[57] Increases in AER from window opening and use of mechanical systems will be estimated based on published studies.[58] Distributions of AER, P, and k will be adjusted according to community-wide responses to reflect the behavioral influence during wildfires. The modeled infiltration factor for wildfire-specific $PM_{2.5}$ (as defined in Objective 1) will be compared with the measured distribution from crowdsourced data to constrain the models.[51,52] This final step will be assisted by additional indoor PM data collection efforts within EJ communities that coincide with the study period for this proposal. The total number of homes included in this parallel study is n=150 within the three study areas (Fresno, Richmond, and San Francisco). The goal of these **already funded projects** is to gather multiple months of data from each home such that infiltration factors can be calculated when indoor sources are minimal while outdoor PM concentrations vary.

Data Sources

- ***Housing Attributes*:** We purchased a dataset with attributes of all residential and commercial buildings in California in both urban and rural counties in 2016,[59] including

type (single-family, multi-family), year built, and year of retrofit, which may indicate weatherization upgrades. The data can be evaluated at the census tract level to examine across EJ and non-EJ communities and at the zip code level to match the resolution of the ED visit and hospitalization data.

- ***Behavioral Data:*** We will modify estimates using survey data collected under Objective 4 (*see* section **2.4**), which will include mitigation behaviors during wildfire events.
- ***Indoor PM Data:*** We will have consumer-grade PM monitoring data from 150 homes in EJ communities; monitors will be similar to the ones used in crowdsourced studies.[51,52] This data will supplement published infiltration factors from existing crowdsourced data that do not reflect the house and household characteristics of EJ communities.

Expected Output: We will derive indoor infiltration estimates for wildfire-specific $PM_{2.5}$, adjusting for housing attributes, outdoor conditions, and other behavioral factors informed by Objective 4, averaged over census tracts, zip codes, and neighborhoods in California. In addition, we will calculate infiltration factors using measured data collected from EJ communities, in order to compare differences and for constraining the model.

2.3 Objective 3: Estimate the added burden of immediate and long-term exposure to wildfire-specific $PM_{2.5}$ on respiratory, cardiovascular, and cerebrovascular emergency department visits and hospitalizations to identify critical exposure windows and examine how these relationships are modified by vulnerability factors across communities in California.

Background: There is robust evidence that short-term $PM_{2.5}$ exposure is associated with increased cardiorespiratory hospital admissions.[10,27,60] Unlike $PM_{2.5}$, wildfire smoke generated $PM_{2.5}$ is not regulated under the Clean Air Act and the health impacts of wildfire-specific $PM_{2.5}$ are not well understood, particularly in vulnerable communities chronically exposed to higher levels of ambient air pollution and other psychosocial stressors that may confer greater susceptibility to pollutants. Most studies on wildfire smoke have used 24-hour average $PM_{2.5}$ concentrations in the analysis of health outcomes.[61] There is also emerging evidence that sub-daily non-wildfire fine particulate exposures may be associated with myocardial infarction (MI) and ischemic events and should similarly be examined for wildfire-specific $PM_{2.5}$.[62] Furthermore, research thus far has exclusively focused on acute effects of wildfire smoke and further investigation on long-term health impacts is warranted. We also aim to identify critical exposure periods that occurred before ED visits and hospitalizations. These approaches will allow us to explore whether the window of susceptibility to wildfire-specific $PM_{2.5}$ is longer and if health effects are greater in vulnerable populations due to individual- and structural- level factors (**Figure 5**).

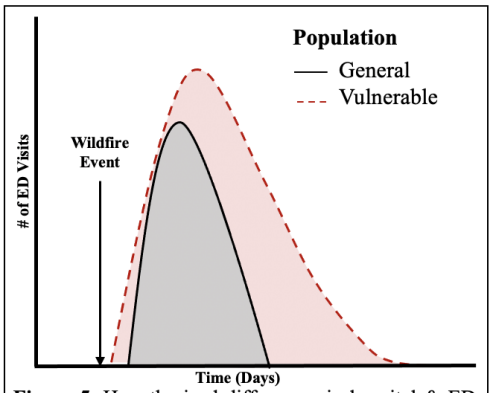


Figure 5. Hypothesized differences in hospital & ED visits between general (black solid line) and vulnerable (red dashed line) populations after a wildfire event.

Preliminary Data: Drs. Balmes, Holm and Noth have a collective experience of over 60 years examining the health effects of non-wildfire and wildfire-specific $PM_{2.5}$. We have extensively published on the health impacts of wildfire smoke, with an emphasis on susceptible populations such as children and people with pre-existing disease.[26,30–32] Our specific contributions/expertise include health effects in wildland firefighters,[31] indoor $PM_{2.5}$ in both the developing[63] and developed[64] world, and effects of ambient pollution on respiratory[65–67] and metabolic[68] health of children. Furthermore, Drs. Thakur and Balmes demonstrated co-occurrence of social and environmental exposures by demonstrating higher rates of asthma ED visits and diesel exhaust exposure in historically redlined census tracts across California.[69]

Data Sources: From the California Health Care Access and Information (HCAI), we will obtain respiratory-, cardiovascular-, and cerebrovascular-related ED visits and hospitalization at the zip code level for the period extending from 2016-2020. For each event, we will have age, sex, and race/ethnicity data. This will allow us to examine the rate of ED visits and hospitalizations during (days) and following (weeks, up to eight weeks) peak smoke exposure, providing a better understanding of how wildfire smoke acutely and subacutely contributes to poor health in pediatric and adult populations across California.

Available Data Elements:

- ***ED visits and hospitalizations*:** We will obtain daily counts that will be aggregated at the zip code level. ED visits and hospitalizations will be converted to rates by dividing counts by the population. Health conditions to be included are as follows:
  - Respiratory events, visits will be identified by ICD-9 codes 460:519 or ICD-10 codes J00:J99 (excluding J95) which include pulmonary diagnoses, such as asthma, COPD, pneumonia, and interstitial lung disease.
  - Cardiovascular events, visits will be identified by ICD-9 codes 410:414 or ICD-10 codes I20:I25 which include acute myocardial infarction (MI) or other acute or chronic ischemic heart disease and ICD-9 code 428 and ICD10 code I50 which is for congestive heart failure.
  - Cerebrovascular events, visits will be identified by ICD-9 codes 430:438 or ICD-10 codes I60:I69 which include hemorrhagic stroke, ischemic stroke, and occlusion of the precerebral and cerebral arteries.
- ***Demographics*:** Age, sex, race/ethnicity for each ED visit and hospitalization.
- ***Vulnerability Factors:*** There is a paucity of studies examining what factors increase susceptibility to the health impacts of wildfire smoke. Understanding what factors are associated with increased susceptibility to wildfire-specific $PM_{2.5}$ will assist with identifying and implementing potential interventions to protect these subgroups. We will examine if identified associations are modified by the following vulnerability factors:
  - ***Age***: We will examine how associations with wildfire-specific $PM_{2.5}$ differ between adults ≥65 years vs <65 years and children 0-5 years vs both older children and adults <65 years. These age groups (≥65 years and <5 years) had higher rates of asthma hospitalizations compared to younger adults (<65 years) after California wildfires.[70]
  - ***Sex***: Emerging evidence suggest women may be more susceptible to wildfire-specific $PM_{2.5}$ for respiratory-related hospitalizations; this will be further explored.[33,62]
  - ***Race/Ethnicity***: Majority Black, Hispanic, and Indigenous census tracts have 50% greater vulnerability to wildfire smoke compared to other census tracts.[71] We will examine if wildfire-specific $PM_{2.5}$-associated hospitalizations differ by race/ethnicity.
  - ***Baseline $PM_{2.5}$ Exposure***: High baseline $PM_{2.5}$ exposure will be defined as having an annual mean concentration > 12μg/m^3. Average baseline $PM_{2.5}$ concentrations will be estimated using month-of-year average $PM_{2.5}$ on non-smoke days across all years in the sample. This geoscience-based model incorporates ground monitor data, satellite observations, chemical transport model predictions, and other features.[72,73]
  - ***Healthy Places Index*** (HPI): We will use the California Healthy Places Index,[74] a composite risk assessment of social vulnerability associated with mortality, to estimate health effects from wildfire-specific $PM_{2.5}$ across communities, comparing the highest and lowest quartiles. This tool was used by the California Department of Public Health to inform equitable resource allocation in response to COVID.
  - ***CalEnviroScreen 4.0*** (CES4.0): We will use the same definitions as CalEPA to designate disadvantaged communities in California based on census tracts that score in the highest quartile for this indicator along with census tracts in the top 5 percentile for the Pollution Burden sub-indicator.

- ***Indoor Filtration***: We will explore the degree to which indoor filtration of wildfire-specific $PM_{2.5}$ changes risk for ED visits or hospitalization. We hypothesize that for communities where indoor penetration ratio estimates are high (i.e. >0.5), ED visits and hospitalizations will be highest.

Wildfire-specific $PM_{2.5}$ exposure estimates: From our models in Objective 1, we will have the daily (average), hourly (average), and sub-daily (number of exceedance hours) concentrations of wildfire-specific $PM_{2.5}$, including exposure estimates to the zip code level. These concentrations will be aggregated for relevant windows of exposure, starting from 8 weeks prior to the start of the study period, through the end of the study period.

Main Analysis Plan: We will use a distributed lag mixed (DLM) model to flexibly analyze the contribution of smoke exposure over the prior two months, and how exposures at different lags (from 0 through 8 weeks prior) affect daily ED visit and hospitalization rates. Distributed lag models allow us to control for exposures at all the different time frames simultaneously, and a random term will be added to the models to control for repeated use of the same census tract over the study interval. These models will use the following structure:

$$y_{ij} = a + a_k x_{ik} + u_{ij}\gamma_{ij} + \sum_{s=0}^{l} \beta_s \delta_{ijs},$$

where y_{ij} is ED or hospitalization rate on the jth day of the study interval for zip code i, a_k (where k = 1, ….) are the coefficients for the fixed effects, x_{ik} are the values of covariates for the ith geographic area (where k = 1, ….), u_{ij} is the coefficient for the random effect, γ_{ij} is an indicator for the jth day in ith geographical area), β_s are the coefficients for each daily exposure lag relative to the date of the ED or hospitalization rate, and δ_{ijs} are the exposure values for the jth day in the ith area, for lag s. Analyses will be adjusted for confounders, including age, sex, race/ethnicity, temperature, and season. This approach will allow us to compare results across a large range of exposures that may be used to develop relative risk ratios comparing exposed and non-exposed areas. A false discovery rate will be applied to account for multiple comparisons.

Subgroup Analyses: We will identify sensitive periods with the main DLM and then use a linear model with an interaction term between vulnerability factors and wildfire-specific $PM_{2.5}$ to evaluate for effect modification of the PM-health relationship. In a sensitivity model, we will run DLM restricted to EJ communities to explore whether the sensitivity periods to wildfire-specific $PM_{2.5}$ may be different in these communities.

Limitations: While DLMs allow us to consider all lag periods simultaneously, they are unable to answer questions about the effect of repeated exposures. We hope to explore this important question in further study.

Power: Of California's 1741 active zip codes, we estimate that we likely be able to get health data for 75% of these (1300 zip codes), with overrepresentation from more densely populated areas. Using the wildfire-specific $PM_{2.5}$ estimates from Aguilera et al. (mean 2.46, range 0-18 µg/m3), as well as their mean rate of respiratory visits (2.5/100,000 population), we simulated outcome data (10,000 repetitions for n=1300) following a Poisson distribution. With data from 1300 zip codes, looking only at data for a single lag, we would have 80% power to detect a difference if a 1 $\mu g/m^3$ increase in wildfire $PM_{2.5}$ increases respiratory visits by 1.7% or more. Given that we will be assessing multiple lags within a single model for each year of the study period (2016-2020), over 5 years of data, we should be able to detect small to moderate effects in the DLMs.

Expected Outcome: Estimated effects of wildfire-specific $PM_{2.5}$ across pediatric and adult relevant health outcomes across communities and vulnerability factors in California.

2.4 Objective 4: Engage closely with community groups to better understand current mitigation behaviors and to identify acceptable place-based mitigation strategies that address short-term health risks of wildfire-specific $PM_{2.5}$ while addressing the ongoing threat of environmental pollution in Environmental Justice (EJ) communities.

Background: We have a good sense of the communities who are most vulnerable and sensitive to wildfire-specific $PM_{2.5}$ in California and their associated risk for health conditions, both of which will be further explored through this award. There are also now a number of evidence-based mitigation strategies that support vulnerable populations during extreme heat and wildfire smoke events.[4] These mitigations vary in invasiveness -- ranging from steps to increase awareness and educate communities about protective behavior, to fan distribution, opening resilience centers, to home and building weatherization.[11] What is lacking from current research efforts of mitigation interventions is the consideration of unique community attributes that may lead an intervention to be successful in one community or neighborhood, but not another. For example, for communities that experience power outages during wildfire events (a common occurrence in Richmond, CA), passive approaches (i.e., not dependent on electrification), such as adding cool roofs to improve thermal comfort and make window closure a viable option, may be preferred over portable filtration devices.

History of Community Partnerships within EJ Communities: Our team has an extensive track-record of community research partnerships, including with the EJ communities included in this award (**Table 1**). Most relevant, is a recently funded award from the Patient Centered Outcomes Research Institute (PCORI, EACB-23028). Under this award, we have already started this engagement effort with local community and neighborhood organizations located in Bayview/Hunters Point and the Tenderloin, two EJ neighborhoods in SF. We will extend this purposeful method of community engagement to North Richmond and South Central Fresno, two EJ communities with AB 617 designation. We are optimistic of success, as we already have established partnerships in these communities (*see* Letters of Support from Dr. Omotoso [Lifelong Medical] and Central California Asthma Collaborative).

Table 1. Examples of Past and Current Academic-Community Partnerships

Academic-Community Partners	Nature of Partnership
Lawrence Berkeley National Laboratory (LBNL)-Association for Energy Affordability, Inc. (AEA)	AEA mission is to achieve energy efficiency to foster and maintain affordable and healthy housing and communities, especially those of low-income. LBNL and AEA partnered and completed a field study (2017-2019) sampling indoor air quality, ventilation, and other parameters in low-income apartments. (San Francisco, Southern CA)
UCB (Chow) and Little Manila Rising (Community-based Organization [CBO] in AB 617 community)	Co-teaching of UCB course to create local design plans to help tackle air quality issues and climate change. Students engaged and attended regular meetings with EJ communities in Stockton, who are actively participating in the AB 617 process to improve local air quality (see this CARB EJ blog post, and project website with student design projects).
UCB (Noth), UC Merced (Bradman) with Little Manila Rising and Central California Asthma Collaborative, both CBOs that serve AB 617 communities.	San Joaquin Valley Pollution and Health Environmental REsearch (SPHERE) study aims to conduct field studies in 120 households assessing total exposures to air pollutants and noise to residents in Stockton and South Central Fresno (AB 617 communities).
UCB (Balmes, Holm, Noth) and Central California Asthma Collaborative (CBO that serves AB 617 community)	Collaborating on a study of ambient air pollution and children's health in the greater Fresno area. This productive ongoing collaboration has followed multiple cohorts of children, and resulted in many research papers linking air pollution with asthma outcomes as well measures of metabolic health and glucose dysregulation.

UCSF (Thakur, Balmes), UCB (Noth) and Lifelong Medical William Jenkins (Community Health Center in AB 617 Community)	Co-lead a Youth Participatory Action Research (YPAR) Internship with high school students residing in North Richmond on place-based social and environmental issues important while training in research skills that allow youth to improve their lives and community. Students have competitively obtained two grants: Richmond City Art's Community Art Mural and Air District's Community Air Monitoring Project.
UCSF (Thakur, PRISE Center) and San Francisco Department of Public Health and Office of Resilience and Capital Planning	PCORI-engagement award will build on the cross-municipality efforts through the Heat and Air Quality Resilience Project to authentically bring in community stakeholders into the City's cross-sector planning on building climate resilience in socially vulnerable neighborhoods.

Framework for Engagement: Our approach incorporates principles of community-based participatory action research (CBPAR).[75,76] PAR deviates from traditional research models where line of inquiry is dictated by the subject matter expert and research is completed on or for a specific community. In these traditional models, the researcher determines the research question, the study design, and analysis plan, leaving the community as a passive player in the process, even when the conducted research may confer benefits for the community. When facing complex social problems, such as combating the disproportionate health effects from wildfire smoke, this traditional model breaks down. Rather, we have adopted an approach where research questions, study design, and analysis are ground-truthed with community partners and strategies addressing social and structural barriers to mitigation are co-developed and tailored to meet the community's specific needs. To accelerate our understanding of which climate mitigation interventions should be translated into wide-spread implementation and incorporated into policy, it is imperative that community stakeholder voices and priorities are at the center of the research agenda. Through purposeful strategies (intentional spaces for bi-directional learning, skill building and leadership training, and prioritization of community engagement, *see* **Community Engagement Plan**), we aim to level the power imbalance and build trusting, fruitful relationships that foster a productive, group dynamic. We will have a multi-stakeholder process to systematically build a mitigation agenda that centers on community priorities, with the shared goal of improving wildfire-impacted health disparities.

SEED Method for Engagement: Implementation of our logic model depends on successful engagement. The SEED (Stakeholder Engagement in question Development and Prioritization) Method is a systematic, iterative approach to engaged stakeholders in health intervention research.[15] Zimmerman and colleagues have demonstrated successful implementation of this method across variety of health concerns and partnerships, including those involving community and local governmental stakeholders.[16] The SEED Method is based in participatory research principles nested within the socio-ecological model that are action oriented, aligning well with our proposal goals of engaging community stakeholders around adoption of evidence-based mitigation interventions.

Formation of Community Stakeholder Group: We will proactively engage community-based organizations who meet one of the following criteria: located within and/or actively engages within the included EJ communities in Fresno, Richmond, and San Francisco; interest or mission aligns with wildfire smoke-impacted health conditions; or, interests or mission align with mitigation strategies for wildfire smoke events. To ensure the process of stakeholder identification is comprehensive, we will use the SEED Stakeholder Identification and Recruitment Matrix (available: https://tinyurl.com/n8wfs7bw). We will set up "coffee-break meetings" with prospective community groups and stakeholders. The purpose of these meetings will center around information exchange. To ensure community partners feel adequately prepared prior to the meetings, each group will receive an overview document of the purpose of the engagement and a list of questions for discussion. Each meeting will follow the following structure: brief overview of EPA proposal and reason for engagement, purpose and goals of meeting, space for stakeholder to state their goals for

meeting, discussion. We will have two dedicated note-takers to capture discussion. Each meeting will end asking stakeholders 1) if they would like to move on to the next steps to be formally part of the Community Stakeholder Group, and 2) who else they recommend us to meet with until no further community stakeholders are identified or until we have at least five partners within each community wanting to move forward. Meetings will take place virtually, at a community center, or at the organization's location site. The final Community Stakeholder Group will include at least three stakeholders from each EJ community (n=9).

Identifying Barriers to Acceptable and Promising Mitigation Strategies in EJ Communities: Implementation Science frameworks are increasingly being recommended to develop complex behavior change interventions. While there is "no magic bullet" for changing behavior, passive dissemination of guidelines and broad, non-specific messaging are known to be largely ineffective at changing practice. Similarly, success is limited when the choice of intervention lacks an explicit rationale. Theory can be used to understand which mitigation behaviors need to be changed, the factors that influence the behaviors being targeted, and which potential behavior change techniques and modes of delivery are likely to be effective. The Behavior Change Wheel (BCW) is a comprehensive intervention development framework derived from 19 behaviour change frameworks to holistically address the "behavior system".[77] The BCW framework uses the **Capability Opportunity Motivation Behavior** (COM-B) model to understand behavior (**Figure 7**). Thus, the BCW framework provides a coherent basis for considering all potential barriers to behavior change and the interventions expected to overcome those barriers in a given context/population.

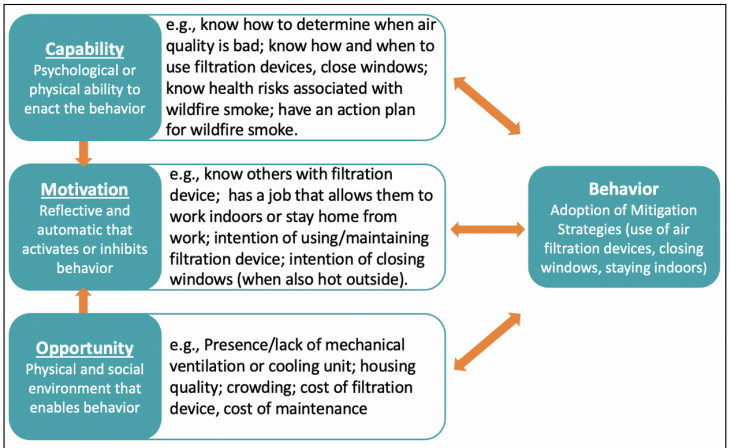


Figure 7. COM-B Framework for examining barriers to mitigation behaviors during Wildfire Smoke Events in EJ Communities.

Survey Development, Distribution, and Analysis. Using this COM-B framework, academic researchers in partnership with the Community Stakeholder Group will co-develop a community-wide survey to gain understanding of the current use and barriers to existing mitigation strategies for wildfire smoke and which potential strategies are viewed as acceptable. Surveys will be distributed through social and community networks of the community stakeholder groups and through the network developed through the "coffee break" meetings. Survey will be anonymized with no participant identifying information shared. We aim to survey 150 individuals within each EJ community (total n=450). Results will be used to develop conceptual models to identify potential targets for acceptable mitigation strategies. Sample questions provided in **Table 2**. This survey is intended to garner descriptive data only and the provided sample size will allow for sufficient variability to adjust infiltration models (Objective 2) and inform focus group discussion.

Table 2. Sample Survey Questions

1. What are your experiences of wildfire smoke?
2. How often do you use these strategies during wildfire events?*
3. What are some reasons you do not use these strategies during wildfire events?*
3. What strategies do you think could address wildfire smoke in your community? Which ones do you not think would be effective?
**In actual survey, will provide list of strategies and Likert option response*

Focus groups. After preliminary conceptual models are developed for each identified acceptable mitigation intervention, the community stakeholder group and the academic research team

will co-develop specific questions for each focus group relevant to their experience/area of expertise. From these generated questions an interview guide will be developed. Each focus group will include 5-7 participants. Interested Community Stakeholder Group members will be trained by Dr. Thakur's team to co-moderate focus groups. Focus groups will be audio recorded and transcribed.

Thematic Analysis. Themes will be categorized according to the COM-B framework (Figure 7) as Capability, Opportunity, and Motivating barriers and enablers to implementation of mitigation strategies. We will further characterize subcategories of barriers and enablers across several levels reflecting, for example, community views on structural and systems factors affecting mitigation success, those that relate to skills required to enact mitigation efforts, and those that affect motivation to engage with the mitigation strategy. Additionally, themes that relate to pre-existing drivers of mitigation challenges experienced by community members (such as poorly ventilated housing) versus those that are emerging factors (such as power outages affecting the ability to cool), will be characterized.

Revise and Prioritize Strategies. Resulting themes will be used to help identify and revise implementation strategies to move forward for pilot testing. The process of prioritization will be facilitated by Dr. Thakur's team using guides from the SEED Toolkit and by applying the APEASE (Acceptability, Practicability, Effectiveness, Affordability, Side-effects, and Equity) Criteria.[7817] The SEED Toolkit include a process of multiple rounds of voting until a preset number of strategies is identified (for example, 15-20 strategies may be presented, but only 5 will be moved forward for pilot testing). The APEASE criteria will be used to help determine feasibility and relevance of each of the proposed mitigation strategies. These criteria query whether the proposed strategy exhibits Affordability (Cost to implement?); Practicality (Intervention feasible?); Effectiveness (Evidence for the intervention?); Acceptability (Intervention acceptable to those receiving/delivering the intervention?); Side-effects (Unintended consequences of the intervention?); and Equity (Will the intervention increase disparities?). One example is the do-it-yourself box filter fan. This intervention is low cost (affordable), easy to assemble (practical), and shown to reduce indoor concentration of $PM_{2.5}$ (effective). However, concerns have been raised about its actual use as it requires windows to be closed which is not possible in buildings without central ventilation (feasibility?) and concerns of causing a fire if left in use for too long (side-effects). Further, fans do not address the exposure to chronic sources of $PM_{2.5}$ as they are intended for short-term use (equity).

Expected Outcome: In addition to forming a cross-county community stakeholder group, we will have increased understanding of the existing barriers to uptake of mitigation interventions for wildfire-specific $PM_{2.5}$ across multiple counties, allowing us to uniquely identify common barriers that are ripe for intervention. Lastly, with our stakeholder partners we will co-develop implementation strategies to target these identified barriers.

2.5 Environmental Justice: Central to the PROTECT Health Effects proposal is partnerships with stakeholders who live and serve Environmental Justice communities. In addition to being equipped to answer important quantitative questions regarding the cumulative effect wildfire-specific $PM_{2.5}$ has across EJ communities, we uniquely have established partnerships with local governmental agencies and community organizations in EJ communities that will allow for co-development of strategies to mitigate the negative health effects of wildfire-specific $PM_{2.5}$ that are informed by local contexts to address barriers.

2.6 Innovation: Our proposal features multiple dimensions of innovation targeted to yield impactful outcomes. First, our focus on sub-daily effects of wildfire-specific $PM_{2.5}$ on relevant pediatric and adult health outcomes is both highly important and innovative. This proposal is one of the first to attempt to quantify exposures on this level and at this scale. Furthermore, we will examine these effects across socially vulnerable communities. Second,

our assessment of how housing attributes and mitigation behaviors modify indoor filtration of wildfire-specific $PM_{2.5}$ across California is also highly important and innovative, especially with regard to vulnerable communities that likely have poorer housing stock. Lastly, our application of an *Implementation Science* approach to examine health inequities due to the disproportionate burden of exposure to $PM_{2.5}$ through community collaboration is a new approach to environmental health effects research and focuses on sustainability as a key feature of adoption for considering strategies that increase uptake of mitigation interventions.

2.6 Expected Results, Benefits, Outputs and Outcomes: The results generated from this proposal will have multiple targets of influence. We have shaped our research questions to fill important gaps in developing State and Federal guidelines and policies - specifically, our analyses on the sub-daily effects of wildfire-specific $PM_{2.5}$ on health outcomes will help inform decisions around public building closures, including schools. Our proposed work with community partners will provide much needed information on existing challenges to accessing mitigation efforts - for example, high upfront cost of retrofitting vs. on-going cost of portable air filtration devices. Lastly, at the conclusion of this award, we will have promising, community-led implementation strategies to push forward evidence-based mitigation strategies at a cross-county level.

2.8 Project Management

Research Team: We have assembled leading researchers from **University of California San Francisco** (UCSF, Thakur [PI], Balmes, and Holm), **UC Berkeley** (UCB, Chow, de la Rosa, and Noth), **Lawrence Berkeley National Laboratory** (LBNL, Chan, Kirchstetter), and the **California Office of Environmental Health Hazard Assessment** (OEHHA, Basu). Our interdisciplinary team includes expertise spanning exposure and building science, environmental engineering, atmospheric modeling, epidemiology, and implementation science, and community-based participatory research. Dr. Thakur (PI) is a physician-scientist who is PI of multiple grants with strong community engagement components, including from PCORI on capacity building for climate change in socially vulnerable populations. She is an expert at bridging disciplines and leading diverse teams - including, incorporating community groups onto the leadership team - to conduct science with clear policy relevance. Dr. Balmes is a world-renowned expert on the health effects of environmental pollution and is the Physician Member of the California Air Resources Board (CARB) and thus is in a position to advocate for policy initiatives at the state level that can benefit communities impacted by wildfire smoke. Dr. Holm is an environmental pediatrician and epidemiologist who works in the Children's Environmental Health Center within California EPA, and who has been heavily involved in wildfire smoke guidance for children at the national level.

From UCB, Dr. Chow is a leader in the development and application of atmospheric transport modeling over complex terrain and in urban areas. She brings this experience to community-engaged air pollution mitigation work in her teaching and to wildfire smoke modeling in collaboration with the HRRR-Smoke team at NOAA. Dr. de la Rosa is an environmental health scientist and toxicologist with expertise on approaches to assess cumulative risk from combined exposure to chemical and non-chemical stressors. Dr. Noth is an experienced exposure scientist with over 20 years of experience in air pollution exposure assessment; she has collaborated extensively with Dr. Balmes on air pollution studies, including wildfire smoke studies in Fresno and California state-wide for many years. From LBNL, Dr. Chan is an expert in indoor air quality and building science with deep knowledge in estimating housing stock air infiltration and experience leading studies of indoor PM. Dr. Kirchstetter has studied air pollutant emissions and controls for 30 years. He has recently been leading research to invent and deploy low-cost air pollution sensors to study air quality in partnership with underserved communities. Dr. Basu is a senior scientist at the OEHHA, a

sister agency to CARB in Cal/EPA and can also assist in the development of state-level policy initiatives to reduce exposures to wildfire smoke.

Our team of academic researchers and policymakers/scientists in state government is uniquely positioned to not only fill scientific gaps in our understanding of the health risks of wildfire-specific $PM_{2.5}$ across communities, but also to ensure that our analyses provide policy-relevant information that will enhance public health guidance. To this cross-sector team, we add our local community and governmental partners (*see* Letters of Support) from Fresno (Central California Asthma Collaborative), Richmond (Contra Costa Health System, Dr. Omotoso), and San Francisco (Brightline, San Francisco Department of Public Health and the Office of Resilience and Capital Planning). **Our team has a strong and extensive history of productive research relationships in the involved communities** (*see* Table 1 and the **Community Engagement Plan).**

Project structure and management. The overall structure of the academic team includes the following groups: (a) UCSF, (b) UCB, (c) LBNL, and (d) OEHHA. Our community partner team includes Central California Asthma Collaborative, San Francisco Department of Public Health and Office of Resilience and Capital Planning, Contra Costa Health Services, and Dr. Omotoso (member of the North Richmond AB 617 Community Monitoring Group); we will add members to this team through this award. UCSF will serve as the primary coordinating center for the grant activities. Principal Investigator Thakur will take overall responsibility for the project, including setting and monitoring milestones and target dates, overseeing the budget, and tracking progress toward the project outputs and outcomes (*see* Timeline below). Leah Murphy will support Dr. Thakur in these tasks. Dr. Chow (UCB) will oversee and guide the process for deriving an hourly 3-km statewide grid of wildfire-specific $PM_{2.5}$ from NOAA HRRR Smoke model with adjustments from observational data. Dr. Noth (UCB) will oversee and guide the process for assigning area unit exposure estimates, including daily exceedance measures, that will be used in the health analyses. Drs. Kirchstetter and Chan (LBNL) will guide and oversee trainees to generate the infiltration estimates for wildfire-specific $PM_{2.5}$. Dr. Holm (UCSF) and Dr. de la Rosa (UCB) will oversee the health analyses, including examining health effects across socially vulnerable groups. Dr. Basu (OEHHA) will advise on health analyses, including planned approach. Drs. Thakur and Balmes (UCSF), working with the community partner team, will oversee the recruitment of members to the community stakeholder group, survey administration, and focus group conduct. The core project team (Thakur, Chow, Noth, Kirchstetter, Chan, Holm, de la Rosa, and Balmes) will meet biweekly to report progress and ensure coordination across the institutions and project tasks. Drs. Thakur and Balmes will meet monthly for the first six months of the award and then quarterly (after the community stakeholder group is established) with the community partner team to report progress of deliverables under Objective 4. All investigators on the core project team will assist with the interpretation of findings and plans for dissemination.

Table 3. PROTECT Health Effects Timeline

Study Activity	Year 1				Year 2				Year 3			
1-1 Derive statewide 3-km concentration grid	■	■	■	■								
1-2 Derive area level exposure estimates				■	■	■						
2-1 Derive infiltration ratios, adjusting for housing attributes				■	■	■	■					
2-2 Derive infiltration ratios, adjusting for behavior							■	■	■			
3-1 Primary health analysis						■	■	■	■			
3-2 Health analysis across vulnerable groups								■	■	■	■	
4-1 Form community stakeholder group	■	■	■									
4-2 Conduct community surveys				■	■	■						
4-3 Conduct focus groups							■	■	■			
Refine analyses and publish results										■	■	■

Funding Opportunity: EPA-G2021-STAR-H1, Cumulative Health Impacts at the Intersection of Climate Change, Environmental Justice, and Vulnerable Populations/ Lifestages: Community-Based Research for Solutions

Partnering for Resilient Opportunities To Eliminate Cumulative Toxic (PROTECT) Health Effects from Wildfire $PM_{2.5}$ in Environmental Justice Communities.

Quality Assurance Statement

(1) **QA/QC personnel**

Neeta Thakur MD, MPH, Assistant Professor in the Division of Pulmonary Critical Care Medicine at UCSF will serve as project Principal Investigator (PI), with overall responsibility for project management, quality oversight, and financial oversight. She will also have lead oversight for the establishment of the analysis plan and analysis methods, identification of applicable data, analysis of the data, and authorship of the study report and/or paper.

Fotini (Tina) Chow, PhD, Professor and Vice Chair for Graduate Studies in the Department of Civil and Environmental Engineering at UC Berkeley will guide the selection of the analysis methods, identification of applicable data, and analysis of the data for Objective 1, which are to generate estimates for hourly wildfire-specific $PM_{2.5}$, and lead and/or co-author resulting manuscripts.

Wanyu (Rengie) Chan, PhD, Research Scientist in Indoor Environment Group at Lawrence Berkeley National Laboratory will advise on the selecting the analysis methods, identification of applicable data, and analysis of the data for Objective 2, which are to generate indoor Wildfire $PM_{2.5}$ filtration ratios, and lead and/or co-author resulting manuscripts.

Stephanie Holm, MD, MS PhD, Assistant Professor in the Department of Pediatrics at UCSF will have responsibility for selecting the analysis methods, identification of applicable data, and analysis of the data for Objective 3, which are to calculate the estimate health risk of wildfire-specific $PM_{2.5}$, and lead and/or co-author resulting manuscripts.

Together, this team has extensive experience in the types of analyses planned for this project.

(2) **Project Objectives**

The objectives of the PROTECT Health project are to estimate the health burden of Wildfire-specific $PM_{2.5}$ across communities in California with a specific focus of understanding the disproportionate burden experienced by environmental justice (EJ) communities; to determine how housing quality and mitigating behaviors may modify this risk; and, to increase our understanding of current behaviours during Wildfire events and barriers to existing mitigation strategies in EJ communities.

The hypotheses for this study include: 1) That exposure to wildfire-specific $PM_{2.5}$ increases risk of respiratory-, cardiovascular-, and cerebrovascular-related emergency department (ED) visits and hospitalizations; 2) These effects will be greater in socially vulnerable communities and 3) modifiable by housing quality and adoption of mitigation behaviors. These hypotheses will be tested using a combination of data assimilation techniques and regression-based models and through qualitative (focus groups) and quantitative (surveys) information obtained from residents living in EJ communities. All aspects of the work will be reviewed by our Community partner group comprised of scientists, health officials, and stakeholders from local departments of public health and community-based organizations.

(3) **Collection of Data**

The PROTECT Health project does not include the collection of primary environmental data, method development, or the development or operation of environmental technology; therefore, sections (a), (c), and (e) are not applicable and not included.

(b) *Use of Existing/Secondary Data*

Data obtained will overlap the study period (2016-2020), except where noted, for all secondary data sources. The secondary data applicable to the project are as follows:

- ***NOAA HRRR-Smoke Model*** hourly $PM_{2.5}$ estimates, available across California at 3-km grid resolution from 2016-present.
- ***Statewide regulatory monitoring stations.*** Data are available from EPA's Air Quality System (AQS) database and include hourly $PM_{2.5}$ and other pollutants.
- ***Purple Air $PM_{2.5}$ data.*** There are 8,700 community-installed sensors in California. These low-cost sensors are not as accurate as AQS sensors, but can be easily adjusted using newly established correction factors and capture spatial and temporal trends.[1–3]
- ***Berkeley Atmospheric CO_2 Observation Network ($BEACO_2N$).*** A 70-sensor network in the SF Bay Area (2 km apart), measuring 5 sec concentrations of NO, NO_2, O_3, CO, CO_2, size resolved particle number from 100 nm to 10 microns, and boundary layer height.
- ***Satellite aerosol optical depth (AOD) data.*** Hourly daytime AOD data from GOES-16/17.
- ***NASA AERONET (AErosol RObotic NETwork).*** Hourly daytime ground-based AOD measurements, may be limited due to cloudiness.
- ***California Tax Assessor County Office data***. Attributes of all residential and commercial buildings in California as geospatial files from data vendor ParcelQuest.
- ***Emergency department visits and hospitalization data.*** Data will be available from the California Health Care Access and Information as daily counts across zip codes.
- ***U.S. Census and American Community Survey.*** Provides population demographic and social data, including factors such as crowding, vacancy rates, and poverty. 2015-2019 Five-year estimates will be used for analyses.
- ***Healthy Places Index.*** Composite index of social and population data used to identify socially vulnerable communities across California.
- ***CalEnvironscreen 4.0.*** Composite index of environment, social, and health data used to identify Environmental Justice Communities across California.

QUALITY OF SECONDARY DATA

Environmental data: Secondary data sources will be used to adjust the HRRR-Smoke model wildfire PM2.5 estimate (*see section d: modify existing model*)

Sociodemographic and health data: Key sources of data are from state or federal departments. When multiple sources of such data are available, they will be compared for consistency. Results from the scientifically strongest sources will be used if the strongest sources can be identified, otherwise suitable averages will be used based on the data from the multiple sources. Non-referred sources will be used as a last resort. Non-refereed sources (e.g., housing attribute data) needed to estimate indoor filtration of wildfire $PM_{2.5}$ will be compared with other published data sources, such as the American Housing Survey (U.S. Census), to check for consistency. The resulting infiltration factors will also be cross checked with Purple Air observational data from indoor air sensors located within diverse housing types (single family homes, multiple unit housing, dense housing, and those located within and outside of EJ communities).

d) <u>*Development or Refinement of Models*</u>: HRRR-Smoke data is available in a public archive and support will be provided by the HRRR-Smoke modeling team from NOAA (see letter of support). Data quality will be assessed by quantitative evaluation and comparison with surface and satellite based observations, then creating a new model-data fusion product with higher accuracy. The following step wills be taken to ensure accuracy of the model:

- The $PM_{2.5}$ model errors using the HRRR-Smoke atmospheric model will be quantified by detailed comparison with satellite data and dense air pollution monitoring networks.
- Bayesian source inversion will be performed using the highly efficient Markov chain Monte Carlo (MCMC) approach to retrieve improved fire radiative power (FRP)

estimates; these will be used to adjust plume source strength and to better constrain biomass burning fluxes. The MCMC approach will create a probabilistic composite smoke field which indicates the 90% confidence intervals for $PM_{2.5}$ concentration levels. When more than one fire is burning, NOAA's Hazard Mapping System (HMS) will be used to identify separate plumes, then MCMC source inversion can be applied separately to correct for FRP detections within each wildfire cluster. These corrections to FRP are critical for adjusting the overall fire source strength and for improving estimates for biomass burning fluxes. To further improve accuracy of the predicted $PM_{2.5}$ and correct for additional model errors, such as boundary layer processes, turbulence, topography-driven effects etc., data assimilation can be used to correct model predictions.

- Data assimilation (a form of machine learning) will be used to incorporate surface observations and hourly daytime surface and satellite aerosol optical depth (AOD) data to improve smoke plume and biomass burning flux accuracy. The NOAA Gridpoint Statistical Interpretation (GSI) is a 3-dimensional variational data assimilation system (3DVar) which is available for use with HRRR.[43,79,80] We propose to use GSI as a tool for assimilating both ground based $PM_{2.5}$ and AOD data, as well as satellite AOD, to correct the historical $PM_{2.5}$ model products from HRRR-Smoke. GSI 3DVar is being used to assimilate satellite retrievals of AOD into NCEP's Next-Generation Regional Air Quality Forecasting System in the development of the new Rapid Refresh Forecast System (RRFS) which will replace HRRR in the future.[81,82]

This process will result in a prototype $PM_{2.5}$ "analysis product" (a term used in weather forecasting for data-model fusion) based on HRRR-Smoke, to be input into the health exposure models. Various alternatives will be explored using either source inversion and machine learning/data assimilation techniques to improve the skill of the smoke pollution product. Subsets of observation data will be incorporated, and the analysis product will be validated with comparisons to other data using standard statistical measures.

(f) *Conducting Surveys:* We will administer 450 surveys across three study areas to elicit information on current mitigation behaviors used during wildfire events and on acceptable mitigation interventions. This survey is intended to garner descriptive data only, inform infiltration models, and inform the focus group discussions. Data will be entered into the Research Environment Data Capture (REDCap) system.

(4) **Data management activities:** Survey data will be recorded in REDCap, a HIPPA compliant system that includes a suite of software tools, supported by UCSF, which enables the collection, cleaning and viewing of research data. Data can be entered and changed only by those with the rights to do so. Varying interfaces allow for multiple study teams to access, view, and/or enter data, depending on access rights, into the database, while allowing for research participants to respond to questionnaires directly through electronic data capture. (e.g., record-keeping procedures, data-handling procedures and the approach used for data storage and retrieval on electronic media). Health data will be stored and only accessed in a secure data hosting and computer service, UCSF Research Analysis Environment (RAE) after a DUA is in place. Sociodeomographic and environmental data will be uploaded to the RAE for analyses. This HIPAA compliant desktop environment is hosted on servers housed at the UCSF Data Center on Minnesota Street. The MyResearch environment is hosted on six Dell PowerEdge R710s and Five Equal Logic PS6100E SAN, which are located inside the locked rack. There are two layers of physical redundant Cisco firewalls that protect the servers and SAN. To facilitate archiving of journal publications, Open Access choices will be made whenever possible.

Funding Opportunity: EPA-G2021-STAR-H1, Cumulative Health Impacts at the Intersection of Climate Change, Environmental Justice, and Vulnerable Populations/ Lifestages: Community-Based Research for Solutions

Partnering for Resilient Opportunities To Eliminate Cumulative Toxic (PROTECT) Health Effects from Wildfire $PM_{2.5}$ in Environmental Justice Communities.

Protection of Human Subjects

1. Risks to Human Subjects

a. Human Subjects Involvement, Characteristics and Design

Objectives 1 and 2 do not involve human subjects, rather we propose to estimate the ground level wildfire-specific $PM_{2.5}$ over a 3-km grid over the state of California (objective 1) and estimate the indoor filtration ratio of wildfire-specific $PM_{2.5}$ adjusted on housing characteristics (objective 2) and behavioral data (objective 4).

For Objective 3, we will estimate the sub-daily and daily effects of wildfire-specific $PM_{2.5}$ on respiratory, cardiovascular, and cerebrovascular ED-visits and hospitalizations across zip codes in California. This is an ecological study design, i.e., no personal identifying information obtained, and all analyses will be performed at the zip code level. Below, we will refer to this study as the "ecological health analysis".

For Objective 4, human subjects are involved as participants in surveys, focus groups, and interviews. Eligible participants are age 18 year and older and representative of one of the following three groups: lives within and/or actively engages with an identified climate change vulnerable community; represents an organization whose interest or mission aligns with climate-impacted health conditions; or, represents an organization whose interests or mission align with mitigation strategies for wildfire smoke events. It is anticipated that all participants will be able to speak English. However, all study materials including recruitment scripts, consent forms, surveys, focus group and interview guides will be available in English, Spanish, and Chinese.

Vulnerable populations. Participants recruited for Objective 4 will be residents or with community-based organizations that support Environmental Justice (EJ) communities, i.e., communities that are exposed to disproportionate environmental pollution and experience an excess of social stress. We believe it is necessary to focus our engagement with this vulnerable population when attempting to understand current behaviors and barriers to mitigation strategies for wildfire smoke within these communities.

b. Sources of Materials

Research Material. For the ecological health analysis, we will obtain a dataset from the California Health Care Access and Information (HCAI) that includes daily ED-visits and hospitalizations for respiratory (ICD9 codes: 460:519 or ICD10 codes: J00:J99, excluding J95), cardiovascular (ICD9 codes: 410:414, 428 or ICD10 codes: I20:I25, I50), and cerebrovascular (ICD9 codes: 430:438 or ICD10 codes: I60:I69) events aggregated at the zip code level. Events will be appended with age, sex, and race/ethnicity data. Research materials collected under Objective 4 from human subjects include participants' responses to focus groups, interview questions, and responses to surveys. Focus groups and interviews will be audio recorded and transcribed.

Data Collection, Management, and Protection. Only research team members who have appropriate training and certification in human subject research will have access to any research material. The ecological health dataset will be transferred to UCSF only after a DUA is in place and stored and accessed in a secure data hosting and computer service, UCSF Research Analysis Environment (RAE). All focus group and interview data will contain minimal subject identifiers (i.e., age, sex, language spoken, role in community and relation to climate mitigation strategies). Survey data will be linked to consented participants only through study ID. All survey data will be entered into Research Electronic Data Capture (REDCap), a secure and HIPPA-compliant web-based system for building and managing web-based research projects. All other data, including audio recordings, will be kept on secure, password protected servers in locked rooms and separated from the file linking study ID to participants, which will also be kept in a secure, password protected computer.

c. Potential Risks

Potential Risks. The main potential risks to patients are loss of confidentiality and invasion of privacy. There may be some psychological risk such as anxiety generated by the questions.

Alternative Procedures. The alternative procedure for all participants is not to participate in focus groups, interviews, or surveys. Potential Stakeholders who wish to not participate in the evaluation study on engagement efforts will still be allowed to complete trainings and be on the Community Stakeholder Group. There is no loss of any patient or employee privileges and rights for not participating in the study.

2. Adequacy of Protection Against Risk

a. Recruitment and Informed Consent

Ecological Health Study. As no patient-identifying information is collected for this analysis, all the health data has already been collected, and that the level of the analysis is at the zip-code level, this qualifies as exempt research.

Recruitment of Community Stakeholder Group. Working with our local partners (SFDPH, SFORCP, and Brightline in San Francisco, CCHS and Lifelong Medical in Richmond, and CCAC in Fresno), we will proactively engage community-based organizations who meet one of the following criteria: located within and actively engages with an identified climate change vulnerable community; interest or mission aligns with climate-impacted health conditions; or, interests or mission align with mitigation strategies for wildfire smoke events. Given the role of this group as a research partner, potential participants need to be English-proficient. Identified groups will be approached by a local partner, who will set up a "coffee-break" meeting which will include a research partner, a local partner, and a community stakeholder to determine interest in partnering. Those expressing interest, will be invited to take part in Participatory Action Research Training sessions. As we will be collecting satisfaction and engagement data, participating stakeholders will be informed that we will collect information on the engagement process and asked to participate in this evaluation study using a standardized recruitment script. Interested participants will be given written informed consent in English. Participants will be given an opportunity to ask questions before signing the informed consent. This process will be repeated with the formed Community Stakeholder Group to allow for ongoing assessment of engagement efforts. No additional compensation will be provided for participating in the evaluation study. However, community stakeholders will be compensated at a rate $100/meeting for their time and efforts on the Community Stakeholder Team.

Survey Participants. Identification of potential participants will be led by the Community Stakeholder Group and local community partners on this grant. The recruitment script will be standardized to state that we are recruiting for a study to understand how wildfire events impact their health and gather information on behaviors during wildfire and which mitigation strategies they already use and/or find acceptable. Interested participants will be directed to a private, secure website to read the informed consent and respond to the survey in the participant's preferred language. Incentive for participation in a survey is $20.

Focus Group Participants. Identification of potential participants will be led by the Community Stakeholder Group and local community partners on this grant. The recruitment script will be standardized to state that we are recruiting for a study to understand the ways in which they use mitigation strategies and why or why not they may decide to use one strategy over another. After ascertaining eligibility, the community liaison will then schedule the participant for a focus group meeting. At the focus group, all participants will be given written informed consent in English, Spanish, or Chinese per the participant's preference. Participants will be given an opportunity to ask questions before signing the informed consent. All participants will sign the consent form. Incentive for participation in focus groups is $40 per person.

b. Protection Against Risk

Protection Against Loss of Confidentiality and Invasion of Privacy. Only research team members who have appropriate training and certification in human subject research will have access to any research material. Researchers will not identify any participant in any publication or presentation, and all research data will be presented in aggregate.

All focus group, interview, and survey data will contain minimal subject identifiers (i.e., age, sex, language spoken, ethnicity, neighborhood). During focus group or interviews, participants will be addressed using first names only. Notes and transcripts will not include names or other identifying information. Once the data on the audiotapes has been transcribed, the tapes will be destroyed.

Protection Against Psychological Risk. We recognize that participants may experience discomfort or distress with some of the questioning. Participants will be informed that they do not have to discuss, answer, or do anything they are uncomfortable with and can withdraw from the study at any time.

Protection for Children. All participants will be 18 years of age or older.

3. ***Potential Benefits of the Proposed Research to Human Subjects and Others***

There will be no direct benefit to survey and focus group participants. Stakeholder participants may confer some personal benefit from leadership training. The potential risks in this project in terms of loss of privacy and discomfort from questioning are minimal.

4. ***Importance of the Knowledge to be Gained***

The knowledge to be gained from this study is a better understanding of the health risks associated with wildfire-specific $PM_{2.5}$ and how this risk is distributed across communities. In addition, at the conclusion we will have increased understanding of the barriers to mitigation strategies and, with community stakeholders, would have identified acceptable strategies to move forward for implementation. This has the potential impact of improving the design of interventions that will reduce the health effects of wildfire smoke events.

Funding Opportunity: EPA-G2021-STAR-H1, Cumulative Health Impacts at the Intersection of Climate Change, Environmental Justice, and Vulnerable Populations/ Lifestages: Community-Based Research for Solutions

Partnering for Resilient Opportunities To Eliminate Cumulative Toxic (PROTECT) Health Effects from Wildfire $PM_{2.5}$ in Environmental Justice Communities.

Scientific Data Management Plan

Data generated under this project will be administered in accordance with both University and EPA policies.

1. **Types of Data Produced:** Data capture will occur in several ways. Modeled data for exposure concentration and estimates, participant-administered questionnaires, and through focus groups. A summary of the data products include:

- **Integrated model-data smoke product** (hourly, 3km grid)**:** Concentrations will be estimated by fusion of HRRR-Smoke model output and surface and satellite observations of PM2.5.
- **Wildfire-specific PM2.5 exposure estimates:** Using concentrations from the fused model-data smoke product, area level estimates at the census tract and county level will be derived. Estimates will be as daily means (to allow for comparability to other methods for estimation) and as hours in exceedance of daily thresholds (set at 55µg/m^3, the upper boundary of the AQI orange zone). For this second measure, estimates will be expressed in mean hourly exposure and number of hours over threshold.
- **Indoor Wildfire $PM_{2.5}$ Filtration Ratio estimates:** Hourly distribution of infiltration factors in homes averaged over census tracts.
- **Survey Data:** Current use and behaviors, in addition to acceptability of mitigation strategies from 450 residents from included study areas (Fresno, Richmond, and San Francisco, California).
- **Qualitative Data:** Focus group themes on barriers to promising mitigation strategies from 45 residents from included study areas.

2. **Data Format**

The data formats of our collaborative research will include:

- Fused model-data products from HRRR-Smoke and observations will be output in netCDF format. We will also produce a library of graphics comparing simulation results to observed data to facilitate case browsing. NetCDF is a set of software libraries and self-describing, machine-independent data formats that support the creation, access, and sharing of array-oriented scientific data (direct quotation from http://www.unidata.ucar.edu/software/netcdf/).
- Wildfire $PM_{2.5}$ infiltration factors distribution estimates will be developed using a statistical software package, such as R. Results and the key influencing parameters, such as housing attributes and occupant behaviors, will be outputted as R data objects.
- Survey data will be entered into the Research Electronic Data Capture (REDCap) system, a HIPAA-compliant web-based system. All data will be verified for accuracy (i.e. double entered and merged). REDCap supports several data output downloads, including .csv, .dta, .xml, etc.
- Audio recordings (.mpa) of focus groups will be transcribed and destroyed. Transcripts will be stored as .pdf and/or .doc files and as coded files after thematic analysis.

3. **Access to data, and data sharing practices and policies**

- **Integrated model-data smoke product:** We will establish a publicly-available data archive for the fused model-data smoke product. The original data produced from the

simulation code, HRRR-Smoke, are already available in a public web archive. Our new data will be provided to the data archive within one year of the project end date for international public access.

- **Deidentified dataset:** We will create (de-identified) public use datasets of survey data from Objective 4, which would be available without restriction to any member of the public. Any such datasets would be made publicly available through DataShare (http://datashare.ucsf.edu), which was developed by a partnership of the UCSF Clinical & Translational Science Institute, UCSF Library, and UC Curation Center at the California Digital Library. This service provides public access via persistent URLs, tools for long-term data management, and permits permanent storage options. Data will be discoverable by either searching or browsing the website. Each dataset will be required to include the following metadata: title of dataset, creator, description, technical description, subject headings, and related publications. All required fields will be searchable as will optional fields.

Beyond the sharing of observations, our data sharing policy will include:

- Providing code, post-processing files, and datasets to any journal that requires data posting
- Code, post-processing files, datasets, and graphics being made available to qualified investigators within one year after completion of our investigators' data analyses and publication of papers presenting the results of those analyses, whichever is later.
- A process for sharing data that will be dependent on University policies and likely require a Data Use Agreement, pending the data types requested. To facilitate the process we will develop a proposal submission process. This includes submitting a request in writing identifying the requestors and their affiliated institution, indicate what they plan to do with the data, include assurances that they will not share the data with others without the written permission of the project principal investigator and agree to give proper credit to the project/investigators who collected the data in publications resulting from the data.

4. Policies and provisions for re-use, re-distribution and production of derivatives

- Results will be disseminated widely through journal publications and conference presentations. Our results will therefore be subject to peer review. We have requested funding to make presentations at the American Geophysical Union, American Meteorological Society, Society for Epidemiologic Research, and the American Thoracic Society meetings.
- Journal publications will be archived in pdf format and Open Access choices will be made whenever possible.
- All publications, presentations, and results from this project will be available through the main project website, creating an integrated internet resource where scientific results will be available to the public.

5. Storage and Archiving of data

We anticipate that the fused model-observation analysis product will generate a few terabytes of data that will need to be archived for further processing and data analysis during the course of the project. The data will be stored on a parallel file server most likely hosted by UC Berkeley through the Berkeley Research Computing Center, with copies on local disks. Final health data for this project will be archived in UCSF's Secure Research Analysis Environment (RAE).

Funding Opportunity: EPA-G2021-STAR-H1, Cumulative Health Impacts at the Intersection of Climate Change, Environmental Justice, and Vulnerable Populations/ Lifestages: Community-Based Research for Solutions

Partnering for Resilient Opportunities To Eliminate Cumulative Toxic (PROTECT) Health Effects from Wildfire $PM_{2.5}$ in Environmental Justice Communities.

Community Engagement Plan

Our approach incorporates principles of community-based participatory action research (CBPAR) as a mechanism for addressing the negative effects of climate change.[13,14] PAR deviates from traditional research models where line of inquiry is dictated by the subject matter expert and research is completed on or for a specific community. Based in PAR, our logic model for engagement (**Figure 1**) begins with the context in which relationships with the community will be formed. Wildfire smoke events have significant, cascading, and compounding health impacts on the people who live, work, and recreate across California. Health impacts are not evenly distributed; the neighborhoods that carry the heaviest health burden are the ones most exposed and least likely to have the economic, social, or political resources needed to prepare for or respond to them. However, historic and present-day decision making by local and federal governments on climate issues have *not* consistently placed these environmental justice (EJ) communities' interests central. It is within this context renewed partnerships will be formed with community partners, with transparency and acknowledgement of past actions.

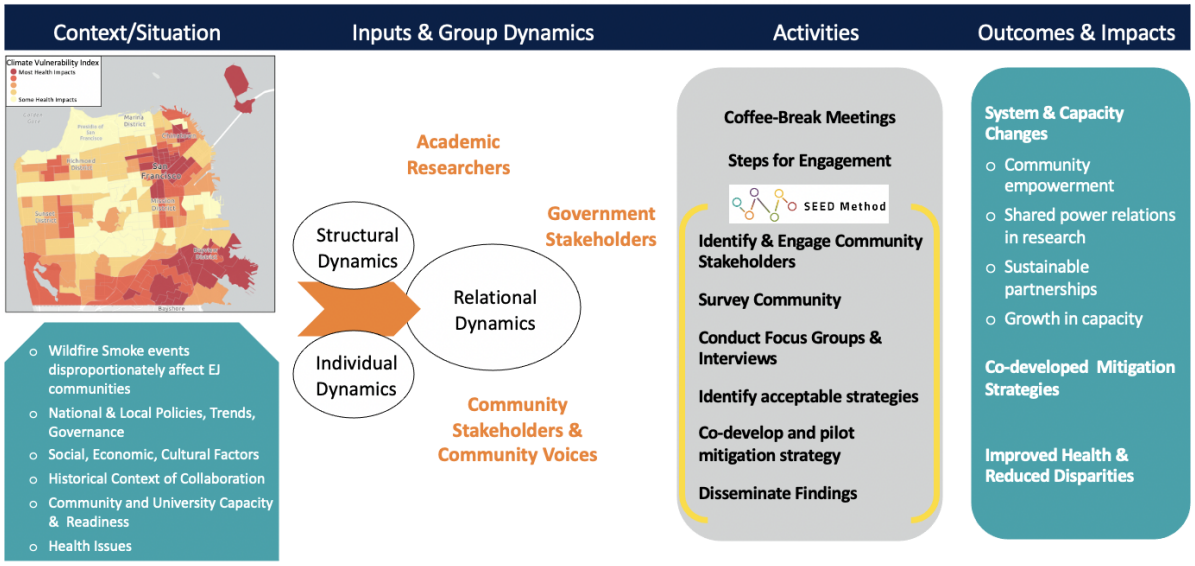


Figure 1. Logic Model for Engaging Community Stakeholders to Address Climate-Impacted Health Conditions

For authentic partnerships to occur, several barriers must be addressed. 1) Acknowledgement of historic and current actions that have contributed to ongoing mistrust of climate change efforts. 2) Address socio-cultural differences and skill-set imbalances that contribute to overt and unconscious power imbalances when partnering with a community. 3) Emphasis of a community-first model that brings community stakeholders to the table at the start of planning and increases transparency of the decision-making process.

1. **Provide neutral spaces to facilitate bidirectional informational exchange.** Lack of transparency and parachute research within socially vulnerable communities continues to foster mistrust. Research may be seen as contractual without consideration of community needs or priorities. In addition, historic and present-day decision making by local and

federal government on climate issues have not consistently placed socially vulnerable interests central; at times having a downstream effect of worsening climate impact.[83] Programs that happen to align with community priorities or interest are limited in impact as they lack vital input from community stakeholders and are subject to closure as grant funding ends. To counter, we must offer neutral spaces where community stakeholders are able to openly share concerns and opine on preferred methods of engagement. Neutral spaces are those that are in the community. We, as the "researchers", are invited to these community spaces, shifting power dynamics. Under the current proposal, we will set up "coffee-break" meetings with community stakeholders that allow for information sharing in a neutral space that is not tied to a particular agenda.. This network can later be leveraged for forming a community stakeholder group, co-development of mitigation strategies, and for dissemination of research findings and public health messages around wildfire events.

2. **Equip community stakeholders with necessary skills to off-set power imbalances**. Community members and organizations hold historic and current knowledge and perspective of how wildfire smoke exposures impact their community. The addition of this knowledge helps ground truth the results that will be generated under Objective 1-3 of this proposal. These stakeholders are also key in identifying barriers to potential mitigation interventions and where levers may exist to facilitate implementation of promising strategies. As mitigation is complex, crossing multiple sections and social conditions, it is critical to bring in community partners on equal footing. Equipping stakeholders with the necessary research literacy and leadership skill development will move us towards leveling the research-community power dynamic and have a more equitable partnership. Specifically, during the first six months of the award, we will host monthly 1.5hour meetings around research methods and skill building with interested partners. Sessions will center on building research vocabulary for stakeholders and provide training on certain skills, including an overview of the SEED Method (*see* below), how to develop a research question, data types,and methodologies for querying the community (i.e., qualitative interview techniques vs. quantitative surveys).
3. **Prioritize community-stakeholder engagement on the community-academic team.** By bringing stakeholders into the Research Agenda at the start of the proposal, as opposed to when quantitative analyses proposed under Objective 1-3 are already completed, ensuring community perspective is prioritized and incorporated at every stage of the project. Furthermore, we have laid out an intentional plan to engage community members extending from enriching our analyses with behavioral data, actively discussing community-specific barriers to mitigation interventions, to co-developing implementation strategies to increase uptake of acceptable mitigation strategies. The community stakeholder group will be a key partner on the research team.

These steps are foundational to authentically incorporating community voices into the research agenda. To ensure success, we will use the Stakeholder Engagement in question Development and Prioritization (SEED) Method, developed through PCORI funding by investigators at the Virginia Commonwealth University Center on Society and Health. The SEED Method is an evidence-based systematic, iterative process that brings in community stakeholders as equal creators of a research agenda. Through this partnership between community stakeholders, local and state governmental stakeholders, and academic researchers, we will build capacity for research related to climate and health that centers on community concerns and priorities, furthering the capacity and reach of this proposal in a way that is centered on health equity.

Evaluation of Engagement: We will take several steps to ensure authentic engagement with community partners around climate and health impacts. The SEED Method incorporates several points of evaluation to ensure initial engagement and successful output of such engagement. We have adapted this evaluation scheme for the present proposal, focusing on community stakeholder engagement with the process and satisfaction (**Table 1**). Briefly, after forming the Community Stakeholder Group, we will survey all partners to ask if there are additional community partners missing from the discussion. This will occur at month 9 and again at month 18 understanding that priorities may shift over time. To evaluate engagement, we will anonymously survey community partners regarding satisfaction with the process and query for suggestions to improve the process. These surveys (Group Dynamics Questionnaire) will immediately follow every group-wide community-academic meeting to capture immediate reactions to the process with built-in time for follow-up in 1:1 meetings with community partners, which will be facilitated by Dr. Thakur's team. In addition, after each co-developed product (survey, focus interview guide, pilot project), the community partner will complete an activity log documenting the level of engagement by all stakeholders (providing a time for self-reflecting on their own engagement in the process). We will also debrief with the Community Stakeholder Group to elicit process feedback to help improve upon the process of engagement.

Table 1. Evaluation activities

	Activities	Evaluation Tool*
Identify and engage (months 2-8)	- "Coffee Break Meetings" - Participatory Action Research skill building and leadership training - Form Community Stakeholder Group	**Training Satisfaction Questionnaire** **Group Dynamics Questionnaire**
Consult #1 (months 9-18)	- Community-academic team co-design survey - Administer survey to participants (broader community engagement)	**Activity Log** – Question Development **Debrief:** After Action Review & Questionnaire
Conceptualize (month 19-21)	- Co-generate preliminary conceptual models based on community survey	**Activity Log** – Conceptual Model **Debrief:** After Action Review & Questionnaire
Generate strategies (month 22-24)	- Co-generate preliminary mitigation strategies based on community survey	
Consult #2 (month 24-28)	- Co-develop Interview guide for focus groups - Community Stakeholder Group co-facilitated focus group - Co-identification of themes from focus groups	**Activity Log** – Guide Development **Debrief:** After Action Review & Questionnaire
Prioritize and finalize strategies (Month 29)	- Use voting process to prioritize strategies - Finalize strategies for focus based on community needs and APEASE criteria	**Activity Log** – Prioritize strategies **Debrief:** After Action Review & Questionnaire
Pilot Development (Month 30-36)	- Prototype and pilot implementation strategy for increasing uptake	**Activity Log** – Pilot Development **Debrief:** After Action Review & Questionnaire
Wrap up/next steps (Month 24)	- Develop a sustainability plan and action steps for implementation	**After Action Review**

*Adapted from SEED Method Toolkit[84]

Coordination with Complementary Activities in Planned Study Areas: Several members of the research team have active collaborations with community and local governmental partners that are relevant to this proposal. Our goal is to not duplicate efforts, but rather build on these collaborations. Below, we provide a detailed description of current work in each EJ community and how this award will complement or enhance current efforts.

Fresno, California

There are two relevant partnerships to highlight, one is specifically with the AB 617 designated EJ community, South Central Fresno.

UCB and Central California Asthma Collaborative: Drs. Balmes and Holm (UCSF) and Dr. Noth (UCB) have been collaborating with the Central California Asthma Collaborative (CCAC) for approximately 4 years on the planning and implementation of the co-funded EPA(83543501) and NIH (R24ES022849) study to retain and follow longitudinally two cohorts of children participating in the Children's Health and Air Pollution Study (CHAPS) in Fresno. CCAC's mission is to provide education and direct services, build regional capacity and advocate for sensible policies that improve health and address inequities by reducing environmental impacts and emphasizing the prevention and management of chronic disease. http://cencalasthma.org The CCAC is currently providing the field office for CHAPS. Dr. Balmes has worked with CCAC for over a decade regarding advocacy for clean air and environmental justice at both the state and local levels. Dr. Balmes is currently the Chair of CARB's AB 617 Consultation Group of which the Director of CCAC, Kevin Hamilton, is a key member. CCAC will be actively involved in the PROTECT Health Effects as a Community Stakeholder Partner and lead engagement efforts in Fresno County.

UCB and South Central Fresno: Drs. Noth (UCB) and Bradman (UC Merced) are implementing a total exposure study to air pollution and noise in the San Joaquin Valley, including South Central Fresno - SPHERE (San joaquin valley Pollution and Health Environmental REsearch study), funded by the California Air Resources Board. We are collaborating with the CCAC in order to recruit community members to our study. We plan to include public health students Fresno State, a Hispanic Serving Institution, in conducting the field studies. Because Fresno State is primarily a teaching university and does not have a large environmental health research portfolio, this would offer the students practical experience in scientific research. In the past, through the CHAPS National Children's Environmental Health Center, we collaborated with Fresno State professors Dr. Zografos, Kwan and Capitman and their students to conduct community mapping of neighborhood social and built environments,[85] as well as air pollution. This work, called a Structured Social Observation, was made available to Dr. Thakur via training from Fresno State, and she applied it very successfully in Richmond, California, as part of the Youth Participatory Action Research Summer Internship in 2019 (below). We expect that our fieldwork for SPHERE will take place in early 2022, and will include collecting matched indoor and outdoor $PM_{2.5}$ measurement data in 120 residences in San Joaquin Valley communities, including South Central Fresno. It is anticipated that these data will be informative for the work proposed in Objective 2.

Richmond, California

There is one relevant partnership to highlight, both of which are located within the AB 617 designated EJ community, North Richmond and focused on youth engagement.

UCSF-UCB and Lifelong Medical William Jenkins Health Center: Since 2016, UCSF-UCB have worked in partnership with Lifelong Medical to increase our understanding of place-based risk factors for asthma in North Richmond, CA. To increase community perspective and engagement with the research agenda, UCSF-UCB-Lifelong Medical

launched a Youth Participatory Action Research Summer Internship in 2019. Over the past three years, we have trained 14 youth in research methods and engagement to empower this group to formulate research questions about their own community and partner on strategies that have the potential to improve health. This rich engagement has already had several successful outputs relevant to the current proposal: mapping of the social riskscape in Richmond, qualitative work that has led to understanding sources of wellness and safety across the community, and, most recently, mapping of perceived environmental hazards in partnership with a grant from the Air District. This group is primed to assist with community surveying activities proposed in Objective 4. The data from this award will also inform these youth researchers on promising strategies to move forward through pilot testing within their community.

San Francisco, California

There are two collaborations to highlight that will increase our likelihood of success in implementing this grant. Furthermore, the information garnered under this award has immediate impact on activities currently being pursued through these collaborations.

Brightline and Lawrence Berkeley National Laboratory: Brightline is a nonprofit organization dedicated to promoting sustainability and empowerment of low-income, frontline communities within and outside of California. In efforts to better understand exposure burden for residents of high-density housing, such as single room occupancies (SROs), Brightline - in partnership with Lawrence Berkeley National Laboratory - has successfully obtained funding from the California Air Resource Board (CARB) for hyperlocal community air monitoring for this high-risk population, who are often not included in crowdsourced monitoring studies. The information obtained from their sensors will enrich our wildfire-specific $PM_{2.5}$ model and building infiltration study. Furthermore, Brightline has completed surveys with residents of SROs to understand barriers to use of do-it-yourself box filter fans during wildfire, the data of which will inform the basis of the community survey on barriers to mitigation interventions. Reciprocally, information learned from this survey will be shared with Brightline to further their own intervention efforts.

UCSF PRISE Center and the Heat and Air Quality Resilience Project: Dr. Thakur, as Director of Subspecialty Care of the PRISE Center, recently obtained funding with the San Francisco (SF) Department of Public Health (DPH) and the Office of Resilience and Capital Planning from the Patient Centered Outcome Research Initiative (PCORI) for an engagement award to improve the city-wide response to extreme health and air quality issues, including those associated with wildfire events. The UCSF PRISE Center (PRISE stands for Partnerships for Research in Implementation Science for Equity) was established in partnership with SFDPH to accelerate uptake of evidence-based clinical and public health interventions with a focus on health equity. This award will enhance cross-municipality efforts already underway through the Heat and Air Quality Resilience (HAQR) Project. HAQR includes all municipal departments involved in emergency preparedness and response services, housing, and infrastructure. Using a similar method of engagement proposed here, we are currently underway and recruiting stakeholders to outfit the HAQR Leadership team. This project specifically focuses on implementation and lacks capacity for the type of detailed and informative research to take place under this award. The findings generated from this award will be shared with the HAQR team. This team also provides a ready group for engagement, particularly when at the pilot prototyping stage of the grant proposal.

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Budget Justification

PERSONNEL: Pursuant to University of California (UC) policy, salaries in the initial budget period are based on current published UC salary scales and include University mandated range adjustments and merit increases scheduled to occur before the proposed project start date of July 1, 2022.

Position Title	Annual Salary	% of Time to Project	Year 1	Year 2	Year 3	Total
Neeta Thakur, Principal Investigator	$263,315	10%	$26,332	$26,332	$26,332	$78,996
Stephanie Holm, Co-investigator	$167,003	Yr1 = 5% Yr 2-3 =10%	$8,350	$16,700	$16,700	$41,750
John Balmes, Co-investigator	$326,342	3%	$9,790	$9,790	$9,790	$29,370
Leah Murphy, Project Manager	$122,960	10%	$12,296	$12,296	$12,296	$36,888
Total			**$56,768**	**$65,118**	**$65,118**	**$187,004**

Neeta Thakur, MD MPH, Principal Investigator, UCSF Assistant Professor. Dr. Thakur will direct and oversee all aspects of the project implementation, including coordination of activities and evaluation activities with grant partners. In addition to overseeing environmental health analyses with Drs. Holm and de la Rosa, Dr. Thakur, in partnership with Community Partners, will lead the Community Stakeholder Group meetings. This includes overseeing the Community Stakeholder Group in administering community survey and carrying out the thematic analysis of focus groups as proposed under Objective 4.

Stephanie Holm, MD, PhD, MPH, co-investigator, UCSF Assistant Professor. Dr. Holm, along with Drs. de la Rosa and Thakur, will oversee the environmental health analyses. This includes building the health analysis model, supervising analyses by the graduate student, and leading interpretation of the results. Dr. Holm will also be responsible for ensuring the data quality of the health data obtained from the California Health Care Access and Information.

John Balmes MD, co-investigator, UCSF Professor. Dr. Balmes will provide technical and expert input for the health analysis, guidance in the implementation of the community engagement study, and participate in the manuscript preparation phases of the study.

Leah Murphy, Project Manager. The project manager will provide direct back-up to the community partners' day-to-day activities and oversight of communications with Local Partners and the Community Stakeholder Group. The project manager will organize and lead the Participatory Action Research (PAR) training session with Dr. Thakur with interested community stakeholder parties. This person will also be responsible for building the developed survey within Redcap, coding of focus group transcripts, and assisting with the completion of the progress reports and the final report.

FRINGE BENEFITS: Consist of two benefit assessments. The UC-managed Composite Benefit Rates (CBR) and the UCSF-managed Faculty Childbearing Childrearing assessment. UC-approved Composite Benefit Rates (CBRs) include retirement, payroll taxes and assessments, and

health & welfare. Employees are assigned to a benefits group based on job code and benefits eligibility. The FY 2020-21 CBRs were reviewed and added to the Federally negotiated rate agreement on June 29, 2020, by the University's Federal cognizant agency, HHS Office of the Inspector General, Office of Audit Services. *For this proposal, the rates are: Tenured, Ladder Rank Faculty = 24.4% with a 1% Faculty Childbearing leave benefit = 25.4%; Non-tenured Faculty = 32.1% with a 1% Faculty Childbearing leave benefit = 33.1%; Partial Benefit (for Emeritus) = 3.7%; Academic and Staff = 42%.

Title	Base Fringe Rate*	Costs			Total
		Yr 1	Yr 2	Yr 3	
Principal Investigator Thakur	25.4%	$6,688	$6,688	$6,688	$20,064
Co-investigator Holm	33.1%	$2,764	$5,528	$5,528	$13.820
Co-investigator Balmes	3.7%	$362	$362	$362	$1,086
Project Manager Murphy	42%	$5,164	$5,164	$5,164	$15,492
TOTAL		$14,978	$17,742	$17,742	$50,462

TRAVEL: We are requesting $1,067 per year to request travel between sites for community engagement work. We are requesting an additional $7,900 to provide travel for up to five members of the project team to the annual STAR program progress review. Funds will not be used for foreign travel without approval by the EPA. The total travel request is $26,751.

Purpose of Travel	Location	Item	Computation	Cost per year
EPA STAR Progress	Washington DC	Lodging	5 people x $260 per night x 3 nights	$3,900
		Airfare	5 people x $500/roundtrip	$2,500
		Per Diem	5 people x $85 per day for 2 days; travel days at $60 per day	$1,450
Subtotal Per Year:				**$7,850**
In State Travel	Richmond, CA	Mileage	40 miles roundtrip @ .56/per mile = $22.4 per trip x 14 trips per yr	$314
	Fresno, CA	Mileage	380 miles roundtrip @ .56/per mile	$213
		Lodging	$150 x 2 persons @ 1 night	$300
		Per Diem	$60 per person x 2 persons x 2 days	$240
Subtotal Per Year				**$1,067**
TOTAL Per Year				**$8,917**

CONTRACTUAL

CONTRACTED WORK ($12,480)

To-be-Determined Survey Administration: In years 1-2, we request $4160 per community organization (n=3) to administer the survey within the three communities for a total of $12,480. The surveys will be contracted work and not via a subaward agreement.

OTHER($845,703)

Publication costs of $2,000 are requested for year 3 to offset costs to publish "open access" manuscripts to increase access to scientific publications to Environmental Justice communities. **Health Data Pull:** We request $10,000 in year one for the California Health Care Access and Information data pull request.

Participant Support Costs ($43,920)

Community Stakeholder Group: For the formed community stakeholder group, we will provide compensation to members (3 per region, total n=9 members, each receive $100/meeting). We anticipate meeting monthly with this group for a total of 12 meetings/year for all three years, for a total of $32,400.

Focus Groups and Surveys: We will conduct 3 focus group per community with 5-7 members (total n=63), participants will be compensated $40 ($2,520). We will administer 150 surveys/ community (total n=450) to assess current behaviors, barriers to, and acceptance of mitigation strategies. Participants will be compensated $20 ($9,000). We request $11,520 for compensation.

Data Network Recharge *($531/total)* The data network services recharge or data network recharge is a vital component of the University's Enterprise Network Services (**ENS**), which provides funding for critical equipment in support of UCSF's electronic information flow. The Data Network charge for the period of 7/1/22-6/30/23 is $46/per FTE for a calculation of .28 x $46 x 12 months = $155. For the period of 7/1/23-6/30/2024, the cost is $47 per FTE and $48 starting 7/1/24 and beyond. The FTE for this project is stated below.

IT Field Services (ITFS) *($1,105/total*) UCSF ITFS is an integral component of the Enterprise Network Services (**ENS**) providing support to campus voice and data technology functions. ITFS includes software installation/updates, internet security, hardware setup/configuration, and centrally managed patching, storage and backup. The ITFS recharge rate is implemented and effective as of 7/1/20 until amended at $98/month/FTE for premium services

FTE	Year 1 = .28	Year 2 = .33	Year 3 = .33	Total
Data Network	$155	$186	$190	$531
ITFS	$329	$388	$388	$1,105
TOTAL	**$484**	**$574**	**$578**	**$1,636**

SUBAWARDS ($788,147)

University of California Berkeley: Over three years, UCSF will award UC Berkeley $455,710 in direct costs and $249,337 in indirect costs (60.5% rate) to work collaboratively with UCSF on Objective 1: Quantify wildfire specific fine particulate matter for fire seasons, Objective 2: Estimate magnitude of effect by wildfire PM on health outcomes and Objective 3: Determine indoor penetration based on housing attributes data. Dr. Rosemarie de la Rosa will provide the oversight on the UC Berkeley scope of work with her colleagues, Dr. Fotini Chow and Dr. Elizabeth Noth. Drs. de la Rosa, Chow and Noth, and a postdoctoral scholar and graduate student researcher will receive salary and fringe benefit support as well as computer software and IT services to support their work.

UCB	**Year One**	**Year Two**	**Year Three**	**Total**
Direct	$110,575	$169,837	$175,298	$455,710
Indirect	$66,898	$89,889	$92,550	$249,337
TOTAL	**$177,473**	**$259,726**	**$267,848**	**$705,047**

Note: UCB is UCSF's sister campus and its total costs will be excluded from Modified Total Direct Costs (MTDC) Base per Department of Health and Human Services indirect costs rates agreement dated 11/27/2017.

Central California Asthma Collaboration (CCAC): Over three years, UCSF will award CCAC $54,546 in direct costs and $5,455 in indirect costs (10% rate) to employ a research coordinator at 25% effort to engagement efforts, including recruiting stakeholders, administrating surveys, and conducting focus groups.

CCAC	Year One	Year Two	Year Three	Total
Direct	$18,182	$18,182	$18,182	$54,546
Indirect	$1,818	$1,818	$1,818	$5,454
TOTAL	**$20,000**	**$20,000**	**$20,000**	**$60,000**

TBD, Pilot Projects: We request $7,000 per community (n=3) to allow for stakeholder driven piloting of mitigation strategies. Strategies are to be determined in partnership with the stakeholder group. Examples of possible pilots include targeted distribution of portable air filtration devices, development of an early alert system, etc. UCSF will award TBD community organization $7,000 in direct costs and $700 in indirect costs (10% rate) to co-develop and implement a pilot adaptation strategy. Funds will be distribute in years 2 and 3.

TBN	Year One	Year Two	Year Three	Total
Direct		$10,500	$10,500	$21,000
Indirect		$1,050	$1,050	$2,100
TOTAL		**$11,550**	**$11,550**	**$23,100**

FACILITIES AND ADMINISTRATIVE EXPENSES ($208,136)

UCSF's indirect costs are calculated based on Modified Total Direct Costs (MTDC) as defined in 2 CFR Part 200.68 using facilities and administration (F&A) rates approved by the U.S. Department of Health and Human Services (DHHS). MTDC is comprised of total direct costs less capital equipment, alterations and renovations, patient care costs, off-campus rent, tuition and fee remission, scholarships and fellowships, participant support costs, and that portion of subcontract costs in excess of $25,000. Additionally, the total amount of subawards to other UC campuses are excluded. Proration is based on the number of days at the applicable rate.

This project will be located On-Campus. UCSF's F&A rate agreement dated November 27, 2017, provides for an escalating rate for on-campus research:

July 1, 2020, until amended: 61.5%

OMB No. 0925-0001 and 0925-0002 (Rev. 03/2020 Approved Through 02/28/2023)

BIOGRAPHICAL SKETCH

NAME: Thakur, Neeta

eRA COMMONS USER NAME: NThakur

POSITION TITLE: Assistant Professor of Medicine

EDUCATION/TRAINING

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
University of Arizona, Tucson, AZ	B.S.	05/02	Physiology
University of Arizona, Tucson, AZ	M.D./M.P.H.	06/07	
University of California, San Francisco	Resident	06/10	Internal Medicine
University of California, San Francisco	Fellow	06/13	Pulmonary and Critical Care Medicine
University of California, San Francisco	Certificate	06/13	Clinical Research
University of Californa, San Francisco	Certificate	9/2019	Implementation Sciences

A. Personal Statement

I am a physician-scientist specialized in pulmonary and critical care medicine with advance training in clinical research methods, social epidemiology, and implementation sciences. My research program focuses on the short and long-term health effects of multilevel stressors, including air pollution, with special focus on economically disadvantaged communities and communities of color. Our group has linked multiple data types (biologic, individual, and environmental) to demonstrate that social risk factors are geo-spatially distributed, disproportionately burden communities of color, and are associated with specific health outcomes in individuals with chronic lung conditions. We are dedicated to community engagement and bringing in stakeholders as equal partners in research. This is evident in our leadership team of the CIAPM ACES award to test early-life interventions to address social stress that includes our community partner as a multiple PI. In addition, I have developed programs targeted at increasing access to STEM fields for individuals from traditionally underrepresented groups in medicine and science (URM) at the local and national-level. This includes bringing community youth voices to science through youth participatory action research. Relevant to this proposal, I am the contact PI for a PCORI engagement grant, a collaboration between academic researchers and local municipality departments, that will bring in community stakeholders from San Francisco neighborhoods that are disproportionately impacted by extreme heat and poor air quality to co-develop acceptable mitigation strategies to reduce the impact of climate-related events on health. We will build on this effort and expand to neighboring counties under this proposal. My longstanding history of community engagement, on-going collaborations with environmental health experts (Balmes, Noth, and de la Rosa), coupled with my history of examining multi-level stressors and health, make me well-suited to lead this proposal.

1. Nardone A, Casey JA, Morello-Frosch R, Mujahid M, **Balmes JR**, **Thakur N**. Associations between historical residential redlining and current age-adjusted rates of emergency department visits due to asthma across eight cities in California: an ecological study. Lancet Planet Health 2020 Jan;4(1):e24-e31.
2. Martinez A, **de la Rosa R,** Mujahid M, **Thakur N.** Structural racism and its pathways to asthma and atopic dermatitis. JACI *In Press.*

B. Positions and Honors

2013-2015 Clinical Instructor, Medicine, University of San Francisco, San Francisco, CA
2015-2017 Assistant Adjunct Professor, Medicine, University of San Francisco, San Francisco, CA
2017- Assistant Professor in Residence, Medicine, University of San Francisco, San Francisco, CA

2013-2014 Medical Director, Health and Environmental Resource Center, San Francisco, CA
2016- Medical Director, ZSFG Chest Clinic, San Francisco, CA
2016- Nina Ireland Program for Lung Health Executive Advisory Board Member

2019-2021 National Committee on Asthma and Toxic Stress, member
2020- Program for Research in Implementation Science for Equity Program Director
2019- Health Equality and Diversity Committee Chair, ATS

2014 Podell Hewett Fellowship in Airways Disease Research, 2014-15
2014 American Thoracic Society (ATS) Recognition Award for Early Career Investigators
2015 Parker B. Francis Fellowship Program, 2015-2018
2017 Faculty Position, Nina Ireland Program in Lung Health, University of California, San Francisco, CA
2018 The ATS Asian Pacific Society of Respirology Young Investigator Award
2021 ATS Behavioral Sciences and Health Services Research Early Career Achievement Award

C. Contributions to Science

1. Social Stress and Obstructive Lung Disease: We have demonstrated that individual and place-based measures of social stress are associated with having disease and poor health in communities of color.

a. **N. Thakur**, Oh SS, Nguyen EA, Martin M, Roth LA, Galanter J, Gignoux CR, Eng C, Davis A, Meade K, Lenoir MA, Avila PC, Farber HJ, Serebrisky D, Brigino-Buenaventura E, Rodriguez-Cintron W, Kumar R, Williams LK, Bibbins-Domingo K, Thyne S, Sen S, Rodriguez-Santana JR, Borrell LN, Burchard EG. Socioeconomic Status and Childhood Asthma in Urban Minority Youths: The GALA II and SAGE II Studies. AJRCCM. 2013; 188(10):1202-9. PMID: 24050698; PMCID: PMC3863734.

b. **N Thakur***, Barcelo N*, Oh SS, Nguyen EA, Eng C, Davis A, Meade K, Lenoir MA, Avila PC, Farber HJ, Serebrisky D, Brigino-Buenaventura E, Rodriguez-Cintron W, Kumar R, Bibbins-Domingo K, Thyne S, Sen S, Rodriguez-Santana JR, Borrell LN, Burchard EG. Perceived Discrimination Associated with Asthma and Related Outcomes in Minority Youth: The GALA II and SAGE II Studies. Chest.2017;151(4):804-812. PMID 27916618. PMCID: PMC5472516.

c. S. Carlson, Borrell N, Eng C, Nguyen M, Thyne S, LeNoir MA, Burke-Harris N, Burchard EG*, **Thakur N***. Self-reported racial/ethnic discrimination and bronchodilator response in African American youth with asthma. PLoS ONE Jun;12(6): e0179091. PMID 28609485. PMCID: PMC5469454.

d. **N Thakur**, Borrell LN, Ye M, Oh SS, Eng C, Meade K, Avila PC, Farber HJ, Serebrisky D, Brigino-Buenaventura E, Rodriguez-Cintron W, Kumar R, Bibbins-Domingo K, Thyne S, Sen S, Rodriguez-Santana JR, Burchard EG. Acculturation is Associated with Asthma Burden and Pulmonary Function in Latino Youth: The GALA II Study. JACI. 2019 May;143(5):1914-22. PMID: 30682453.

e. A Nardone, Casey JA, Morelle-Frosch R, Mujahid M, Balmes JR, **Thakur N.** Associations between historical residential redlining and current-age adjusted rates of emergency department visits due to asthma across eight cities in California: an ecological study. Lancet Planetary Health. 2020 Jan; 4(1):e24-31. PMID 31999951.

f. **Thakur N**, Hessler D, Koita K, Ye M, Benson M, Gilgoff R, Bucci M, Long D, Burke Harris N. Pediatrics adverse childhood experiences and related life events screener (PEARLS) and health in a safety-net practice. Child Abuse & Neglect. 2020 Oct; 108:104685. PMID: 32898839.

g. Ejike CO, Woo H, Galiatsatos P, Paulin LM, Krishnan JA, Cooper CB, Couper DJ, Kanner RE, Bowler RP, Hoffman EA, Comellas AP, Criner GJ, Barr RG, Martinez FJ, Han MK, Martinez CH, Ortega VE, Parekh TM, Christenson SA, **Thakur N**, Baugh A, Belz DC, Raju S, Gassett AJ, Kaufman JD, Putcha N, Hansel NN. Contribution of Individual and Neighborhood Factors to Racial Disparities in Respiratory Outcomes. AJRCCM. 2021 Apr;203(8):987-997. PMID: 33007162. PMCID: PMC8048743.

2. Air Pollution and Asthma: Through collaborations, we have demonstrated that the health effects of air pollution differ by race/ethnicity and community, stressing the importance of including diverse populations in research and studying risk factors across communities.

a. Nishimura KK, Galanter JM, Roth LA, Oh SS, **Thakur N**, Nguyen EA, Thyne S, Farber HJ, Serebrisky D, Kumar R, Brigino-Buenaventura E, Davis A, LeNoir MA, Meade K, Rodriguez-Cintron W, Avila PC, Borrell LN, Bibbins-Domingo K, Rodriguez-Santana JR, Sen Ś, Lurmann F, Balmes JR, Burchard EG. Early Life Air Pollution and Asthma Risk in Minority Children: The GALA II & SAGE II Studies. AJRCCM. 2013 Aug 1;188(3):309-18. PMID: 23750510. PMCID: PMC3778732.

b. Neophytou AM, White MJ, Oh SS, **Thakur N,** Galanter JM, Nishimura KK, Pino-Yanes M, Torgerson DG, Gignoux CR, Eng C, Nguyen EA, Hu D, Mak AC, Kumar R, Seibold MA, Davis A, Farber HJ, Meade K, Avila PC, Serebrisky D, Lenoir MA, Brigino-Buenaventura E, Rodriguez-Cintron W, Bibbins-Domingo K, Thyne SM, Williams LK, Sen S, Gilliland FD, Gauderman WJ, Rodriguez-Santana JR, Lurmann F, Balmes JR, Eisen EA, Burchard EG. Air Pollution and Lung Function in Minority Youth with Asthma in the GALA II & SAGE II Studies. AJRCCM. 2016 Jun 1; 193(11):1271-80. PMID 26734713. PMCID: PMC4910900.

c. Nardone A, Neophytou AM, Balmes J, **Thakur N**. Ambient Air Pollution and Asthma-Related Outcomes in Children of Color of the USA: a Scoping Review of Literature Published Between 2013 and 2017. Curr Allergy Asthma Rep. 2018 Apr 16; 18(5):29. PMID: 29663154. PMCID: PMC6198325.

Complete List of Published Work in MyBibliography:
https://www.ncbi.nlm.nih.gov/sites/myncbi/neeta.thakur.1/bibliography/47135371/public/?sort=date&direction=ascending

OMB No. 0925-0001 and 0925-0002 (Rev. 03/2020 Approved Through 02/28/2023)

BIOGRAPHICAL SKETCH

NAME: Balmes, John R., MD

eRA COMMONS USER NAME: BALMES

POSITION TITLE: Professor, University of California, Berkeley and San Francisco

EDUCATION/TRAINING

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
University of Illinois	BA	06/1972	Psychology
Mount Sinai School of Medicine	MD	06/1976	Medicine
Mount Sinai Medical Center, NYC	Residency	06/1979	Internal Medicine
Yale University	Post-doctoral fellowship	06/1981	Pulmonary Medicine

A. Personal Statement

I am a physician-scientist who has been studying adverse health effects of air pollutants and other environmental toxins on adults and children in both controlled human exposure and epidemiological studies for over 40 years. In my laboratory at the University of California, San Francisco, I have studied the acute effects of exposure to ozone, SO_2, NO_2, and particulate matter on lung function and airway inflammation in adults with asthma as well as cardiovascular effects of exposure to secondhand tobacco smoke and ozone. In Fresno, CA, I have studied the associations between air pollution and respiratory symptoms, lung function, and immune dysfunction in children with and without asthma. I was one of three multiple PIs leading a NIEHS/EPA-funded Children's Environmental Health Center (the Children's Health and Air Pollution Study or CHAPS); my project for CHAPS involved studying associations of exposure to air pollution with metabolic outcomes. Currently, I am the contact PI for an R24-funded 5-year extension of CHAPS. In Fresno, I have a long history of collaboration with the Central California Asthma Collaborative (CCAC). I have also participated in multiple studies of wildfire smoke and respiratory health (see publications listed below). I have a long-time collaborative relationship with both Drs. Thakur and Holm. The papers below provide evidence of these collaborations.

1. Nardone A, Casey JA, Morello-Frosch R, Mujahid M, **Balmes JR**, **Thakur N**. Associations between historical residential redlining and current age-adjusted rates of emergency department visits due to asthma across eight cities in California: an ecological study. Lancet Planet Health 2020 Jan;4(1):e24-e31.
2. **Holm SM**, Miller MD, **Balmes JR**. Health effects of wildfire smoke in children and public health tools: a narrative review. J Expo Sci Environ Epidemiol 2021 Feb;31(1):1-20.

B. Positions and Honors

1981-1982	Instructor in Medicine, Yale University
1983-1986	Assistant Professor of Medicine, University of Southern California
1986-1992	Assistant Professor of Medicine, University of California, SF
1992-1998	Associate Professor of Medicine, University of California, SF
1998-present	Professor of Medicine, University of California, SF; Emeritus since 1/1/2021
2002-present	Professor of Environmental Health Sciences, University of California, Berkeley; Emeritus since 1/1/2021
1992-2014	Chief, Division of Occupational and Environmental Medicine, SF General Hospital
1988-2015	Director, Human Exposure Laboratory, Lung Biology Center, UCSF
2000-2021	Director, Northern Calif. Center for Occupational and Environmental Health, UC Berkeley
2014-2020	Director, UC Berkeley-UCSF Joint Medical Program
2008-present	Member, California Air Resources Board, Cal/EPA

Pulmonary Academic Award, NHLBI, 1983-1986
Environmental/Occupational Medicine Academic Award, NIEHS, 1991-1996
Clean Air Research Award, American Lung Association of San Francisco and San Mateo, 1997
Clean Air Award, American Lung Association of California, 1999
Jean Spencer Felton Award for Excellence in Scientific Writing, Western Occupational and Environmental Medicine Association, 2002
Robert A. Kehoe Award of Merit, American College of Occupational and Environmental Medicine, 2006
Carl Moyer Award for Scientific Leadership and Technical Excellence, Coalition for Clean Air, 2006
Rutherford T. Johnstone Award, Western Occupational and Environmental Medical Association, 2010
Robert M. Zweig Memorial Clean Air Hero Award, South Coast Air Quality Management District, 2012
Public Service, American Thoracic Society, 2016
John M. Peters Award, American Thoracic Society Assembly on Environmental, Occupational and Population Health, 2016
Fellow, American Thoracic Society, 2018
Distinguished Achievement Award, American Thoracic Society, 2020

C. Contributions to Science

Epidemiological studies of the respiratory health effects of air pollution in children and adults

I have collaborated on multiple research efforts to assess the relationships between exposure to various air pollutants, including household air pollution from domestic cooking with biomass fuels and wildfire smoke, and respiratory outcomes in children and adults. These studies include respiratory symptoms, the growth of lung function, exacerbations of asthma, and incident asthma.

1. Mortimer KM, Neugebauer R, Lurmann F, **Balmes JR**, Tager IB. The effect of prenatal and lifetime exposure to air pollution on the pulmonary function of asthmatic children. Epidemiology 2008;19:550-557. discussion 561-562.
2. Neophytou AM, White MJ, Oh SS, Thakur N, Galanter JM, Nishimura KK, Pino-Yanes M, Torgerson DG, Gignoux CR, Eng C, Nguyen EA, Hu D, Mak AC, Kumar R, Seibold MA, Davis A, Farber HJ, Meade K, Avila PC, Serebrisky D, Lenoir MA, Brigino-Buenaventura E, Rodriguez-Cintron W, Bibbins-Domingo K, Thyne SM, Williams LK, Sen S, Gilliland FD, Gauderman WJ, Rodriguez-Santana JR, Lurmann F, **Balmes JR**, Eisen EA, Burchard EG. Air pollution and lung function in minority youth with asthma in the GALA II & SAGE II studies. Am J Respir Crit Care Med 2016;193(11):1271-1280. PMCID: PMC4910900.
3. Smith KR, McCracken JP, Weber MW, Hubbard A, Jenny A, Thompson LM, **Balmes J**, Diaz A, Arana B, Bruce N. Effect of reduction in household air pollution on childhood pneumonia in Guatemala (RESPIRE): a randomised controlled trial. Lancet 2011 Nov 12; 378(9804):1717-26.
4. Reid CE, Jerrett M, Petersen ML, Pfister GG, Morefield PE, Tager IB, Raffuse SM, **Balmes JR**. Spatiotemporal prediction of fine particulate matter during the 2008 northern California wildfires using machine learning. Environ Sci Technol 2015;49(6):3887-96. PMID: 25648639
5. Pope D, Diaz E, Smith-Sivertsen T, Lie RT, Bakke P, **Balmes JR**, Smith KR, Bruce NG. Exposure to household air pollution from wood combustion and association with respiratory symptoms and lung function in nonsmoking women: results from the RESPIRE trial, Guatemala. Environ Health Perspect. 2015 Apr;123(4):285-92. PMCID: PMC4384202
6. Reid CE, Jerrett M, Tager IB, Petersen ML, Mann JK, **Balmes JR**. Differential respiratory health effects from the 2008 northern California wildfires: A spatiotemporal approach. Environ Res 2016;150:227-235. PMID: 27318255
7. Reid CE, Brauer M, Johnston FH, Jerrett M, **Balmes JR**, Elliott CT. Critical review of health impacts of wildfire smoke exposure. Environ Health Perspect 2016;124(9):1334-43. PMID: 27082891 PMCID: PMC5010409
8. Heinzerling AP, Guarnieri MJ, Mann JK, Diaz JV, Thompson LM, Diaz A, Bruce NG, Smith KR, **Balmes JR**. Lung function in woodsmoke-exposed Guatemalan children following a chimney stove intervention. Thorax 2016;71:421-428. PMID: 26966237.
9. *Mortimer K, Ndamala CB, Naunje A, Malava J, Katundu C, Weston W, Havens D, Pope D, Bruce N G, Nyirenda M, Wang D, Crampin A, Grigg J, **Balmes J**, Gordon S. A cleaner burning biomass-fueled cookstove intervention to prevent pneumonia in children under 5 years old in rural Malawi (CAPS): a cluster randomized controlled trial. Lancet 2016;389(10065):167–175. PMID: 27939058 PMCID: PMC5783287
*Best Environmental Epidemiology Paper of the Year Award – International Society for Environmental Epidemiology
10. Rylance S, Jewell C, Naunje A, Mbalume F, Chetwood JD, Nightingale R, Zurba L, Flitz G, Gordon SB, Lesosky M, **Balmes JR**, Mortimer K. Non-communicable respiratory disease and air pollution exposure in Malawi: a prospective cohort study. Thorax. 2020 Mar;75(3):220-226. PMCID: PMC7063402

Complete List of Published Work in MyBibliography:
http://www.ncbi.nlm.nih.gov/pubmed/?term=balmes+j

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BIOGRAPHICAL SKETCH

NAME: Holm, Stephanie

eRA COMMONS USER NAME: stephaniemholm

POSITION TITLE: Assistant Clinical Professor

EDUCATION/TRAINING

INSTITUTION AND LOCATION	DEGREE	Completion Date MM/YYYY	FIELD OF STUDY
Swarthmore College, Swarthmore, PA	BA	06/2007	Chemistry
University of Pittsburgh School of Medicine	MD	05/2011	Medicine
Children's Hospital and Research Center Oakland	N/A	09/2014	Pediatric Residency
UCSF Benioff Children's Hospital Oakland	N/A	10/2015	Pediatric Pulmonary Fellowship
University of California Berkeley School of Public Health	MPH	05/2017	Epidemiology
University of California San Francisco Division of Occupational and Environmental Medicine	N/A	06/2018	Occupational and Environmental Medicine Residency
University of California Berkeley School of Public Health	PhD	06/2021	Epidemiology

A. Personal Statement

As a physician board-certified in both pediatrics and occupational-environmental medicine, I am passionate about how environmental exposures contribute to child health, with a particular interest in airborne exposures and their contribution to pediatric lung diseases. I felt the draw of working on problems larger than a single patient encounter, yet my grounding in clinical pediatrics provides a useful launch point from which I pursue research in child health. My long-term goals have been to do research, communicate research findings to the public and do regulatory work, and I have been gratified to see that work evolve as I further launch my career. As a Public Health Medical Officer within the California EPA, I collaborate with multiple boards, departments and offices throughout CalEPA on issues surrounding the role of the environment in the health of California's children. In my role as Co-director of the Western States Pediatric Environmental Health Specialty Unit, I have worked on many education and public health communication projects and have particular expertise in disinfectant exposures and wildfire smoke. Working with Dr. Balmes, I have led the AIM project (Airflow Improvements during Meal-prep) and am a collaborator on the Children's Health and Air Pollution Study (CHAPS). Between my expertise in pediatric lung diseases and pediatric environmental epidemiology and Dr. Thakur and Balmes' expertise in adult lung diseases, we bring a breadth of expertise across the lifecourse.

B. Positions and Honors

2020-present Public Health Medical Officer II, Office of Environmental Health Hazard Assessment, Cal EPA
2020-present Graduate Student Researcher, PI: Balmes
2019-present Co-Director, Western States Pediatric Environmental Health Specialty Unit
2018-present Volunteer Assistant Clinical Professor, University of California San Francisco
2018-2019 Graduate Student Instructor in Epidemiology, Biostatistics and Medicine (UC Berkeley)
2018 Educational video editor (Online MPH Program, School of Public Health, UC Berkeley)
2018 Chief Resident, UCSF Occupational and Environmental Medicine Program
2015-2016 Consulting Researcher at UC Berkeley

2020 UC Berkeley Outstanding Graduate Student Instructor Award

2018 American Occupational Health Conference Scholarship
2017 American Thoracic Society Assembly on Environmental, Occupational and Population Health Abstract Scholarship
2011 Richard L. Day Prize for Pediatrics at the Univ of Pittsburgh School of Medicine.
2011 Bert and Sally O'Malley Award for Outstanding Medical Student Research at the University of Pittsburgh School of Medicine.
2010 Sleep Research Society 2010 Honorable Mention Abstract Award for Scientific Merit

C. Contributions to Science

Health Effects of Air Pollution in Children: I led a dual-cohort study in the East Bay Area of Northern California, which found that both living with a smoker and cooking without the use of a venting range hood contributed to household particulate matter levels and has led to ongoing work assessing the effect of a ventilation intervention during cooking. I have also actively participated in analyses of study findings from the Children's Health and Air Pollution (CHAPS) cohort, demonstrating links between air pollutant exposure and metabolic functioning in children. I also recently published a systematic review of the effects of ozone exposure on lung function, which focused heavily on pediatric exposures as much of the recent literature has been related to long-term ozone exposure in children.

1. **Holm SM,** Gillette D, Balmes JR, Hartin K, Seto E, Lindeman D, Polanco D, Fong E "Cooking Behaviors are Related to Household Particulate Matter Exposure in Children with Asthma in the Urban East Bay Area of Northern California," *Plos One,* 13:6 (2018), e0197199
2. Zhang A, Balmes JR, Lutzker L, Mann J, Margolis H, Tyner T, Holland N, Noth E, Lurman F, Hammond SK, **Holm SM.** "Traffic-Related Air Pollution, Biomarkers of Metabolic Dysfunction, Oxidative stress, and CC16 in Children," *JESEE,* 2021 Aug 20
3. Mann JK, Lutzker L, **Holm SM,** Margolis HG, Neophytou AM, Eisen EA, Costello S, Tyner T, Holland N, Tindula G, Prunicki M, Nadeau K, Noth EM, Lurmann F, Hammond SK, Balmes JR. "Traffic-Related Air Pollution is Associated with Glucose Dysregulation, Blood Pressure and Oxidative Stress in Children," *Environ Res.* 2021 Apr, *195*, 110870
4. **Holm SM,** Balmes JR "Systematic Review of Ozone Effects on Human Lung Function, 2013-2020," *CHEST,* 2021 Aug 10

Environmental Pediatrics:

As Co-director of the Region 9 (Western States) Pediatric Environmental Health Specialty Unit, I have expertise in translating scientific knowledge for diverse audiences and have recently led two major projects: reviewing literature relating to potential effects of exposure to disinfectant products among young children in childcare settings and writing a review paper on the state of the epidemiologic literature regarding children's health and exposure to wildfire smoke, as well as considerations for public health responses to wildfire smoke events. I have also been part of the effort leading working groups of diverse public health stakeholders to reach uniform public health recommendations for wildfire smoke guidance regarding children and have given national webinars on this topic as well. As part of that work, I recently spoke about mask and respirator use by children as part of a National Academies of Science, Engineering and Medicine (NASEM) Workshop, and have since been serving on a NASEM committee addressing respiratory protection for the public.

1. **Holm SM,** "Respiratory Protection in Children," National Academies of Science, Engineering and Medicine Workshop: Current Issues in the Assessment of Respiratory Protective Devices, August 4, 2020
2. **Holm SM,** Miller MD, Balmes JR. "Health effects of wildfire smoke in children and public health tools: a narrative review." *JESEE*, 2021 Feb; *31(1)*:1-20
3. **Holm SM,** Leonard V, Durrani T, Miller MD. "Do We Know How Best to Disinfect Child Care Sites," *American Journal of Infection Control,* 47:1 (2019), 82-91

Complete List of Published Work in MyBibliography:
https://www.ncbi.nlm.nih.gov/myncbi/stephanie.holm.1/bibliography/public/

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BIOGRAPHICAL SKETCH
New/Early Stage Investigator

Provide the following information for the Senior/key personnel and other significant contributors.
Follow this format for each person. **DO NOT EXCEED FIVE PAGES.**

NAME: Rosemarie de la Rosa

eRA COMMONS USER NAME (credential, e.g., agency login): rmd1025

POSITION TITLE: Assistant Professor

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
Massachusetts Institute of Technology	BS	06/2010	Biology
University of California, Berkeley	MPH	05/2014	Environmental Health Science
University of California, Berkeley	PhD	08/2019	Environmental Health Science
University of California, San Francisco	Postdoctoral	06/2021	Medicine

A. Personal Statement

I am an Assistant Professor at UC Berkeley in the Division of Environmental Health Sciences. My research aims to understand how the social environment during early and middle childhood influences susceptibility to the toxic effects of chemical exposures. As a doctoral student at UC Berkeley, I was funded by an EPA Science to Achieve Results (STAR) Graduate Fellowship to identify environmental chemicals that interact with glucocorticoid receptor signaling, a stress-induced pathway that has systemic effects on human physiology. I have also published on assessing cumulative risk from multiple environmental stressors using exposomics. I began collaborating with Dr. Thakur as a postdoctoral scholar examining the relationship between adverse childhood experiences and stress-related biomarkers in a diverse and low-income pediatric population. Through this work, I identified a biomarker profile related to metabolic dysregulation among a subset of children that reported high experiences of adverse childhood experiences. Collectively, my training in environmental health, toxicology, and molecular epidemiology has provided me with the foundation to conduct research assessing the independent and joint effect of chemical and non-chemical stressors on human health.

B. Positions and Honors

2010 - 2012	Research Assistant, Children's Hospital Boston
2012 - 2019	Graduate Student Researcher, University of California Berkeley
2019 - 2021	Postdoctoral Scholar, University of California San Francisco
2021 - Present	Assistant Professor, Division of Environmental Health Sciences, School of Public Health, University of California Berkeley

Professional Memberships

2016 - Present	Member, Society of Toxicology (SOT)
2020 - Present	Member, American Thoracic Society

Honors

2014	Chancellor's Fellowship, University of California, Berkeley
2015	EPA STAR Graduate Fellowship
2017	KC Donnelly Externship Award, National Institute of Environmental Health Sciences
2017	Minority in Cancer Research Award, American Association for Cancer Research
2017	Best Student Paper Award, Environmental and Molecular Mutagenesis
2019	University of California President's Postdoctoral Fellowship
2020	Telomere Research Network Pilot Award

C. Contributions to Science

1. Arsenic toxicity and susceptibility. I worked with Dr. Craig Steinmaus to examine the long-term health effects of arsenic exposure. I conducted the first epidemiologic study demonstrating a direct association between genetic differences in AS3MT, the primary enzyme involved in arsenic metabolism, and arsenic-related internal cancer risk. I also found that early-life arsenic exposure was associated with decreased plasma glucocorticoid levels in adulthood, providing preliminary evidence that arsenic may act as an endocrine disruptor of the hypothalamic-pituitary-adrenal axis in humans.
   a. **de la Rosa R**, Steinmaus C, Akers NK, Conde L, Ferreccio C, Kalman D, Zhang KR, Skibola CF, Smith AH, Zhang L, Smith MT (2017) Associations between arsenic (+3 oxidation state) methyltransferase (AS3MT) and N-6 adenine-specific DNA methyltransferase 1 (N6AMT1) polymorphisms, arsenic metabolism, and cancer risk in a Chilean population. *Environ. Mol. Mutagen*. 58, 411–422.
   b. Early-life arsenic exposure has a long-term effect on plasma glucocorticoid levels. Society of Toxicology 57th Annual Meeting, San Antonio, TX, March 13, 2018.
2. Chemicals and glucocorticoid receptor signaling. The overall objective of my doctoral work was to investigate the effect of environmental chemicals on glucocorticoid receptor signaling. As part of this project, I developed a bioassay to identify environmental chemicals that modulate glucocorticoid receptor activation. I was also a recipient of a KC Donnelly Externship Award from NIEHS to develop additivity models that predict the joint effect of chemical mixtures on glucocorticoid receptor signaling.
   a. **de la Rosa R**, Vazquez S, Tachachartvanich P, Daniels SI, Sillé F, Smith MT. (2020) Development of a Cell-Based Bioassay to Screen Environmental Chemicals and Human Serum for Glucocorticogenic Activity. *Environmental Toxicology and Chemistry*.
   b. **de la Rosa R**, Schlezinger JJ, Smith MT, Webster TF. (2020) Application of Generalized Concentration Addition to Predict Mixture Effects of Glucocorticoid Receptor Ligands. *Toxicology in Vitro*.
3. Exposome and cumulative risk. Dr. Martyn Smith and I proposed using exposomics to measure cumulative risk in a review paper and book chapter that we co-authored. I contributed to these projects by proposing potential exposomic methods that could be used to measure the combined effect of chronic psychosocial stress and environmental exposures on human health.
   a. Smith MT, **de la Rosa R**, Daniels SI (2015) Using exposomics to assess cumulative risks and promote health. *Environ. Mol. Mutagen*. 56, 715–723.
   b. Smith MT, McHale CM, **de la Rosa R** (2019) Using exposomics to assess cumulative risks from multiple environmental stressors. In Dagnino S & Macherone A (Eds.), Unraveling the exposome: A Practical View, 3–22. Springer International Publishing.
4. Biological embedding of psychosocial stress. As a Presidential Postdoctoral Fellow, I worked with Dr. Neeta Thakur to explore the association between adverse childhood experiences and stress-related biomarkers during early- and mid- childhood. I characterized allostatic load, or the cumulative burden of stress on the body, in a low-income and predominantly Black pediatric population. I also set up a protocol to quantify telomere length, which allowed us to examine the relationship between various psychosocial stressors and cellular aging.
   a. Measuring the Biological Impact of Childhood Trauma and Resilience in a Diverse Pediatric Population. UC President's Postdoctoral Fellowship Program Spring Meeting, April 18, 2020.

BIOGRAPHICAL SKETCH

NAME: Elizabeth M. Noth, PhD MPH	POSITION TITLE: Associate Researcher
ADDRESS: 2121 Berkeley Way, Berkeley, CA 94720	

EDUCATION/TRAINING

INSTITUTION AND LOCATION	DEGREE	MM/YY	FIELD OF STUDY
University of California, Berkeley	B.S.	05/1996	Conservation and Resource Studies
Boston University, School of Public Health	M.P.H.	01/2000	Environmental Health
University of California, Berkeley	PhD	05/2009	Environmental Health Sciences

A. Personal Statement

I am an exposure assessment scientist with over 20 years of experience in air pollution exposure assessment for children's exposures. Over the last 5 years, I have focused on air pollution exposures that are either extremely high (e.g., during light metal manufacturing) or impact vulnerable populations (e.g., children and pregnant women). My contributions on two major environmental epidemiology studies focus on the San Joaquin Valley in California: developing spatial-temporal air pollution models for criteria pollutants and polycyclic aromatic hydrocarbons to calculate daily exposure estimates for every child on every day of an 8-year follow-up period for the Fresno Asthmatic Children's Environment Study, and on every day of a 5-year follow-up period, plus lifetime exposures for children, for the Children's Health and Air Pollution National Children's Environmental Health Center. More recently, in collaboration with Drs. Thakur and Balmes, I have extended my work to Richmond, CA through the REACH study. My research also includes occupational exposure assessment because of my concern for the very high concentrations that workers are exposed to from such air pollutants as particulate matter, polycyclic aromatic hydrocarbons, fluorides and more in hot environments with high physical demand.

B. Positions and Honors

2000-2009 Graduate Student Researcher in Environmental Health Sciences, University of California, Berkeley, CA
2001-2003 Research Scientist on contract to California Environmental Health Investigations Branch, Impact Assessment, Oakland, CA
2009-2013 Post-doctoral Scholar, Environmental Health Sciences, School of Public Health, University of California, Berkeley
2013-2019 Assistant Researcher, Environmental Health Sciences, School of Public Health, University of California, Berkeley
2016-present Consultant on CHEST Foundation/Pulmonary Fibrosis Foundation Clinical Research Grant in Pulmonary Fibrosis. (PI: Kerri Johannson, MD., University of Calgary.)
2018-present Scientific Director, Lecturer and Mentor for Interdisciplinary Global Endeavors in Technology and Education (IGNITE) and Project AIR (Action, Innovation, Research)
2019-present Associate Researcher, Environmental Health Sciences, School of Public Health, University of California, Berkeley

Honors
1998-2000 Boston University School of Public Health, Dean's Scholarship
2001-2002 University of California, Berkeley, Regent's Fellowship
2004-2005 Marian Rennie Benson Fellowship, University of California Berkeley Public Health Alumni Association.

C. Selected Peer-reviewed Publications – Full bibliography available at https://www.ncbi.nlm.nih.gov/myncbi/elizabeth.noth.1/bibliography/public/

1. Zhang AL, Balmes JR, Lutzker L, Mann JK, Margolis HG, Tyner T, Holland N, **Noth EM**, Lurmann F, Hammond SK and Holm SM. (2021) "Traffic-related air pollution, biomarkers of metabolic dysfunction, oxidative stress, and CC16 in children." *J Expo Sci Environ Epidemiol. In press*
2. Mann JK, Lutzker L, Holm SM, Margolis HG, Neophytou AM, Eisen EA, Costello S, Tyner T, Holland N, Tindula G, Prunicki M, Nadeau K, **Noth EM**, Lurmann F, Hammond SK, Balmes JR. (2021) Traffic-related air pollution is associated with glucose dysregulation, blood pressure, and oxidative stress in children. *Environ Research* 195:110870.

3. Prunicki M, Cauwenberghs N, Lee J, Zhou X, Movassagh H, **Noth E**, Lurmann F, Hammond K, Balmes JR, Desai M, Wu JC, Nadeau KC. (2021) Air pollution exposure is linked with methylation of immunoregulatory genes, altered immune cell profiles, and increased blood pressure in children. Nature Scientific Reports 11(4067). Published Feb 18, 2021.
4. **Noth EM,** Lurmann F, Perrino C, Vaughn D, Minor HA, Hammond SK. (2020) "Decrease in Ambient Polycyclic Aromatic Hydrocarbon Concentrations in California's San Joaquin Valley 2000-2019." *Atmospheric Environment* 242, 117818.
5. Navarro K, Cisneros R, Chowdhary P, **Noth EM**, Balmes J, Hammond SK. (2019) "Incident Command Post Exposure to Polycyclic Aromatic Hydrocarbons and Particulate Matter during a Wildfire." *Journal of Occupational & Environmental Hygiene* 16(11):735-744
6. Navarro K, Cisneros R, **Noth EM**, Balmes JR, Hammond SK (2017). "Occupational Exposure to Polycyclic Aromatic Hydrocarbon of Wildland Firefighters at Prescribed and Wildland Fires." *Environmental Science & Technology* 51(11): 6461–6469

D. Research Support (ongoing + completed in last 3 years, sort by relevance)

California Air Resources Board 19RD003(PI: Hammond) 3/15/2020 – 3/14/2023
Air Pollution Measurements, Exposure Assessment, and Evaluation of the Sources of Particulate Matter in Fresno, CA: The objectives of this study are to a) understand the sources of particulate matter (PM) exposures to residents of Fresno and Clovis and b) estimate concentrations of polycyclic aromatic hydrocarbons, black carbon, brown carbon, and PM from each of these sources at the neighborhood level. We will focus on disentangling the sources of PM exposures (PM originating from traffic-related sources from other combustion sources, e.g., residential wood burning, agricultural burning, prescribed burns, and wildfires. Role: Co-Investigator, Key personnel.

NIEHS R01 ES031261 (PI: Padula, UCSF, subaward PI: Noth) 6/18/2020 – 3/31/2025
Wildfires and intentional biomass burning in California and Preterm Birth
Our overall goal is to study how mothers' exposures to wildfire and intentional biomass burning(i.e. prescribed burns, agricultural fires and residential wood burning) during pregnancy may affect whether her baby is born prematurely. We will also evaluate the role of neighborhood deprivation and race/ethnicity may modify the relationship between fire exposures and preterm birth. Role: Principal Investigator (subaward to UCB)

California Air Resources Board 20RD012 (PI: Noth) 4/1/2021 – 3/31/2023
Title: *San Joaquin Valley Pollution and Health Environmental Research Study (SPHERE)*
This study will be the first in California to measure indoor and outdoor noise levels concurrent with air quality and develop cumulative exposure metrics characterizing exposures to mixtures of air pollutants and noise. The information collected will foster unique insight into how disparities in air quality and noise exposures affect the health of California residents in disadvantaged communities. Role: Principal Investigator

California Office of Environmental Health Hazard Assessment, 19-E0020 (PI: Noth) 05/1/2020 – 04/30/2022
Pilot Air Quality Study for an AB617 Community (PAQS-AB617): The goal of this Pilot Air Quality Study in an AB 617 community is to measure ambient concentrations of selected airborne polycyclic aromatic hydrocarbons (PAHs) at appropriate locations to complement the targeted biomonitoring study being carried out the Office of Environmental Health Hazard Assessment (OEHHA). Role: Principal Investigator

NIEHS R24 ES030888 (MPIs: Balmes, Holland, Noth) 2/15/2020-2/14/2025
CHAPS Cohort Maintenance: The major goal of this project is to continue longitudinal follow-up of the participants in the Children's Health and Air Pollution Study (CHAPS), an epidemiological study that has focused on the effects of air pollution on children growing up in the San Joaquin Valley of California, one of the most polluted areas in the country. Role: Principal Investigator

NIH NIA 5R01 AG026291-1 (PI: Cullen) 9/1/2017 – 5/31/2022
Disease, Disability and Death in an Aging Workforce: To assess the impact on health and function of ubiquitous physical hazards in the work environment as they relate to the preventable causes of the major chronic diseases of working age adults—ischemic heart disease, asthma, musculoskeletal disorders and COPD. Role: Co-Investigator

FOTINI (TINA) KATOPODES CHOW

PROFESSIONAL PREPARATION

Harvard University	Cambridge, MA	Engineering Science (*summa cum laude*)	B.S. 1998
Stanford University	Stanford, CA	Civil & Environmental Engineering	M.S. 1999
Stanford University	Stanford, CA	Civil & Environmental Engineering (Environmental Fluid Mechanics & Hydrology)	PhD 2004
Lawrence Livermore National Laboratory	Livermore, CA	Atmospheric sciences, post-doctoral researcher	Aug 2004 – Jun 2005

APPOINTMENTS

2016-present	Professor, Civil & Environmental Engineering University of California, Berkeley
2011-2016	Associate Professor, Civil & Environmental Engineering University of California, Berkeley
2005-2011	Assistant Professor, Civil & Environmental Engineering University of California, Berkeley
2004-2005	Consulting Assistant Prof., Civil & Environmental Engineering, Stanford

SELECTED HONORS

- UC Berkeley Chancellor's Public Scholar Faculty Fellowship, 2021
- Extraordinary Teaching in Extraordinary Times, 2021 (campus-wide award)
- Henry G. Houghton Award, American Meteorological Society, 2016
- Presidential Early Career Award for Scientists and Engineers (DOE PECASE), 2011
- National Science Foundation CAREER Award, 2007-2012
- UC Berkeley Hellman Family Faculty Fund award, 2007

PUBLICATIONS (published articles available at https://chow.ce.berkeley.edu/)

Related:

Chow, F.K., Yu, K., Young, A., James, E., Grell, G., Csiszar, I.A., Tsidulko, M., Freitas, S., Pereira, G., Giglio, L., and R. Ahmadov. 2021. High-resolution smoke forecasting for the 2018 Camp Fire in California, *Bulletin of the American Meteorological Society,* under review (minor revisions requested). *See also:* https://agu.confex.com/agu/fm20/meetingapp.cgi/Paper/772370

Chen, B., Chow, F.K., and T. Thompson. 2020. Simulations to support local source apportionment using forward and inverse simulations of urban dispersion at the micro-scale. Abstract A065-0012 presented at *2020 AGU Fall Meeting,* online, 1-17 December. https://agu.confex.com/agu/fm20/meetingapp.cgi/Paper/773000 [Paper in prep for submission 12/2021 to *Atmospheric Environment*]

Wiersema, D.J., Lundquist, K.A. and F.K. Chow. 2020. Mesoscale to microscale simulations over complex terrain with the immersed boundary method in the Weather Research and Forecasting model. *Monthly Weather Review* **148**(2), 577–595.

Michioka, T. and F.K. Chow. 2008. High-resolution large-eddy simulations of scalar transport in atmospheric boundary layer flow over complex terrain. *Journal of Applied Meteorology and Climatology* **47**(12), 3150-3169.

Chow, F.K., Kosovic, B., and S.T. Chan. 2008. Source inversion for dispersion in urban environments using building-resolving simulations and Bayesian inference with stochastic sampling. *Journal of Applied Meteorology and Climatology* **47**(6), 1553–1572.

Other significant products:

Arthur, R.S., Mirocha, J.D., Marjanovic, N., Hirth, B.D., Schroeder, J.L., Wharton, S. and F.K. Chow. 2020. Multi-scale simulation of wind farm performance during a frontal passage. *Atmosphere* **11**(1), 245, 1-17.

Chow, F.K., Schär, C., Ban, N., Lundquist, K.A., Schlemmer, L. and X. Shi. 2019. Crossing multiple gray zones in the transition from mesoscale to microscale simulation over complex terrain. *Atmosphere* **10**(5), 274, 1-38.

Simon, J.S., Zhou, B., Mirocha, J.D., and F.K. Chow. 2019. Explicit filtering and reconstruction to reduce grid dependence in convective boundary layer simulations using WRF-LES. *Monthly Weather Review* **147**(5), 1805-1821.

Taylor, D., Chow, F.K., Delkash, M., and P.T. Imhoff. 2018. Atmospheric modeling to assess wind dependence in tracer dilution method measurements of landfill methane emissions. *Waste Management* **73**(3), 197-209.

Bao, J., Chow, F.K., and K.A. Lundquist. 2018. Large-eddy simulation over complex terrain using an improved immersed boundary method in the Weather Research and Forecasting model, *Monthly Weather Review* **146**(9), 2781-2797.

SYNERGISTIC ACTIVITIES

1. Expert in development and applications of atmospheric transport modeling over complex terrain and urban areas

2. Led community-engaged student design projects to improve air quality for the Stockton AB 617 community in 2021, with Little Manila Rising and other nonprofit organizations.

3. Developed micro-scale simulations for local source apportionment, with Environmental Defense Fund, focused in West Oakland, CA.

4. Editor for the *Journal of Atmospheric Sciences* (2016-2020)

5. NCAR Research Applications Lab Advisory Panel Member (2021)

6. AMS Mountain Meteorology Committee Member (2006-2008, 2016-2018)

7. Co-taught new graduate seminar on planetary boundaries, the Anthropocene, and systems thinking (2018, 2020, 2021)

8. Organized and participated in numerous workshops on diversity, equity and inclusion in engineering education and research (2017-present)

9. Vice Chair for Graduate Studies, Civil and Environmental Engineering department (2019-present)

10. Program leader for UC Berkeley Environmental Engineering program, including creation of new graduate professional development events (2017-2020).

Wanyu Rengie Chan, Ph.D.

Professional Preparation

Ph.D **University of California, Berkeley**
Environmental Engineering Program, Civil & Environmental Engineering, 2006
MS **University of California, Berkeley**
Civil & Environmental Engineering, 2002
BS **Carnegie Mellon University, Pittsburgh PA**
Chemical Engineering, 2001

Affiliation

Research Scientist, Deputy Group Leader, Indoor Environment Group, Lawrence Berkeley National Laboratory

Expertise

Indoor air quality, indoor air pollutant transport and fate, field studies measuring occupant exposure and indoor environmental quality, building science, building air leakage, filtration

Experience Summary

Dr. Chan is a Research Scientist with 20+ experience studying indoor air quality. Her work focus on characterizing human exposures to indoor air pollutants in buildings, and the implications to energy use and occupant health. She served on a committee organized by the National Academies of Sciences, Engineering, and Medicine on the topic of indoor exposure to fine particulate matter and mitigation. She led field studies to evaluate the role of kitchen and dwelling ventilation on indoor air quality in 90+ new California single-family homes and retrofitted apartments. The projects were funded by California Energy Commission (CEC), involving multiple collaborators. Dr. Chan is part of an ongoing project funded by the Department of Energy, Building America Program to study indoor air quality in new homes across different U.S. regions. Dr. Chan published several papers on the health benefits of improved filtration and ventilation. Dr. Chan joined the Laboratory as a graduate student and worked on the evaluation of shelter-in-place effectiveness. She collaborated with the National Atmospheric Release Advisory Center to develop an operational indoor model that has been applied in advising emergency responders on protecting buildings against accidental or intentional chemical or biological releases.

Publications

Most closely related to the proposed project

1. Zhao H., W.R. Chan, S. Cohn, W.W. Delp, I.S. Walker, and B.C. Singer. 2020. Indoor air quality in new and renovated low-income apartments with mechanical ventilation and natural gas cooking in California. *Indoor Air*. DOI: 10.1111/ina.12764.
2. Tang H., W.R. Chan, and M.D. Sohn. 2020. Automating the interpretation of PM2.5 time-resolved measurements using a data-driven approach. *Indoor Air*. DOI: 10.1111/ina.12780.
3. Chan W.R., J.M. Logue, X. Wu, N.E. Klepeis, W.J. Fisk, F. Noris, and B.C. Singer. 2018. Quantifying fine particle emission events from time-resolved measurements: method description and application to 18 California low-income apartments. *Indoor Air* 28(1), 89–101. DOI: 10.1111/ina.12425.
4. Fisk W.J. and W.R. Chan. 2016. Health benefits and costs of filtration interventions that reduce indoor exposure to PM2.5 during wildfires. *Indoor Air* 27(1), 191–204. DOI: 10.1111/ina.12285.

5. Chan W.R., J. Joh, and M.H. Sherman. 2013. Analysis of air leakage measurements of US houses. *Energy and Buildings* 66, 616–625. DOI: 10.1016/j.enbuild.2013.07.047.

Other significant publications

1. Laumbach R.J., K.R. Cromar, G. Adamkiewicz, C. Carlsten, D. Charpin, W.R. Chan, A. de Nazelle, F. Forastiere, J. Goldstein, S. Gumy, W.K. Hallman, M. Jerrett, H.M. Kipen, C.S. Pirozzi, B.J. Polivka, J. Radbel, R.E. Shaffer, D.D. Sin, and G. Viegi. 2021. Personal interventions for reducing exposure and risk for outdoor air pollution. *An Official American Thoracic Society Workshop Report.* DOI: 10.1513/AnnalsATS.202104-421ST.
2. Zhao H., W.R. Chan, W.W. Delp, H. Tang, I.S. Walker, and B.C. Singer. 2020. Factors impacting range hood use in California houses and low-income apartments. *International Journal of Environmental Research and Public Health* 17(23), 8870. DOI: 10.3390/ijerph17238870.
3. Fisk W.J., B.C. Singer, and W.R. Chan. 2020. Association of residential energy efficiency retrofits with indoor environmental quality, comfort, and health: A review of empirical data. *Building and Environment* 180. DOI: 10.1016/j.buildenv.2020.107067.
4. Fischer M.L., W.R. Chan, W.W. Delp, S. Jeong, V.H. Rapp, and Z. Zhu. 2018. An estimate of natural gas methane emissions from California homes. *Environmental Science & Technology* 52(17), 10205–10213. DOI:10.1021/acs.est.8b03217.
5. Chan W.R., W.W. Nazaroff, P.N. Price, M.D. Sohn, and A.J. Gadgil. 2005. Analyzing a database of residential air leakage in the United States. *Atmospheric Environment* 39, 3445–3455.

Synergistic Activities

1. PI for Indoor Air Quality Scientific Findings Resource Bank project, sponsored by U.S. Environmental Protection Agency (2018–Current). The goal of this project is to continuedly assess the benefits from specific measure to improve indoor environmental quality through conducting literature reviews and scientific evaluation on the effect to occupant health.

2. Work lead for Indoor Air Quality in New Homes study sponsored by Department of Energy, Building America Program (2018–Current). The study goal is to collect indoor air contaminant and building characteristics in a broad range of new homes in different U.S. climates. Results from this study will inform standards and technology development to enable acceptable IAQ and energy goals.

3. Project team supporting the proposed rule change for manufactured home (2020–Current). Conduct literature search and modeling of indoor air quality as a result of the proposed rule change on air sealing, duct leakage, and ventilation of manufactured homes. This work is sponsored by the Department of Energy, Building America Program.

4. Co-PI for Effective Kitchen Ventilation for Healthy Zero-Net Energy Homes with Natural Gas project, sponsored by California Energy Commission (2017–2019). The project goal is to inform residential codes and standards that protect indoor air quality and health, focusing on kitchen ventilation requirements to enable effective control in homes with gas cooking.

5. Field study lead for Healthy Efficient New Gas Home (HENGH) project, sponsored by California Energy Commission (2014–2018). Field study of new California single-family homes evaluated the role of mechanical ventilation on indoor air quality. Results led to better enforcement of mechanical ventilation system labeling to inform occupants and ensure more compliance with standards.

Biographical Sketch: Thomas W. Kirchstetter

Energy Technologies Area • Lawrence Berkeley National Laboratory
MS90-4026B, Berkeley, California 94720 • Phone: 510-486-7071 • Email: twkirchstetter@lbl.gov

Department of Civil and Environmental Engineering • University of California at Berkeley
655 Davis Hall, Berkeley, California 94720 • Phone: 510-908-1237 • Email: twkirchstetter@berkeley.edu

(a) Professional Preparation

Alexander Hollaender Distinguished Postdoctoral Fellow, LBNL, 1998 – 2000

Ph.D. Environmental Engineering, University of California at Berkeley, 1998

M.S. Environmental Engineering, University of California at Berkeley, 1994

B.S. Atmospheric Science and Mathematics, State University of New York at Albany, 1991

(b) Appointments

Lawrence Berkeley National Laboratory, Energy Analysis & Environmental Impacts Division

Senior Scientist and Scientific Division Director, 2017 – present

Primary steward of research, people, and safety of a scientific division of 160 researchers that connect science and technology with economics and policy by measuring and analyzing energy use and emissions to the environment and providing robust data-driven analysis that informs energy technology development and decision making in the implementation of energy technologies in the transportation, building, electricity, and manufacturing sectors

Previous appointments at Berkeley Lab
Department Head, Sustainable Energy and Environmental Systems, 2015 – 2020
Group Leader, Sustainable Energy Systems, 2015 – 2017
Staff Scientist, 2000 – 2018

University of California Berkeley, Department of Civil & Environmental Engineering

Adjunct Professor, 2018 – present

Teach environmental engineering courses • Lead world class research • Principal advisor of graduate student thesis research • PhD student exam committee service

Previous appointments at UC Berkeley: Associate Adjunct Professor, 2011 – 2018; Lecturer, 2005– 2011

Research interests*:* Air pollution science & technology: Pollutant emissions and controls • Climate and environmental impacts of transportation • Pollutant measurement technologies, development of low-cost sensors, and community air monitoring networks • Chemical and optical characterization of biomass burning and carbonaceous aerosols • Environmental impacts of municipal solid waste-to-energy

(c) Selected Other Professional Service and Synergistic Activities

- Co-founder and Chair of Oppenheimer Leadership Network, 2020 – present
- Member, LBNL Diversity, Equity and Inclusion, Division Director Accountability Committee, 2019
- Member, SMART Mobility Steering Committee, Vehicle Technologies Office, DOE, 2018 – 2020
- Editor, Aerosol Science and Technology Journal, 2013 – 2018
- Organizer, International Conference on Carbonaceous Particles in the Atmosphere, 2000 – 2018
- Contributor, EPA's Integrated Science Assessment for particulate patter welfare effects – 2016
- Editor, Journal of Atmospheric Chemistry and Physics, 2006 – 2013
- Member, Distinguished Lecture Series Committee, Lawrence Berkeley National Lab, 2011 – 2013

(d) Selected Honors

- Nominated Berkley Lab Participant, Oppenheimer Science & Energy Leadership Program, 2019
- R&D 100 Award Winner, Cool Roof Time Machine, 2017
- Outstanding Mentor Award, DOE, Office of Science Undergraduate Research Program, 2005
- Alexander Hollaender Distinguished Postdoctoral Fellowship, Department of Energy, 1998
- Golden West Section Graduate Scholarship, Air & Waste Management Association, 1994
- Science and Engineering Research Semester Award, Department of Energy, 1992

(e) Patents

- Patent 9,856,383, "Mixture and method for simulating soiling and weathering of surfaces" Inventors: Sleiman, M; Kirchstetter, T; Destaillats, H; Levinson, R; Berdahl, P; Akbari, H, Issued January 2018
- Patent 10,495,573, "Instrument for measuring airborne particulate matter" Inventors: Caubel JJ, Cados TE, Kirchstetter, TW, Issued December 2019

(f) Select Peer-Reviewed Journal Publications (out of 85 total)

(Google Scholar h-index = 49, citations = 10,300; Web of Science h-index = 43, citations = 7,000)

85. Singer, BC; Zhao, H; Preble, CV; Delp, WW; Pantelic, J; Sohn, MD; Kirchstetter, TK (2021), Measured Influence of Overhead HVAC on Exposure to Airborne Contaminants from Simulated Speaking in a Meeting and a Classroom, *Indoor Air,* doi.org/10.1111/ina.12917

79. Preble, CV; Harley, RA; Kirchstetter, TW (2019) Control Technology-Driven Changes to In-Use Heavy-Duty Diesel Truck Emissions of Nitrogenous Species and Related Environmental Impacts, *Environ. Sci. Technol.*, doi:10.1021/acs.est.9b04763

78. Caubel, JJ; Cados, TE; Preble, CV; Kirchstetter, TW (2019) A Distributed Network of 100 Black Carbon Sensors for 100 Days of Air Quality Monitoring in West Oakland, California, *Environ. Sci. Technol.*, doi:10.1021/acs.est.9b00282

73. Caubel, JJ; Cados, TE; Kirchstetter, TW (2018) A New Black Carbon Sensor for Dense Air Quality Monitoring Networks, *Sensors*, *18*, 738, doi.org/10.3390/s18030738

72. Apte, JS; Messier, KP; Gani, S; Brauer, M; Kirchstetter, TW; Lunden, MM; Marshall, JD; Portier, CJ; Vermeulen, RCH; Hamburg, SP (2017) High-resolution air pollution mapping with Google Street View cars: exploiting big data, *Environ. Sci. Technol*., doi: 10.1021/acs.est.7b00891

68. Preble, CV, Dallmann, TR; Kreisberg, NM; Hering, SV; Harley, RA; Kirchstetter, TW (2015) Effects of particle filters and selective catalytic reduction on heavy-duty diesel drayage truck emissions at the Port of Oakland, *Environ. Sci. Technol*., doi:10.1021/acs.est.5b01117

62. Thatcher, TL; Kirchstetter, TW; Malejan, CJ; Ward, CE (2014) Infiltration of black carbon particles from residential woodsmoke into nearby homes, *Open J. Air Poll., 3,* doi:10.4236/ojap.2014.34011.

54. Hadley, OL; Kirchstetter, TW (2012) Black carbon snow albedo reduction, *Nature Climate Change*, *2*, 437-440, doi: 10.1038/NCLIMATE1433.

51. Kirchstetter, TW; Thatcher, TL (2012) Contribution of organic carbon to wood smoke particulate matter absorption of solar radiation, *Atmos. Chem. Phys*., 12, 1-6, doi:10.5194/acp-12-1-2012.

31. Kirchstetter, T.W.; Novakov, T. (2007) Controlled generation of black carbon particles from a diffusion flame and applications in evaluating black carbon measurement methods. *Atmos. Environ*., *41*, 1874-1888, doi:10.1016/j.atmosenv.2006.10.067.

24. Kirchstetter, TW; Novakov, T; Hobbs, PV. (2004) Evidence that spectral light absorption by aerosols emitted from biomass burning and motor vehicles is different due to organic carbon. *J. Geophys. Res., 109*, D21208, doi:10.1029/2004JD004999.

BIOGRAPHICAL SKETCH

NAME	POSITION TITLE
Rupa Basu	Chief, Air and Climate Epidemiology Section
eRA COMMONS USER NAME (credential, e.g., agency login) rupabasu	

EDUCATION/TRAINING

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	MM/YY	FIELD OF STUDY
University of California, San Diego, CA	B.S.	06/94	Biology
University of California, Los Angeles, CA	M.P.H.	12/95	Environmental Health
The Johns Hopkins University, Baltimore, MD	Ph.D.	10/01	Epidemiology

A. Personal Statement

I am an epidemiologist and Chief of the Air and Climate Epidemiology Section at the Office of Environmental Health Hazard Assessment (OEHHA), California Environmental Protection Agency with over two decades of experience. My area of expertise is on health effects associated with climate change exposures, such as heat/temperature, air pollutants, and wildfire smoke, while identifying vulnerable subgroups to help prevention efforts. I also focus my research on current methodologic approaches for conducting epidemiologic studies, including the time-stratified case-crossover and times-series study designs. I have collaborated with external agencies such as the Scripps Institute of Oceanography and the Kaiser Division of Research as well as several statewide and national climate change investigators. I have been an invited guest speaker on many occasions from academic settings in addition to governmental leaders, such as former Governor Schwarzenegger. My work is widely cited and has received media attention, including *The New York Times*, *LA Times*, and NPR. I have served as a referee for many health journals and have reviewed several grant proposals and reports for federal and state governmental agencies.

B. Positions

POSITIONS

2002-2003	Environmental Scientist, U.S. Environmental Protection Agency, Washington, DC
2003-2005	Senior Scientist, Exponent Inc., Washington, DC and Oakland, CA
2005-2014	Research Scientist III, Office of Environmental Health Hazard Assessment, Oakland, CA
2014-	Section Chief, Air and Climate Epidemiology Section, Office of Environmental Health Hazard Assessment, Oakland, CA
2018	Lecturer for “Health Implications of Climate Change,” UC Berkeley School of Public Health, Berkeley, California

PROFESSIONAL AFFILIATIONS AND SERVICE

Professional society memberships: Society International Society for Environmental Epidemiology; Genetic and Environmental Toxicology Association; Society for Epidemiologic Research; Society for Paediatric and Perinatal Epidemiology; American Public Health Association

External committees: U.S. EPA Panel Reviewer for Coarse Particulates and Health Effects; U.S. EPA Panel Reviewer for STAR Fellowship/Global Change; NIH grant proposal reviewer for Temperature and Preterm Delivery; *USGCRP Review Editor for Climate and Health Assessment, Chapter on Temperature-Related Death and Illnesses; US EPA Panel Reviewer for Coarse Particulates and Health Effects*

Invited Committees: Climate Action Team (2008-), Heat adaptation workgroup (2011-), Governor’s climate change conference (2011), Mediterranean Climate Change Conference planning committee and co-chair public health session (2012-), US Climate and Health Alliance (2013-); outside reader for PhD thesis committees at Boston University (2020) and Monash University (2016)

HONORS AND AWARDS

Emmy award for “Years of Living Dangerously” climate change documentary (2014)

Mercury Rising episode featuring Matt Damon http://yearsoflivingdangerously.com/story/mercury-rising/
Travel awards to attend various meetings (2006-2019)
Valued author certificate from the *American Journal of Epidemiology (*2011)
Director's Award Awarded for outstanding achievement and recognition of peer-reviewed (2010)
publications at the Office of Environmental Health Hazard Assessment
"S" Award for superior research contributions at the U.S. Environmental Protection Agency (2003)
Johns Hopkins University Summer Epidemiology Program Grant for Dissertation Work (1999-2000)
Johns Hopkins University, Epidemiology Department tuition grant for doctoral studies (1998-2001)

C. Contributions to Science

1. Fine particulate matter and adverse health outcomes
   - Malig B, Fairley D, Pearson D, Wu X, Ebisu K, **Basu R.** Examining Fine Particulate Matter and Cause-Specific Morbidity During the 2017 North San Francisco Bay Wildfires. *Science of the Total Environment.* 787*,* 147507. https://doi.org/10.1016/j.scitotenv.2021.147507*,* 2021
   - Nguyen, A-M, Malig B, **Basu R**. The association between ozone and fine particles and mental health-related emergency department visits in California, 2005-2013. *PLOS One*. 16(4): e0249675, doi: 10.1371/journal.pone.0249675, 2021.
   - Sarovar V. Malig B. **Basu R**. A case-crossover study of short-term air pollution exposure and the risk of stillbirth in California, 1999-2009. *Environmental Research.* https://doi.org/10.1016/j.envres.2020.110103, 2020.
   - **Basu R**, Pearson D, Ebisu K, Malig B. Association between $PM_{2.5}$ and $PM_{2.5}$ constituents and preterm birth in California, 2000-2006. *Pediatric and Perinatal Epidemiology,* doi: 10.1111/ppe.12380, 2017.
   - Ostro B, Malig B, Broadwin R, **Basu R**, Gold E, Bromberger JT, Derby C, Feinstein S, Greendale GA, Jackson E, Kravitz HM, Matthews KA, Sternfeld B, Tomey K, Green RR, Green RS. Chronic $PM_{2.5}$ Exposure and inflammation: determining sensitive subgroups in mid-life women. *Environmental Research*, 132C:168-175, 2014.
2. Heat and adverse birth outcomes
   - Bekkar B, Pacheco S, **Basu R**, DeNicola N. Association of Air Pollution and Heat Exposure With Preterm Birth, Low Birth Weight, and Stillbirth in the US: A Systematic Review. *JAMA Netw Open*. 3(6):e208243. doi: 10.1001/jamanetworkopen.2020.8243, 2020.
   - **Basu R**, Chen H, Li D-K, Avalos LA. The impact of maternal factors on the association between temperature and preterm delivery. *Environmental Research,* 154:109-114. doi: 10.1016/j.envres.2016.12.017, 2017.
   - Sarovar, V, Malig B, **Basu R**. High ambient temperature exposure increases the risk of stillbirth in California. *American Journal of Epidemiology*, 183(10):894-901, 2016.
   - **Basu R**, Malig B, Ostro B. High ambient temperature and the risk of preterm delivery. *American Journal of Epidemiology*, 172(10):1108-17, 2010.
   - **Basu R**, Rau R, Pearson D, Malig B. Temperature and term low birth weight in California. *American Journal of Epidemiology*, 187(11):2306-2314, doi: 10.1093/aje/kwy116, 2018.
3. Heat and other health outcomes
   - **Basu R**, Gavin L, Pearson D, Ebisu K, Malig B. Examining the association between temperature and emergency room visits for mental health-related outcomes in California. *American Journal of Epidemiology*, 187(4):726-735. doi:10.1093/aje/kwx295, 2018.
   - **Basu R**, Ostro BD. A multi-county analysis identifying the populations vulnerable to mortality associated with high ambient temperature in California. *American Journal of Epidemiology*, 168(6): 632-7, 2008.
   - **Basu R**, Pearson D, Broadwin R. A case-crossover study of temperature and infant mortality in California. *Paediatric and Perinatal Epidemiology;* doi: 10.1111/ppe.12204, 2015.
   - **Basu R**, Pearson D, Malig B, Broadwin R, Green S. The effect of elevated ambient temperature on emergency room visits, *Epidemiology*, 23(6):813-20, 2012.

Other Support

Thakur, Neeta

EACB-23028 (Thakur) 12/1/2021-11/30/2023 5%
PCORI (Patient-Centered Outcomes Research Institute) $249,974/total
Building Capacity for Research to Address Climate-Impacted Health Conditions
Goals: Extreme heat and wildfire smoke events have significant health impacts in communities with the least economic, social, or political resources to respond. This project will engage a diverse group of stakeholders in San Francisco to understand priority health conditions, identify relevant patient-centered outcomes affected by climate, and collect information on the barriers to exisiting migration strategies.

#77655 (Thakur) 06/15/2020-06/30/2022 10%
Robert Wood Johnson Foundation $238,068/total
Project Title: Social and Economic Barriers to Public Health and Clinical Interventions for COVID-19 in Vulnerable Populations
Goals: To understand and address barriers to public health and clinical interventions for COVID-19 in vulnerable populations across ten sites in the US. Identifying key intervention targets will require detailed information regarding the drivers of barriers to both health care access and ability to self-isolate, with special attention to barriers to COVID-19 testing and treatment; telemedicine; and shelter in place regulation adherence.

G-88022(MPI: Thakur, Long) 8/1/2020-7/31/2022 3.5%
Genentech Foundation $500,000/total
Project Title: ACES and Resilience—from Biologic-Response to the Community (ARC)
Goals: Adverse Childhood Experiences (ACES) are associated with behavioral, mental and clinical outcomes in children. Tools that are easy to incorporate into pediatric practice, effectively screen for adversities and identify children at high risk for poor outcomes are lacking. We will establish methods for multiplex assays in diverse pediatric sample types and for telomere length.

OPR20142 (Thakur) 7/1/2021-6/30/2024 15%
California Governor's $2,988,695/total
Office of Planning and Research
The Collaborative Approach to Examining Adversity and Building Resilience (CARE) Program
Goals: While knowledge of ACEs impact on health has advanced rapidly, two critical gaps persist: 1) sufficient understanding of early childhood specific biological pathways, and 2) how to best bolster resilience. These gaps severely limit identification and effective intervention. To address this crisis, we need to move research and intervention development forward collaboratively and with community partnership, leveraging Precision Medicine. We plan to address these gaps.

Koret Foundation 9633 (Thakur) 09/01/2017-09/30/2022 5%
UC Berkeley $701,522/total
Title: The Koret Institute for Precision Prevention at the Berkeley Global Campus
Project Title: Richmond Environment and Asthma Community Health Study
Goals: UCSF is leading the Health Project of the Koret Institute for Precision Prevention (KIPP). The study will examine the social and environmental contributors to asthma in vulnerable populations.

K23HL12551-01A1 (Thakur) 1/01/2016-12/31/2021 13%
NIH/NHLBI $1,025,503/total
Title: Social Adversities and Asthma: A New Phenotype?
Goals: To define a profile of characteristics, which includes biomarker data, that will better identify individuals at high risk for poor asthma outcomes who are from communities burdened by social adversities.

K12 HL138046 (Bibbins-Domingo) 09/01/2017-06/30/2022 2%
NIH/NHLBI $2,907,100/total
UCSF Career Development Program in Implementation Research in Heart and Lung Diseases
Goals: To develop the careers of post-doctoral scholars interested in using implementation science to improve the delivery of evidence-based care for heart and lung diseases.
Role: Learner Health System Embedded Experience Director

PENDING

R01HL161049 (Thakur) 12/1/2021-11/30/2026 20%
NIH/NHLBI $3,824,076/total
Title: Rehabilitation in Safety-Net Environments (RISE) for COPD
Goals: Pulmonary rehabilitation is one of the few interventions that has been shown to effectively modify the course of Chronic Obstructive Pulmonary Disease (COPD) and improve health outcomes; however, challenges in implementation and access to this high resource intervention in real-life settings have led to low-availability and engagement due to both healthcare system-level and patient-level barriers. The proposed Type 1 effectiveness-implementation hybrid designed study will test an innovative low-resource, community-based pulmonary rehabilitation program (COPD Wellness) with social supports (Health Advocates) for patients with symptomatic COPD through a three-arm randomized waitlist-controlled trial.

United States
ENVIRONMENTAL PROTECTION AGENCY
Washington, DC 20460

OMB Control No. 2030-0020
Approval expires 04/30/2021

Current and Pending Support

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: John R. Balmes, MD

Other agencies (including NSF) to which this proposal has been/will be submitted.

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Northern California Education and Research Center

Source of Support: CDC/NIOSH
Total Award Amount: 8,995,000.00 Total Award Period Covered: 07/01/2015 to 06/30/2025
Location of Project: UC Berkeley School of Public Health
Person-Months Per Year Committed to the Project. Cal: 1.20 Acad: Sumr:

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: CHAPS Cohort Maintenance

Source of Support: NIEHS
Total Award Amount: 1,250,000.00 Total Award Period Covered: 02/15/2020 to 02/14/2025
Location of Project: UC Berkeley School of Public Health
Person-Months Per Year Committed to the Project. Cal: 0.60 Acad: Sumr:

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: AIM to Improve Asthma in Meal prep

Source of Support: NIEHS
Total Award Amount: 416,928.00 Total Award Period Covered: 03/18/2020 to 12/31/2021
Location of Project: UC Berkeley School of Public Health
Person-Months Per Year Committed to the Project. Cal: 0.60 Acad: Sumr:

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Sustainable Household Energy Adoption in Rwanda [SHEAR]: Promoting Rural Health with Solar and Gas

Source of Support: NIEHS; subcontract from Colorado State University
Total Award Amount: 106,667.00 Total Award Period Covered: 09/15/2019 to 05/31/2024
Location of Project: UCSF
Person-Months Per Year Committed to the Project. Cal: 0.48 Acad: Sumr:

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Interventions and Communication Strategies to Reduce Health Risks of Wildland Fire Smoke Exposures

Source of Support: EPA; subcontract from Public Health Institute (PHI) $994,482
Total Award Amount: Total Award Period Covered: 10/01/2021 to 09/30/2024
Location of Project: PHI
Person-Months Per Year Committed to the Project. Cal: 0.60 Acad: Sumr:

*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

United States
ENVIRONMENTAL PROTECTION AGENCY
Washington, DC 20460

OMB Control No. 2030-0020
Approval expires 04/30/2021

Current and Pending Support

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: Stephanie M. Holm

Other agencies (including NSF) to which this proposal has been/will be submitted.

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Children's Health and Air Pollution Study (CHAPS)

Source of Support: National Institute of Environmental Health Sciences
Total Award Amount: 1,250,000.00 Total Award Period Covered: 02/14/2020 to 11/29/2024
Location of Project: UC Berkeley
Person-Months Per Year Committed to the Project. Cal: 2.00 Acad: Sumr:

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Air-Quality Improvements during Meal-Prep to Improve Asthma (AIM to improve Asthma)

Source of Support: National Institute of Environmental Health Sciences
Total Award Amount: 275,000.00 Total Award Period Covered: 03/31/2020 to 12/30/2022
Location of Project: UC Berkeley
Person-Months Per Year Committed to the Project. Cal: 1.00 Acad: Sumr:

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Western States Pediatric Environmental Health Specialty Unit

Source of Support: Subcontract from American Academy of Pediatrics (funded via cooperative agreement with ATSDR and US EPA)
Total Award Amount: 171,000.00 Total Award Period Covered: 09/21/2020 to 08/31/2021
Location of Project: UC San Francisco
Person-Months Per Year Committed to the Project. Cal: 3.60 Acad: Sumr:

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Participatory design of effective risk communication about wildfire smoke for hard-to-reach populations

Source of Support: Environmental Protection Agency, STAR Grant
Total Award Amount: 259,812.00 Total Award Period Covered: 09/01/2021 to 02/29/2024
Location of Project: UC Berkeley
Person-Months Per Year Committed to the Project. Cal: 0.60 Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal:

Source of Support:
Total Award Amount: Total Award Period Covered: to
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

United States
ENVIRONMENTAL PROTECTION AGENCY
Washington, DC 20460

OMB Control No. 2030-0020
Approval expires 06/30/2024

Current and Pending Support

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: Rosemarie de la Rosa, PhD, MPH

Other agencies (including NSF) to which this proposal has been/will be submitted.

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: The Collaborative approach to examining Adversity and building Resilience Program

Source of Support: California Governor's Office of Planning and Research; subcontract from UCSF
Total Award Amount: 42,729.00 Total Award Period Covered: 07/02/2021 to 06/30/2024
Location of Project: UC Berkeley School of Public Health
Person-Months Per Year Committed to the Project. Cal: 0.76 Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal:

Source of Support:
Total Award Amount: Total Award Period Covered: to
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal:

Source of Support:
Total Award Amount: Total Award Period Covered: to
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal:

Source of Support:
Total Award Amount: Total Award Period Covered: to
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal:

Source of Support:
Total Award Amount: Total Award Period Covered: to
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

PHS OTHER SUPPORT

*Name of Individual: Elizabeth Noth
Commons ID: ELIZABETHNOTH

Other Support – Project/Proposal

*Title: CHAPS Cohort Maintenance

*Major Goals: The major goal of this project is to continue longitudinal follow-up of the participants in the Children's Health and Air Pollution Study (CHAPS), an epidemiological study that has focused on the effects of air pollution on children growing up in the San Joaquin Valley of California, one of the most polluted areas in the country.

*Status of Support: Active

Project Number: R24ES030888
Name of PD/PI: John Balmes, Nina Holland and Elizabeth Noth (multiple-PI project)

*Source of Support: NIH

*Primary Place of Performance: UC Berkeley, Berkeley, CA

Project/Proposal Start and End Date: (MM/YYYY) (if available): 2/15/2020-11/30/2024

* Total Award Amount (including Indirect Costs):$1,922,554

* Person Months (Calendar/Academic/Summer) per budget period.

Year (YYYY)	Person Months (##.##)
1. 2/15/20 -11/30/20	1.20 Calendar
2. 12/1/20 -11/30/21	1.20 Calendar
3. 12/1/21-11/30/22	1.20 Calendar
4. 12/1/22-11/30/23	1.20 Calendar
5. 12/1/23-11/30/24	1.20 Calendar

Title: Total Exposures to Air Pollutants and Noise in Disadvantaged Communities

*Major Goals: This study will be the first in California to measure indoor and outdoor noise levels concurrent with air quality and develop cumulative exposure metrics characterizing exposures to mixtures of air pollutants and noise. The information collected will foster unique insight into how disparities in air quality and noise exposures affect the health of California residents in disadvantaged communities.

*Status of Support: Active

Project Number: 20RD012
Name of PD/PI: Elizabeth Noth

*Source of Support: California Air Resources Board

*Primary Place of Performance: UC Berkeley, Berkeley, CA

Project/Proposal Start and End Date: (MM/YYYY) (if available): 04/01/2021-03/31/2023

* Total Award Amount (including Indirect Costs):$799,981

* Person Months (Calendar/Academic/Summer) per budget period.

Year (YYYY)	Person Months (##.##)
1. 04/01/21-03/31/22	2.4 Calendar
2. 04/01/22-03/31/23	2.4 Calendar
3.	
4.	
5.	

Title: Wildfires and Intentional Biomass Burning in California and Preterm Birth

*Major Goals: Our overall goal is to study how mothers' exposures to wildfire and intentional biomass burning(i.e. prescribed burns, agricultural fires and residential wood burning) during pregnancy may affect whether her baby is born prematurely. We will also evaluate the role of neighborhood deprivation and race/ethnicity may modify the relationship between fire exposures and preterm birth.

*Status of Support: Active

Project Number: 12153sc
Name of PD/PI: Elizabeth Noth

*Source of Support: UC San Francisco/NIH

*Primary Place of Performance: UC Berkeley, Berkeley, CA

Project/Proposal Start and End Date: (MM/YYYY) (if available): 6/17/2020 – 3/30/2022

* Total Award Amount (including Indirect Costs):$149,025

* Person Months (Calendar/Academic/Summer) per budget period.

Year (YYYY)	Person Months (##.##)
1. 6/17/20-3/30/21	1.5 Calendar
2. 6/17/21-3/30/22	1.5 Calendar
3.	
4.	
5.	

Title: Pilot Air Quality Study for an AB617 Community (PAQS-AB617)

*Major Goals: The goal of this Pilot Air Quality Study in an AB 617 community is to measure ambient concentrations of selected airborne polycyclic aromatic hydrocarbons (PAHs) at appropriate locations to complement the targeted biomonitoring study being carried out the Office of Environmental Health Hazard Assessment (OEHHA).

*Status of Support: Active

Project Number: 19-E0020
Name of PD/PI: Elizabeth Noth

*Source of Support: California Office of Environmental Health Hazard Assessment

*Primary Place of Performance: UC Berkeley, Berkeley, CA

Project/Proposal Start and End Date: (MM/YYYY) (if available): 5/1/2020 – 4/30/2022

* Total Award Amount (including Indirect Costs):$49,999

* Person Months (Calendar/Academic/Summer) per budget period.

Year (YYYY)	Person Months (##.##)
1. 5/1/20- 6/30/20	0.5 Calendar
2. 7/1/20- 6/30/21	0.75 Calendar
3. 7/1/21- 6/30/22	0.5 Calendar
4.	
5.	

Title: Intergovernmental Personnel Agreement: Wildland Firefighter Exposure to Smoke and COVID-19

*Major Goals: The goal of this project is to deploy the Wildland Firefighter Exposure to Smoke and COVID-19 research questionnaire to assess exposures to both smoke and covid-19 via self-report by wildland firefighters.

*Status of Support: Active

Project Number: 21IPA2116214
Name of PD/PI: Elizabeth Noth

*Source of Support: DHHS CDC Centers for Disease Control

*Primary Place of Performance: UC Berkeley, Berkeley, CA

Project/Proposal Start and End Date: (MM/YYYY) (if available): 6/1/2021 – 5/31/2022

* Total Award Amount (including Indirect Costs):$17,000

* Person Months (Calendar/Academic/Summer) per budget period.

Year (YYYY)	Person Months (##.##)
1. 6/1/21- 5/31/22	1.35 Calendar
2	
3.	
4.	
5.	

Title: Disease, Disability and Death in an Aging Workforce

*Major Goals: To assess the impact on health and function of ubiquitous physical hazards in the work environment as they relate to the preventable causes of the major chronic diseases of working age adults—ischemic heart disease, asthma, musculoskeletal disorders and COPD.

*Status of Support: Active

Project Number: 61624544-45510
Name of PD/PI: Ellen Eisen

*Source of Support: Stanford University/NIH

*Primary Place of Performance: UC Berkeley, Berkeley, CA

Project/Proposal Start and End Date: (MM/YYYY) (if available): 8/1/2017 – 5/31/2022

* Total Award Amount (including Indirect Costs):$844,050

* Person Months (Calendar/Academic/Summer) per budget period.

Year (YYYY)	Person Months (##.##)
1. 8/1/17 – 5/31/18	2.0 Calendar
2. 06/01/18-5/31/19	2.0 Calendar
3. 06/01/19-5/31/20	1.5 calendar months
4. 06/01/20-5/31/21	0.9 calendar
5. 05/31/21-5/31/22	0.6 calendar

Title: Occupational Safety and Health Educational and Research Centers

*Major Goals: The award supports a consortium of occupational health and safety training programs.

*Status of Support: Active

Project Number: 2 T42OH008429
Name of PD/PI: John Balmes

*Source of Support: DHHS CDC Center for Disease Control

*Primary Place of Performance: UC Berkeley, Berkeley, CA

Project/Proposal Start and End Date: (MM/YYYY) (if available): 7/1/2020-6/30/2025

* Total Award Amount (including Indirect Costs):$3,593,139

* Person Months (Calendar/Academic/Summer) per budget period.

Year (YYYY)	Person Months (##.##)
1. 7/1/20-6/30/21	2.4 Calendar
2. 7/1/21-6/30/22	2.4 Calendar
3. 7/1/22-6/30/23	2.4 Calendar

Year (YYYY)	Person Months (##.##)
4. 7/1/23-6/30/24	2.4 Calendar
5. 7/1/24-6/30/25	2.4 Calendar

Title: Air Pollution Measurements, Exposure Assessment, and Evaluation of the Sources of Particulate Matter in Fresno, CA

*Major Goals: The objectives of this study are to a) understand the sources of particulate matter (PM) exposures to residents of Fresno and Clovis and b) estimate concentrations of polycyclic aromatic hydrocarbons (PAH), black carbon (BC), brown carbon (BrC), and PM from each of these sources at the neighborhood level. We will focus on disentangling the sources of PM exposures (PM originating from traffic-related sources from other combustion sources, e.g., residential wood burning, agricultural burning, prescribed burns, and wildfires.

*Status of Support: Active

Project Number: 19RD003
Name of PD/PI: S Katherine Hammond

*Source of Support: California Air Resources Board

*Primary Place of Performance: UC Berkeley, Berkeley, CA

Project/Proposal Start and End Date: (MM/YYYY) (if available): 5/1/2020 – 4/20/2023

* Total Award Amount (including Indirect Costs):$300,000

* Person Months (Calendar/Academic/Summer) per budget period.

Year (YYYY)	Person Months (##.##)
1. 5/1/20-4/30/21	2.4 Calendar
2. 5/1/21-4/30/22	2.4 Calendar
3. 5/1/22-4/30/23	2.4 Calendar
4.	
5.	

Title: Sports Injury Epidemiology: Impact of Episodic Environmental Events on Acute Health in Student Athletes

*Major Goals: To enhance an understanding of adverse health outcomes among student athletes from increased ambient temperatures and episodic air pollution exposures, we propose to assess the impact of two types of environmental exposures – heat waves and unusually high air pollution episodes.

*Status of Support: Pending

Project Number: UCB 20220875
Name of PD/PI: Elizabeth Noth

*Source of Support: PAC-12 Conference

*Primary Place of Performance: UC Berkeley, Berkeley, CA

Project/Proposal Start and End Date: (MM/YYYY) (if available): 7/1/2022 – 6/30/2025

* Total Award Amount (including Indirect Costs):$446,457

* Person Months (Calendar/Academic/Summer) per budget period.

Year (YYYY)	Person Months (##.##)
1. 7/1/22-6/30/23	2.7 Calendar
2. 7/1/23-6/30/24	3 Calendar
3. 7/1/24-6/30/25	3 Calendar
4.	
5.	

Title: Covid-19: Individual-level Air Pollution and SARS-CoV-2 Infection in Fresno, California

*Major Goals: The goal of the study is to understand the role that air pollution exposure plays in risk of SARS-CoV-2 infection.

*Status of Support: Pending

Project Number: UCB 20210781
Name of PD/PI: John R. Balmes and Elizabeth Noth (Multiple-PI project)

*Source of Support: NIH-NIEHS

*Primary Place of Performance: UC Berkeley, Berkeley, CA

Project/Proposal Start and End Date: (MM/YYYY) (if available): 11/1/2020 – 10/31/2022

* Total Award Amount (including Indirect Costs):$428,337

* Person Months (Calendar/Academic/Summer) per budget period.

Year (YYYY)	Person Months (##.##)
1. 11/1/20-10/31/21	3.00 Calendar
2. 11/1/21-10/31/22	1.20 Calendar
3.	
4.	
5.	

IN-KIND

*Summary of In-Kind Contribution: None

***Overlap** (summarized for each individual):

There is no scientific or budgetary overlap, any commitment overlap will be addressed prior to the funding of this application.

I, PD/PI or other senior/key personnel, certify that the statements herein are true, complete and accurate to the best of my knowledge, and accept the obligation to comply with Public Health Services terms and conditions if a grant is awarded as a result of this application. I am aware that any false, fictitious, or fraudulent statements or claims may subject me to criminal, civil, or administrative penalties.

*Signature: 

Date: 11/2/2021

United States
ENVIRONMENTAL PROTECTION AGENCY
Washington, DC 20460

OMB Control No. 2030-0020
Approval expires 06/30/2024

Current and Pending Support

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: Fotini Chow

Other agencies (including NSF) to which this proposal has been/will be submitted.

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Collaborative Research: Perdigao--The Stable Boundary Layer over Complex Terrain

Source of Support: NSF National Science Foundation
Total Award Amount: 368,827.00 Total Award Period Covered: 07/01/2016 to 06/30/2022
Location of Project: UC Berkeley
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr: 0.05

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal:

Source of Support:
Total Award Amount: Total Award Period Covered: to
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal:

Source of Support:
Total Award Amount: Total Award Period Covered: to
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal:

Source of Support:
Total Award Amount: Total Award Period Covered: to
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal:

Source of Support:
Total Award Amount: Total Award Period Covered: to
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

OTHER SUPPORT

Chan, Wanyu

None

United States
ENVIRONMENTAL PROTECTION AGENCY
Washington, DC 20460

OMB Control No. 2030-0020
Approval expires 06/30/2024

Current and Pending Support

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: Thomas Kirchstetter	Other agencies (including NSF) to which this proposal has been/will be submitted.

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: An Integrated Framework to Guide Improvements in Air Quality at Community, Urban and Regional Scales

Source of Support: California Air Resources Board
Total Award Amount: 50,000.00 Total Award Period Covered: 03/20/2021 to 09/19/2022
Location of Project: University of California, Berkeley
Person-Months Per Year Committed to the Project. Cal: 0.00 Acad: Sumr:

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Assessment of Regulatory Air Pollution Dispersion Models to Quantify the Impacts of Transportation Sector Emissions.

Source of Support: ICF International, Inc.
Total Award Amount: 150,000.00 Total Award Period Covered: 06/12/2020 to 12/31/2020
Location of Project: University of California, Berkeley
Person-Months Per Year Committed to the Project. Cal: 0.00 Acad: Sumr:

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Richmond Air Monitoring Network Phase II: Black Carbon and Particulate Matter Characterization

Source of Support: PSE Healthy Energy
Total Award Amount: 150,500.00 Total Award Period Covered: 07/01/2020 to 06/30/2023
Location of Project: University of California, Berkeley
Person-Months Per Year Committed to the Project. Cal: 0.00 Acad: Sumr:

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: San Joaquin Valley Black Carbon Monitoring

Source of Support: Central California Asthma Collaborative
Total Award Amount: 60,000.00 Total Award Period Covered: 08/01/2020 to 01/01/2022
Location of Project: University of California, Berkeley
Person-Months Per Year Committed to the Project. Cal: 0.00 Acad: Sumr:

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Plume Capture Measurement of Vehicle Emissions at the Caldecott Tunnel for Heavy-Duty Emission Program Development and Verification

Source of Support: California Air Resources Board
Total Award Amount: 449,571.00 Total Award Period Covered: 02/01/2021 to 01/31/2025
Location of Project: University of California, Berkeley
Person-Months Per Year Committed to the Project. Cal: 2.00 Acad: Sumr:

*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

OTHER SUPPORT

Basu, Rupa

None

Dr. Rupa is a State of California employee and does not have Support from other entities.

Letters of Support

Co-Investigators

University of California, Berkeley

- Drs. de la Rosa, Chow, Noth

Lawrence Berkeley National Laboratory

- Drs. Chan and Kirchstetter

Office of Environmental Health Hazard Assessment

- Dr. Basu

Community Partners

Fresno, CA

- Central California Asthma Coalition

Richmond, CA

- Contra Costa Health System
- Dr. Omotoso

San Francisco, CA

- San Francisco Department of Public Health
- San Francisco Office of Resilience and Capital Planning
- Brightline

Scientific Consultant

Cooperative Institute for Research in Environmental Sciences

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Rosemarie de la Rosa, PhD MPH
Assistant Professor of Environmental Health Sciences
UC Berkeley, School of Public Health

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Email: rmd1025@berkeley.edu

November 4, 2021

Dear Dr. Thakur,

Re: EPA STAR application 'Partnering for Resilient Opportunities To Eliminate Cumulative Toxic (PROTECT) Health Effects from Wildfire $PM_{2.5}$ in Environmental Justice Communities'

This letter is to express my strong support for your important proposal, "**Partnering for Resilient Opportunities To Eliminate Cumulative Toxic (PROTECT) Health Effects from Wildfire $PM_{2.5}$ in Environmental Justice Communities**". My research examines the role of social determinants in shaping susceptibility to the toxic effects of environmental exposures. I have specific expertise in toxicology and molecular epidemiology. I have also published on assessing the cumulative effect of chemical and non-chemical stressors on human health. As you know, we are long-standing collaborators on the Richmond Environment and Asthma Community Health (REACH) Study, which aims to determine the combined role of intrinsic factors and extrinsic factors (e.g. psychosocial stress and environmental chemical) on asthma burden in adolescents. I am also a Co-Investigator on your project "A Collaborative approach to examining Adversity and building Resilience (CARE) Program" funded by the California Governor's Office, where my role is to examine biomarkers of toxic stress and resilience. We also recently reviewed in the *Journal of Allergy and Clinical Immunology* how structural racism contributes to disparities in asthma and atopic disease burden. I look forward to extending our collaborations through this project investigating the cumulative health effects from climate change in high-burden communities across California.

Dr. Noth also has ongoing collaborations with both Drs. Thakur and Kirchstetter. Dr Noth has worked together on the REACH study with Dr. Thakur, in gathering time-location data from participants as well as an on-going exposure assessment for outdoor air pollutants. Dr. Noth is currently collaborating with Dr. Kirchstetter on the San Joaquin Valley Pollution and Health Environment (SPHERE) study, in which they will characterize indoor and outdoor air pollution and noise exposures to children and adults in San Joaquin Valley communities that have high burdens of environmental toxins and noise. Dr. Noth will extend this expertise in exposure assessment to the current project.

Dr. Chow has expertise in modeling high-resolution smoke forecasting and will provide technical and scientific assistance to this project.

Our collective expertise will help provide guidance in the implementation, analysis, and interpretation of our research findings to ensure the success of the proposed project.

Sincerely,

Rosemarie de la Rosa, PhD, MPH

Energy Technologies Area

November 16, 2021

Neeta Thakur, MD
Assistant Professor
School of Medicine
University of California San Francisco

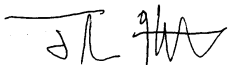
Subject: Support for your EPA-G2021-STAR-H1 proposal/project

Dear Dr. Thakur,

We are excited to support your proposal titled Partnering for Resilient Opportunities To Eliminate Cumulative Toxic (PROTECT) Health Effects from Climate Change in Environmental Justice Communities. The proposed objectives to understand how buildings mitigate exposures to wildfire smoke and to engage with community groups to identify mitigation strategies fall within our active areas of research expertise. Should EPA award you a grant to conduct this research, we will be willing participants. We understand that, as employees of Berkeley Lab (an FFRDC), we cannot receive salary from the grant. Nonetheless, we look forward to advising the research team throughout the project.

Sincerely,

Wanyu (Rengie) Chan
Deputy, Indoor Environment Group, Berkeley Lab



Thomas Kirchstetter
Director, Energy Analysis & Environmental Impacts Division, Lawrence Berkeley National Laboratory
Adjunct Professor, Civil & Environmental Engineering Department, UC Berkeley
510-908-1237; twkirchstetter@lbl.gov, twkirchstetter@berkeley.edu

CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF ENVIRONMENTAL HEALTH HAZARD ASSESSMENT

Lauren Zeise, Ph.D., Director
Jared Blumenfeld, Secretary for Environmental Protection
Gavin Newsom, Governor

November 4, 2021

Neeta Thakur, MD, MPH
Assistant Professor
UCSF Pulmonary and Critical Care Medicine

Dear Dr. Thakur,

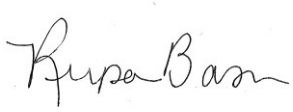
As the Chief of the Air and Climate Epidemiology Section of the Office of Environmental Health Hazard Assessment (OEHHA) at the California Environmental Protection Agency, it is with great pleasure that I extend this letter of support for your application *Partnering for Resilient Opportunities to Eliminate Cumulative Toxic (PROTECT) Health Effects from Climate Change* to the EPA.

OEHHA is the lead state agency for the assessment of health risks posed by environmental contaminants. OEHHA's mission is to protect and enhance the health of Californians and our state's environment through scientific evaluations that inform, support, and guide regulatory and other actions. Your proposal to the US EPA will further our understanding of the risk of exposure from wildfire smoke $PM_{2.5}$, in terms of intensity and duration, health effects across communities in California and possible effect modification by housing attributes (e.g., age of the building, date of retrofitting), building evidence for a promising mitigation strategy. Furthermore, this proposed study will provide important information regarding which mitigation strategies address community needs and are viewed as acceptable by residents that are affected by wildfire smoke $PM_{2.5}$ and disproportionately burdened. This study aligns with our goals at OEHHA and will provide important learning opportunities and models to public health programs.

I am committed to my role as a Co-Investigator for this proposed study. I have over two decades of research experience in environmental epidemiology, and I have specifically focused on identifying vulnerable subgroups from climate change and adverse health outcomes. I will provide comments on the study design of the proposed health analyses so that your study results will help answer important gaps in our understanding of wildfire and health research. The findings will also be valuable for targeting high-risk communities and have direct practical applications by helping provide state guidelines for preventive and mitigation efforts.

I am delighted to be included in this innovative and impactful proposal. I am confident that, if funded, your proposed work will contribute to California's aim of achieving better health outcomes and to the state's health equity goals for wildfire research.

Sincerely,



Rupa Basu, PhD, MPH
Chief, Air and Climate Epidemiology Section
Cal EPA/OEHHA
1515 Clay Street, 16th floor
Oakland, CA 94612
Rupa.Basu@oehha.ca.gov; phone (510) 622-3156

CENTRAL CALIFORNIA ASTHMA COLLABORATIVE

November 15, 2021

Neeta Thakur, MD, MPH
UCSF Assistant Professor
UCSF PRISE Center

Re: EPA-G2021-STAR-H1: Cumulative Health Impacts at the Intersection of Climate Change, Environmental Justice, and Vulnerable Populations/ Lifestages: Community-Based Research for Solutions

Dear Dr. Thakur:

We at the Central California Asthma Collaborative (CCAC) are enthusiastic about your application entitled **Partnering for Resilient Opportunities To Eliminate Cumulative Toxic (PROTECT) Health Effects from Wildfire $PM_{2.5}$ in Environmental Justice Communities.** Your proposal will improve our understanding of the health risks associated with wildfire smoke $PM_{2.5}$ – including much needed information on how building characteristics affect penetration of smoke indoors.

At CCAC, we promote sustainability and empowerment of low-income, disadvantaged communities within the San Joaquin Valley of California, one of the most polluted regions in the country. For over 10 years CCAC has been recognized as a leading voice for social and environmental justice in Fresno and the San Joaquin Valley. CCAC has played a significant role in developing both community capacity to participate in local, regional, and state activities targeting climate change, but also both provided and facilitated development of health focused interventions to mitigate or eliminate climate related health exposures in low income and communities of color in the region. We have worked with low-income residents of Fresno to improve their understanding of impacts that air pollution and climate change, including increasing exposures to wildfire smoke, have on their health. As you know, this community has higher burden of chronic medical conditions and little access to indoor air filtration and personal protective equipment. We have worked with Dr. John Balmes on research projects in the Fresno community for many years and are pleased that he has connected us to you.

We are especially interested in the interested in the information that will be generated from your community engagement and hope to partner with you on carrying out these efforts in our local communities in Fresno. Developing formal partnerships with community stakeholders to improve our understanding of barriers while identifying acceptable community-level interventions is key in our ability to our plan to mitigate the effects of poor air quality. This study aligns with our goals at CCAC and will provide important learning opportunities regarding community preferences and barriers to existing mitigation efforts.

CCAC is pleased to support and endorse this proposal. We look forward to the potential to partner with you on this project. Please do not hesitate to contact me directly with any questions.

Sincerely,

Kevin D Hamilton, RRT, ACS

ANNA M. ROTH, RN, MS, MPH
HEALTH SERVICES DIRECTOR

DAN PEDDYCORD, RN, MPA/HA
CHIEF CLIMATE & HEALTH POLICY OFFICER

CONTRA COSTA
HEALTH SERVICES

CONTRA COSTA
PUBLIC HEALTH
597 CENTER AVENUE, SUITE 200
MARTINEZ, CALIFORNIA 94553
PH (925) 222-1472
FAX (925) 313-6721
DANIEL.PEDDYCORD@CCHEALTH.ORG

Neeta Thakur, MD, MPH
UCSF Assistant Professor
UCSF PRISE Center Subspecialty Program Director

Re: Funding Opportunity: EPA-G2021-STAR-H1

Dear Dr. Neeta Thakur:

Contra Costa Health Services (CCHS) is pleased to support the application of The University of California, San Francisco (UCSF) entitled **Partnering for Resilient Opportunities To Eliminate Cumulative Toxic (PROTECT) Health Effects from Climate Change.**

We have recently launched a Climate and Health initiative at CCHS, which is focused on building public health capacity to effectively and equitably identify and mitigate the health impacts of climate change. This initiative will identify ways to reduce the carbon footprint of CCHS, implement programs and policies to enable CCHS to help our clients reduce their carbon footprint and adapt to the impacts of climate change, and advocate for policies and practices in the County and the region that address the disproportionate impacts that climate change will have on vulnerable populations. Specifically related to this grant application, we are in the second year of a Green and Healthy Homes program designed to assist MediCal patients with moderate to severe asthma. This program provides in-home asthma trigger and energy efficiency assessments and then deploys mitigation measures that will address the impacts of wildfire smoke.

We very much support the work proposed in this study as it will further our understanding of the extent of the health risks associated with wildfire smoke $PM_{2.5}$ and provide much needed evaluation information on mitigation efforts. In addition to the health effect data that will come from this study, we are specifically interested in the information that will be generated from the community engagement and outreach efforts. Developing formal partnerships with community stakeholders to improve our understanding of barriers while identifying acceptable community-level interventions is key in our ability to our plan to mitigate the effects of poor air quality. This study aligns with our goals at CCHS and will provide important learning opportunities and models to public health programs such as ours.

CCHS is pleased to support and endorse this proposal. We look forward to working with UCSF on this project. Please do not hesitate to contact me directly with any questions.

Sincerely,

Daniel Peddycord

Daniel W. Peddycord RN MPA/HA

Chief Climate and Health Policy Officer

Contra Costa Health Services

, MD

Chris Farnitano, MD

County Health Officer

Contra Costa Health Services

November 15, 2021.

Neeta Thakur, MD, MPH
UCSF Assistant Professor
UCSF PRISE Center

Re: EPA-G2021-STAR-H1: Cumulative Health Impacts at the Intersection of Climate Change, Environmental Justice, and Vulnerable Populations/ Life Stages: Community-Based Research for Solutions

Dear Dr. Neeta Thakur,

I, Dr. Omoniyi Omotoso, am thrilled to build on ongoing collaborative work over the past five years and fully support your application entitled "**Partnering for Resilient Opportunities To Eliminate Cumulative Toxic (PROTECT) Health Effects from Climate Change.**" Your proposal will improve our understanding not only of the health risks associated with wildfire smoke $PM_{2.5}$ – but also much needed information on how to address barriers to the adoption of mitigation strategies here in our community in Richmond, California. As you know, this community has a higher burden of chronic medical conditions, little access to indoor air filtration, and is also disproportionately burdened by environmental pollution and social stress.

Over the past five years in Richmond, we have been partnering on community-based research. Most relevant to this proposal, is our joint support of the Youth Participatory Action Research (YPAR) Internship as part of the Richmond Environment Asthma Community Health (REACH) Study. For the past three years, we have hired four to six local high school students who are residents of the Richmond community and also patients at Lifelong Medical Care, where I serve as the Associate Medical Director of Pediatrics. Empowering youth with research skills has enriched the REACH study with community perspective and has identified important areas for further exploration. Recently, as you know, these students were successful in obtaining a mini-grant from the Air District to better understand the sources of environmental pollution in the community, complimenting their work during the YPAR Internship that identified barriers to safe, recreational spaces in Richmond. We have also partnered on related efforts to address social needs coupled with resource navigation and linkage in the primary care setting, with this work being currently being funded by a California State grant.

Recently as a means to further leverage our community partnerships and clinical expertise, I joined the Community Emissions Reduction Plan (CERP) Steering Committee. This CERP Steering Committee was formed under Assembly Bill 617 for the Richmond, North Richmond and San Pablo communities. Our CERP Steering Committee's is a community-led initiative for strategies to reduce harmful air pollution impacts on the quality of life of people who live, work, play and pray in Richmond. As you can see, these goals closely align with the proposed EPA application and I can connect other Richmond community stakeholders in partnership.

I am pleased to endorse and fully support this proposal. I look forward to partnering with you on this project. Please do not hesitate to contact me directly with any questions.

Sincerely,

Omoniyi Omotoso, MD, MPH, FAAP

LifeLong Medical Care Associate Medical Director of Pediatrics

Vice Chair, Alta Bates Department of Pediatrics

San Francisco Department of Public Health
Grant Colfax, MD
Director of Health

City and County of San Francisco
London N. Breed
Mayor

November 16, 2021

Neeta Thakur, MD, MPH
UCSF Assistant Professor
UCSF PRISE Center Subspecialty Program Director

Re: Funding Opportunity: EPA-G2021-STAR-H1

Dear Dr. Thakur:

The San Francisco Department of Public Health (SFDPH) is pleased to support the application of The University of California, San Francisco (UCSF) entitled **Partnering for Resilient Opportunities To Eliminate Cumulative Toxic (PROTECT) Health Effects from Climate Change.**

Over the last several years, SFDPH has led efforts to build public health capacity to effectively and equitably identify the health impacts of climate change. SFDPH has spent considerable time identifying the populations most vulnerable to climate-related health impacts; this work has included the development of maps, data tools, and planning to identify the communities that carry the heaviest health burden due to extreme heat and poor air quality. Though these communities are the most exposed to climate-impacted health conditions, they are the least likely to have the economic, social, or political resources to prepare for and respond to them. In response to the critical need to implement community-level interventions to mitigate the negative health effects exacerbated by climate change, SFDPH launched the Heat and Air Quality Resilience Project (HAQR). HAQR includes all municipal departments involved in emergency preparedness and response services, housing, and infrastructure. The purpose of HAQR is to bring together key City departments to align objectives, share data and collaboratively strategize how to improve the city-wide response to extreme heat and air quality issues, especially among vulnerable populations. SFDPH sits on the HAQR Project leadership team and plays an essential role by chairing the coordinating committee, serving as the point of contact for implementation teams and regularly drafting reports on project status.

In partnership with you, we recently received funding from PCORI to formally incorporate into HAQR voices from community residents and advocacy groups living in neighborhoods disproportionally impacted by extreme heat and poor air quality. With this community stakeholder group, we hope to assess for barriers and identify acceptable community-level interventions to mitigate extreme health and poor air quality. This proposal is a potential extension of this work. Specifically, this grant would accelerate this engagement work forward at an unprecedent pace and

San Francisco Department of Public Health
Grant Colfax, MD
Director of Health

City and County of San Francisco
London N. Breed
Mayor

allow for the co-development of mitigation strategies that address both the immediate threats of Wildfire $PM_{2.5}$ and the chronic environmental pollution that also burdens vulnerable communities in San Francisco.

SFDPH is pleased to support and endorse this proposal. We look forward to collaborating with UCSF on this project if it is funded.

Sincerely,

Grant Colfax, MD
Director of Health

City & County of San Francisco
London N. Breed, Mayor

Office of the City Administrator
Carmen Chu, City Administrator
Brian Strong, Chief Resilience Officer & Director,
Office of Resilience and Capital Planning

Neeta Thakur, MD, MPH
UCSF Assistant Professor
UCSF PRISE Center Subspecialty Program Director

Re: Funding Opportunity: EPA-G2021-STAR-H1, Cumulative Health Impacts at the Intersection of Climate Change, Environmental Justice, and Vulnerable Populations/ Lifestages: Community-Based Research for Solutions

Dear Dr. Thakur:

The San Francisco Office of Resilience and Capital Planning (ORCP) is pleased to support the application of The University of California, San Francisco (UCSF) entitled **Partnering for Resilient Opportunities To Eliminate Cumulative Toxic (PROTECT) Health Effects from Wildfire $PM_{2.5}$ in Environmental Justice Communities.**

ORCP promotes the preservation and sustainability of San Francisco's public capital assets and the city's overall resilience to acute shocks and chronic stresses, including preparing for and responding to stressors exacerbated by climate change. OCRP developed San Francisco's Hazards and Climate Resilience Plan, a road map with over 90 strategies to reduce the risks and adapt to climate change impacts. As part of this work, ORCP works closely with the San Francisco Department of Public Health (SFDPH) to study the overlap between vulnerable populations and vulnerable buildings to identify community-approved, infrastructure-related solutions to mitigate the health impacts of climate change.

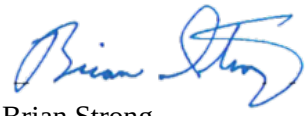
In response to the critical need to implement community-level interventions to mitigate the negative health effects exacerbated by climate change, ORCP is a key stakeholder in the Heat and Air Quality Resilience Project (HAQR). The HAQR includes all municipal departments involved in emergency preparedness and response services, housing, and infrastructure. The purpose of the HAQR is to bring together key City departments to align objectives, share data and collaboratively strategize how to improve the city-wide response to extreme heat and air quality issues, especially among vulnerable populations. ORCP sits on the HAQR project leadership team and plays an essential role by co-chairing the coordinating committee with SFDPH, serving as a point of contact for implementation teams and regularly drafting reports on project status.

As you know, in partnership with you, we recently received funding from PCORI to formally incorporate voices into HAQR from community residents and advocacy groups living in neighborhoods disproportionally impacted by extreme heat and poor air quality. With this community stakeholder group, we hope to assess for barriers and identify acceptable community-level interventions to mitigate extreme health and poor air quality. Through this proposal, we would be able to accelerate this engagement work forward at an unprecedent speed and start to co-develop mitigation strategies that address both the immediate threats of Wildfire $PM_{2.5}$ and the chronic environmental pollution that also burden vulnerable communities in San Francisco.

if this proposal is funded, ORCP would participate as a key stakeholder in these efforts. Our staff are leaders in developing and overseeing policies, programs, interagency initiatives and financial strategies to support the resilience of communities and the city's infrastructure to prepare for and respond to the

stressors of climate change. ORCP is pleased to support and endorse this proposal. We look forward to working with UCSF on this project. Please do not hesitate to contact me directly with any questions.

Sincerely,



Brian Strong
Chief Resilience Officer and Director
Office of Resilience and Capital Planning
City and County of San Francisco
Brian.Strong@sfgov.org

brightline DEFENSE
1028A Howard Street
San Francisco, CA 94103
415.252.9700 | brightlinedefense.org
@brightlinedefense @brightlinedef

Neeta Thakur, MD, MPH

UCSF Assistant Professor

UCSF PRISE Center

Re: EPA-G2021-STAR-H1: Cumulative Health Impacts at the Intersection of Climate Change, Environmental Justice, and Vulnerable Populations/ Lifestages: Community-Based Research for Solutions

Dear Dr. Thakur:

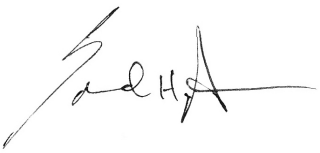
We at Brightline are enthusiastic about your application entitled **Partnering for Resilient Opportunities To Eliminate Cumulative Toxic (PROTECT) Health Effects from Wildfire PM2.5 in Environmental Justice Communities.** Your proposal will improve our understanding of the health risks associated with wildfire smoke $PM_{2.5}$ – including much needed information on how building characteristics affect penetration of smoke indoors.

Since 2006, our nonprofit organization has promoted sustainability and empowerment of low-income, frontline communities within and outside of California. In addition to establishing a localized air quality montoring program, we have deeply engaged dense urban environmental justice communities throughout the Bay Area. In this work, we recently highlighted the impacts that climate change, including wildfire smoke, on residents of high-density, low-income housing (i.e., single-room occupancy). As you know, this community has higher burden of chronic medical conditions and little access to indoor air filtration and personal protective equipment.

We are especially interested in the interested in the information that will be generated from your community engagement and hope to partner with you on carrying out these efforts in our local communities in San Francisco. Developing formal partnerships with community stakeholders to improve our understanding of barriers while identifying acceptable community-level interventions is key in our ability to our plan to mitigate the effects of poor air quality. This study aligns with our goals at Brightline and will provide important learning opportunities regarding community preferences and barriers to existing mitigation efforts.

Brightline is pleased to support and endorse this proposal. We look forward to the potential to partner with you on this project. Please do not hesitate to contact me directly with any questions.

Sincerely,



Eddie H. Ahn
Executive Director

University of Colorado at Boulder
Cooperative Institute for Research in Environmental Sciences

Campus Box 216
Boulder, Colorado 80309-0216
(303) 492-1143
FAX: (303) 492-1149

Neeta Thakur, MD, MPH
UCSF Assistant Professor
UCSF PRISE Center Subspecialty Program Director

Re: Funding Opportunity: EPA-G2021-STAR-H1

Dear Dr. Neeta Thakur:

The HRRR-Smoke modeling team at NOAA Global Systems Laboratory and CIRES is pleased to support the application of The University of California, San Francisco (UCSF) entitled **Partnering for Resilient Opportunities to Eliminate Cumulative Toxic (PROTECT) Health Effects from Climate Change.**

The HRRR-Smoke model provides critical predictions for wildfire smoke exposures across the country, using satellite detection of fire "hot spots" to drive a 3D numerical weather prediction model which simulates smoke transport and its feedback on meteorology. HRRR-Smoke output has been archived since 2016 and provides a unique dataset for examining spatial and temporal variability in smoke exposure across the state of California. We have worked closely with Dr. Tina Chow at UC Berkeley and a co-Investigator for this award on analysis of HRRR-Smoke for recent wildfire events, and we are excited about continued collaboration opportunities.

The work proposed in this proposal will further our understanding of the extent of the health risks associated with wildfire smoke ($PM_{2.5}$) and provide much needed information on mitigation efforts. We are excited to support the development of a model-data fusion product for HRRR-Smoke. This merged dataset will lead the way to creating a smoke "analysis" product (data assimilation using smoke $PM_{2.5}$ observations) which can be used in various applications in the future.

This study aligns with our goals at HRRR-Smoke to provide the most accurate smoke predictions for human health and public safety. The study will provide important learning opportunities on the role of smoke modeling and exposure studies.

The HRRR-Smoke team is pleased to support and endorse this proposal. We look forward to working with UCSF and UC Berkeley on this project and will provide support with HRRR-Smoke data analysis. Please do not hesitate to contact us with any questions.

Sincerely,
Dr. Ravan Ahmadov
Cooperative Institute for Research in Environmental Sciences
University of Colorado at Boulder
Boulder, CO 80303

OMB Number: 2030-0020
Expiration Date: 04/30/2021

Preaward Compliance Review Report for All Applicants and Recipients Requesting EPA Financial Assistance

Note: Read Instructions before completing form.

I. A. Applicant/Recipient (Name, Address, City, State, Zip Code)

Name: The Regents of the University of California San Francisco

Address: Office of Sponsored Research
490 Illinois, Fourth Floor

City: San Francisco

State: CA: California Zip Code: 94143-0000

B. DUNS No. 0948783370000

II. Is the applicant currently receiving EPA Assistance? ☐ Yes ☒ No

III. List all civil rights lawsuits and administrative complaints pending against the applicant/recipient that allege discrimination based on race, color, national origin, sex, age, or disability. (Do not include employment complaints not covered by 40 C.F.R. Parts 5 and 7.)

NA

IV. List all civil rights lawsuits and administrative complaints decided against the applicant/recipient within the last year that allege discrimination based on race, color, national origin, sex, age, or disability and enclose a copy of all decisions. Please describe all corrective actions taken. (Do not include employment complaints not covered by 40 C.F.R. Parts 5 and 7.)

NA

V. List all civil rights compliance reviews of the applicant/recipient conducted by any agency within the last two years and enclose a copy of the review and any decisions, orders, or agreements based on the review. Please describe any corrective action taken. (40 C.F.R. § 7.80(c)(3))

NA

VI. Is the applicant requesting EPA assistance for new construction? If no, proceed to VII; if yes, answer (a) and/or (b) below.

☐ Yes ☒ No

a. If the grant is for new construction, will all new facilities or alterations to existing facilities be designed and constructed to be readily accessible to and usable by persons with disabilities? If yes, proceed to VII; if no, proceed to VI(b).

☐ Yes ☐ No

b. If the grant is for new construction and the new facilities or alterations to existing facilities will not be readily accessible to and usable by persons with disabilities, explain how a regulatory exception (40 C.F.R. 7.70) applies.

VII. Does the applicant/recipient provide initial and continuing notice that it does not discriminate on the basis of race, color, national origin, sex, age, or disability in its program or activities? (40 C.F.R 5.140 and 7.95) ☒ Yes ☐ No

a. Do the methods of notice accommodate those with impaired vision or hearing? ☒ Yes ☐ No

b. Is the notice posted in a prominent place in the applicant's offices or facilities or, for education programs and activities, in appropriate periodicals and other written communications? ☒ Yes ☐ No

c. Does the notice identify a designated civil rights coordinator? ☒ Yes ☐ No

VIII. Does the applicant/recipient maintain demographic data on the race, color, national origin, sex, age, or handicap of the population it serves? (40 C.F.R. 7.85(a)) ☒ Yes ☐ No

IX. Does the applicant/recipient have a policy/procedure for providing access to services for persons with limited English proficiency? (40 C.F.R. Part 7, E.O. 13166) ☒ Yes ☐ No

X. If the applicant is an education program or activity, or has 15 or more employees, has it designated an employee to coordinate its compliance with 40 C.F.R. Parts 5 and 7? Provide the name, title, position, mailing address, e-mail address, fax number, and telephone number of the designated coordinator.

UCSF Office for the Prevention of Harassment and Discrimination; Nyoki Sacramento, Director, EEO/AA, ADA and Title IX, 415-502-3400; OPHD@ucsf.edu; 490 Illinois Street, Floor 11, San Francisco, CA; https://diversity.ucsf.edu/nyoki-sacramento-appointement
Renee Navarro, PharmD, MD, Vice Chancellor for Diversity and Outreach is the head of this department

XI. If the applicant is an education program or activity, or has 15 or more employees, has it adopted grievance procedures that assure the prompt and fair resolution of complaints that allege a violation of 40 C.F.R. Parts 5 and 7? Provide a legal citation or Internet Address for, or a copy of, the procedures.

The Office of Prevention of Harassment and Discrimination lists various policies at this website: https://ophd.ucsf.edu/policies-guidelines. Complaints may be filed and the procedures are listed here: https://ophd.ucsf.edu/interim-procedures-august-2012

For the Applicant/Recipient

I certify that the statements I have made on this form and all attachments thereto are true, accurate and complete. I acknowledge that any knowingly false or misleading statement may be punishable by fine or imprisonment or both under applicable law. I assure that I will fully comply with all applicable civil rights statutes and EPA regulations.

A. Signature of Authorized Official	B. Title of Authorized Official	C. Date
Mae Moredo	UCSF Contracts and Grants Officer	11/16/2021

For the U.S. Environmental Protection Agency

I have reviewed the information provided by the applicant/recipient and hereby certify that the applicant/recipient has submitted all preaward compliance information required by 40 C.F.R. Parts 5 and 7; that based on the information submitted, this application satisfies the preaward provisions of 40 C.F.R. Parts 5 and 7; and that the applicant has given assurance that it will fully comply with all applicable civil rights statures and EPA regulations.

A. *Signature of Authorized EPA Official	B. Title of Authorized Official	C. Date

*** See Instructions**

Instructions for EPA FORM 4700-4 (Rev. 06/2014)

General. Recipients of Federal financial assistance from the U.S. Environmental Protection Agency must comply with the following statutes and regulations.
Title VI of the Civil Rights Acts of 1964 provides that no person in the United States shall, on the grounds of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving Federal financial assistance. The Act goes on to explain that the statute shall not be construed to authorize action with respect to any employment practice of any employer, employment agency, or labor organization (except where the primary objective of the Federal financial assistance is to provide employment). Section 13 of the 1972 Amendments to the Federal Water Pollution Control Act provides that no person in the United States shall on the ground of sex, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under the Federal Water Pollution Control Act, as amended. Employment discrimination on the basis of sex is prohibited in all such programs or activities. Section 504 of the Rehabilitation Act of 1973 provides that no otherwise qualified individual with a disability in the United States shall solely by reason of disability be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving Federal financial assistance. Employment discrimination on the basis of disability is prohibited in all such programs or activities. The Age Discrimination Act of 1975 provides that no person on the basis of age shall be excluded from participation under any program or activity receiving Federal financial assistance. Employment discrimination is not covered. Age discrimination in employment is prohibited by the Age Discrimination in Employment Act administered by the Equal Employment Opportunity Commission. Title IX of the Education Amendments of 1972 provides that no person in the United States on the basis of sex shall be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any education program or activity receiving Federal financial assistance. Employment discrimination on the basis of sex is prohibited in all such education programs or activities. Note: an education program or activity is not limited to only those conducted by a formal institution. 40 C.F.R. Part 5 implements Title IX of the Education Amendments of 1972. 40 C.F.R. Part 7 implements Title VI of the Civil Rights Act of 1964, Section 13 of the 1972 Amendments to the Federal Water Pollution Control Act, and Section 504 of The Rehabilitation Act of 1973. The Executive Order 13166 (E.O. 13166) entitled; "Improving Access to Services for Persons with Limited English Proficiency" requires Federal agencies work to ensure that recipients of Federal financial assistance provide meaningful access to their LEP applicants and beneficiaries.

Items “Applicant” means any entity that files an application or unsolicited proposal or otherwise requests EPA assistance. 40 C.F.R. §§ 5.105, 7.25. “Recipient” means any entity, other than applicant, which will actually receive EPA assistance. 40 C.F.R. §§ 5.105, 7.25. “Civil rights lawsuits and administrative complaints” means any lawsuit or administrative complaint alleging discrimination on the basis of race, color, national origin, sex, age, or disability pending or decided against the applicant and/or entity which actually benefits from the grant, but excluding employment complaints not covered by 40 C.F.R. Parts 5 and 7. For example, if a city is the named applicant but the grant will actually benefit the Department of Sewage, civil rights lawsuits involving both the city and the Department of Sewage should be listed. “Civil rights compliance review” means any review assessing the applicant’s and/or recipient’s compliance with laws prohibiting discrimination on the basis of race, color, national origin, sex, age, or disability. Submit this form with the original and required copies of applications, requests for extensions, requests for increase of funds, etc. Updates of information are all that are required after the initial application submission. If any item is not relevant to the project for which assistance is requested, write “NA” for “Not Applicable.” In the event applicant is uncertain about how to answer any questions, EPA program officials should be contacted for clarification. * Note: Signature appears in the Approval Section of the EPA Comprehensive Administrative Review For Grants/Cooperative Agreements & Continuation/Supplemental Awards form.

BUDGET INFORMATION - Non-Construction Programs

OMB Number: 4040-0006
Expiration Date: 02/28/2022

SECTION A - BUDGET SUMMARY

Grant Program Function or Activity (a)	Catalog of Federal Domestic Assistance Number (b)	Estimated Unobligated Funds		New or Revised Budget		
		Federal (c)	Non-Federal (d)	Federal (e)	Non-Federal (f)	Total (g)
1. N/A	66.509	$	$	$ 1,330,536.00	$ 0.00	$ 1,330,536.00
2.						
3.						
4.						
5. Totals		$	$	$ 1,330,536.00	$ 0.00	$ 1,330,536.00

Standard Form 424A (Rev. 7- 97)
Prescribed by OMB (Circular A -102) Page 1

SECTION B - BUDGET CATEGORIES

6. Object Class Categories	GRANT PROGRAM, FUNCTION OR ACTIVITY (1)	(2)	(3)	(4)	Total (5)
	N/A	N/A	N/A		
a. Personnel	$ 56,768.00	$ 65,118.00	$ 65,118.00	$	$ 187,004.00
b. Fringe Benefits	14,978.00	17,742.00	17,742.00		50,462.00
c. Travel	8,917.00	8,917.00	8,917.00		26,751.00
d. Equipment					
e. Supplies					
f. Contractual	4160.00	4160.00	4160.00		12,480.00
g. Construction					
h. Other	225,597.00	306,490.00	313,616.00		845,703.00
i. Total Direct Charges (sum of 6a-6h)	312,500.00	404,507.00	405,393.00		$ 1,122,400.00
j. Indirect Charges	72,192.00	70,812.00	65,132.00		$ 208,136.00
k. TOTALS (sum of 6i and 6j)	$ 384,692.00	$ 475,319.00	$ 470,525.00	$	$ 1,330,536.00
7. Program Income	$	$	$	$	$

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SECTION C - NON-FEDERAL RESOURCES

(a) Grant Program	(b) Applicant	(c) State	(d) Other Sources	(e)TOTALS
8. N/A	$ 0.00	$ 0.00	$ 0.00	$ 0.00
9.				
10.				
11.				
12. TOTAL (sum of lines 8-11)	$ 0.00	$ 0.00	$ 0.00	$ 0.00

SECTION D - FORECASTED CASH NEEDS

	Total for 1st Year	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
13. Federal	$ 384,692.00	$ 96,173.00	$ 96,173.00	$ 96,173.00	$ 96,173.00
14. Non-Federal	$				
15. TOTAL (sum of lines 13 and 14)	$ 384,692.00	$ 96,173.00	$ 96,173.00	$ 96,173.00	$ 96,173.00

SECTION E - BUDGET ESTIMATES OF FEDERAL FUNDS NEEDED FOR BALANCE OF THE PROJECT

(a) Grant Program	FUTURE FUNDING PERIODS (YEARS) (b)First	(c) Second	(d) Third	(e) Fourth
16. N/A	$ 475,319.00	$ 470,525.00	$	$
17.				
18.				
19.				
20. TOTAL (sum of lines 16 - 19)	$ 475,319.00	$ 470,525.00	$	$

SECTION F - OTHER BUDGET INFORMATION

21. Direct Charges: 1,122,400

22. Indirect Charges: 208,136

23. Remarks: UCSF adheres to calculating the budget using the MTDC at 61.5%, excluding UC Berkeley, as our sister campus, in the first $25,000 of their subcontract.

AREAS AFFECTED BY PROJECT

For the ecologic health analysis, all cities in the 58 counties in California will be studied.

For Objective 4, the community engagement project, the cities of San Francisco, Fresno and Richmond, California will be included. The counties are San Francisco, Fresno and Contra Costa County.

Congressional Districts:

For the ecologic health analysis, all 53 Congressional Districts in California will be studied.

For Objective 4, the community engagement project, the California Congressional Districts include: CA-04, CA-11, CA-12, CA-13, CA-015, CA-16, CA-21, CA-22.

EXHIBIT C

Outlook

Notice of EPA Award: Assistance Agreement RD-84048101

From Brooks, Jennifer <Brooks.Jennifer@epa.gov>
Date Tue 11/22/2022 5:52 AM
To Thakur, Neeta <Neeta.Thakur@ucsf.edu>
Cc HQgrantsnotification <HQgrantsnotification@epa.gov>; Hahn, Intaek <hahn.intaek@epa.gov>

1 attachment (221 KB)
Assistance Agreement 84048101-0.pdf;

This Message Is From an External Sender
This message came from outside your organization.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
MISSION SUPPORT

Re: Notice of EPA Assistance Award

Dear Authorized Representative:

Attached is your Notice of Award from the U.S. Environmental Protection Agency. **Please carefully review the assistance agreement and all of the terms and conditions.**

Please make a copy for your records and provide the appropriate copies within your organization (page three of the award package intentionally left blank). The recipient's signature is not required on the enclosed agreement in order to signify acceptance. Award recipients demonstrate acceptance of the award and commitment to carry out the award by either: 1) drawing down funds within 21 calendar days after the mailing date indicated on the face page of the award; or 2) not filing a notice of disagreement with the award terms and conditions within 21 calendar days after the mailing date indicated on the face page of the award. The terms and conditions of some awards require additional signed certifications or assurances. These should be scanned and emailed to the EPA Grants Specialist listed on the face page of the award document. To file a notice of disagreement with the terms and conditions, the authorized representative of the recipient may also contact the Grants Specialist via email. Alternatively, hard copies of documents or correspondence may be sent to one of the addresses below:

For regular postal delivery: **For courier or Federal Express delivery:**

U.S. Environmental Protection Agency
Office of Grants and Debarment
1200 Pennsylvania Avenue, NW (3903R)
Fifth Floor, Room 51234
Washington, DC 20460

U.S. Environmental Protection Agency
Office of Grants and Debarment
1300 Pennsylvania Avenue, NW
Fifth Floor, Room 51234
Washington, DC 20004

Payment will be made available after any required certifications and/or assurances are received, if applicable. The Research Triangle Park Finance Center (RTPFC) will provide information about how you will receive payment and report on your financial transactions during the period of performance.

Guidance, regulations and additional forms needed throughout the life of your award are located at https://www.epa.gov/grants/grant-regulations-and-forms-new-grantees. You may refer to the terms and conditions of your award for guidance on completing and submitting all forms requested or required.

Please pay particular attention to the following items that are procedural changes contained in EPA's Online General Terms and Conditions linked directly to within the Administrative Terms and Conditions of this award. Take note of the "Award Date," also listed on the award document face page, which corresponds to a set of online conditions unique to a specific period in time that apply to your individual award:

- ***SF-425: FEDERAL FINANCIAL REPORTS (FFR) ANNUAL SUBMISSION:***
  Any monetary action (new, incremental and supplemental) issued on or after **October 6, 2015** now requires EPA grant recipients to submit the SF-425: Federal Financial Report no later than 30 days after the end of each specified reporting period for quarterly and semi-annual reports, and 90 calendar days for annual reports. Final reports are due no later than 120 calendar days after the end date of the period of performance of the award. Extension of reporting due dates may be approved by EPA upon request of the recipient. The FFR form is available on the internet at: http://www2.epa.gov/financial/forms. All FFRs and manual payment requests (if not using ASAP) must be submitted to the RTPFC via email at **rtpfc-grants@epa.gov** or mail to:

  US Environmental Protection Agency
  RTP-Finance Center (Mail Code AA216-01)
  4930 Page Rd.
  Durham, NC 27703

  Refer to the Online General Term and Condition titled: "Federal Financial Reporting" or "Final Federal Financial Report" as applicable.

- ***SUBAWARDS:***
  As of **March 29, 2016**, the Office of Grants and Debarment issued the EPA Subaward Policy for EPA Assistance Agreements Recipients. Monetary actions (new, incremental and supplemental) issued after March 29 are subject to the subaward reporting requirements provisions of 2 CFR 200 and the EPA Subaward Policy. If your work plan and budget include subawards of financial assistance as defined in 2 CFR 200.1 and 2 CFR 200.331, EPA's National Term and Condition for Subawards titled: "Establishing and Managing Subawards" will apply.

By accepting this assistance agreement your organization is certifying that it either has systems in place to comply with the regulatory or EPA policy requirements specified in the National Term and Condition for Subawards, or that it will refrain from making subawards with funding EPA provides under this agreement until the systems are designed and implemented. Should your organization decide to make a subaward(s) that was not described in the work plan and budgeted for under this agreement, you must obtain prior written approval from EPA's Award Official as provided at 2 CFR 200.308(c)(6).

If you have any questions, please contact your Grants Specialist identified on the award document. Please reference the EPA assistance number on all future correspondence regarding this assistance agreement.

Attachment (Official EPA Award Document)

Jennifer Brooks
Environmental Protection Agency
Grants & Interagency Agreement Management Division
1200 Pennsylvania Ave., NW Mail Code 3903R
Washington, DC 20460
202-564-6374
Office Hours 6:30am – 3:00pm EST

https://intranet.epa.gov/ogd/contacts/ogdcontact/contact_grant_specialist.htm

EXHIBIT D

U.S. ENVIRONMENTAL PROTECTION AGENCY

Grant Agreement

GRANT NUMBER (FAIN): 84048101 **MODIFICATION NUMBER:** 0 **PROGRAM CODE:** RD	**DATE OF AWARD** 11/17/2022
TYPE OF ACTION New	**MAILING DATE** 11/22/2022
PAYMENT METHOD: ASAP	**ACH#** 90202

RECIPIENT TYPE:
State Institution of Higher Learning

Send Payment Request to:
Contact EPA RTPFC at: rtpfc-grants@epa.gov

RECIPIENT:
The Regents of the University of CA - SF
1855 Folsom St. Suite 425 Box 0812
San Francisco, CA 94143-4249
EIN: 94-6036493

PAYEE:
The Regents of the University of CA - San Francisco
1855 Folsom Street, Suite 425
San Francisco, CA 94143-4249

PROJECT MANAGER	EPA PROJECT OFFICER	EPA GRANT SPECIALIST
Neeta Thakur 1001 Potrero Avenue, 228 San Francisco, CA 94143-0841 **Email:** Neeta.Thakur@ucsf.edu **Phone:** 415-476-0735	Intaek Hahn 1200 Pennsylvania Ave, NW, 8725P Washington, DC 20460 **Email:** Hahn.Intaek@epa.gov **Phone:** 202-564-4377	Jennifer Brooks 1200 Pennsylvania Ave, NW 3903R Washington, DC 20460 **Email:** Brooks.Jennifer@epa.gov **Phone:** 202-564-6374

PROJECT TITLE AND DESCRIPTION

Partnering for Resilient Opportunities To Eliminate Cumulative Toxic Health Effects from Wildfire

See Attachment 1 for project description.

BUDGET PERIOD	PROJECT PERIOD	TOTAL BUDGET PERIOD COST	TOTAL PROJECT PERIOD COST
12/01/2022 - 11/30/2025	12/01/2022 - 11/30/2025	$1,330,536.00	$1,330,536.00

NOTICE OF AWARD

Based on your Application dated 11/16/2021 including all modifications and amendments, the United States acting by and through the US Environmental Protection Agency (EPA) hereby awards $690,000.00. EPA agrees to cost-share 100.00% of all approved budget period costs incurred, up to and not exceeding total federal funding of $690,000.00. Recipient's signature is not required on this agreement. The recipient demonstrates its commitment to carry out this award by either: 1) drawing down funds within 21 days after the EPA award or amendment mailing date; or 2) not filing a notice of disagreement with the award terms and conditions within 21 days after the EPA award or amendment mailing date. If the recipient disagrees with the terms and conditions specified in this award, the authorized representative of the recipient must furnish a notice of disagreement to the EPA Award Official within 21 days after the EPA award or amendment mailing date. In case of disagreement, and until the disagreement is resolved, the recipient should not draw down on the funds provided by this award/amendment, and any costs incurred by the recipient are at its own risk. This agreement is subject to applicable EPA regulatory and statutory provisions, all terms and conditions of this agreement and any attachments.

ISSUING OFFICE (GRANTS MANAGEMENT OFFICE)	AWARD APPROVAL OFFICE
ORGANIZATION / ADDRESS	**ORGANIZATION / ADDRESS**
Environmental Protection Agency , Grants and Interagency Agreement 1200 Pennsylvania Ave, NW Mail code 3903R Washington, DC 20460	Environmental Protection Agency, OSAPE ORD - Office of Research and Development 1200 Pennsylvania Ave, NW Washington, DC 20460

THE UNITED STATES OF AMERICA BY THE U.S. ENVIRONMENTAL PROTECTION AGENCY

Digitally signed by EPA Award Official Digital signature applied by EPA Award Official	Jill Young - Chief - Grants Management Branch LaShaun Phillips - Associate Award Official
DATE 11/17/2022	

EPA Funding Information

FUNDS	FORMER AWARD	THIS ACTION	AMENDED TOTAL
EPA Amount This Action	$0	$690,000	$690,000
EPA In-Kind Amount	$0	$0	$0
Unexpended Prior Year Balance	$0	$0	$0
Other Federal Funds	$0	$0	$0
Recipient Contribution	$0	$0	$0
State Contribution	$0	$0	$0
Local Contribution	$0	$0	$0
Other Contribution	$0	$0	$0
Allowable Project Cost	$0	$690,000	$690,000

Assistance Program (CFDA)	Statutory Authority	Regulatory Authority
66.509 - Science to Achieve Results (STAR) Program	Clean Air Act: Sec. 103	2 CFR 200, 2 CFR 1500, 40 CFR 33 and 40 CFR 40

Fiscal									
Site Name	Req No	FY	Approp. Code	Budget Oganization	PRC	Object Class	Site/Project	Cost Organization	Obligation / Deobligation
-	232631M001	2223	C	2631000	000FK8XPV	4141	-	26A6A	$690,000
									$690,000

Budget Summary Page

Table A - Object Class Category (Non-Construction)	Total Approved Allowable Budget Period Cost
1. Personnel	$187,004
2. Fringe Benefits	$50,462
3. Travel	$26,751
4. Equipment	$0
5. Supplies	$0
6. Contractual	$12,480
7. Construction	$0
8. Other	$845,703
9. Total Direct Charges	$1,122,400
10. Indirect Costs: 61.50 % Base MTDC	$208,136
11. Total (Share: Recipient 0.00 % Federal 100.00 %)	$1,330,536
12. Total Approved Assistance Amount	$1,330,536
13. Program Income	$0
14. Total EPA Amount Awarded This Action	$690,000
15. Total EPA Amount Awarded To Date	$690,000

Attachment 1 - Project Description

The goal of the project is to understand the cascading impacts of recurrent and prolonged wildfire smoke exposure on health and well-being of the residents in underserved communities in conjunction with other relevant environmental factors such as social adversity in low-income, minority communities in California. The project will 1) estimate the health effects of sub-daily exposure to wildfire-specific PM2.5 in California, including across social vulnerability factors, with

particular focus on effects within EJ communities; 2) analyze community recovery from short-term health effects following exposure; 3) quantify indoor infiltration of wildfire

smoke and the mitigating effect of housing quality and behaviors; and 4) work with communities to develop mitigation interventions to fit the specific needs of the communities. Deliverables include annual and final research reports as well as scientific publications with more accurate estimates of wildfire-specific PM2.5 distributions across communities and smoke infiltration data for housing across California. Expected outcomes include the reduction of wildfire-related PM exposure. Intended beneficiaries include low-income, minority residents living in underserved communities across California, public health professionals, environmental managers, air quality specialists, and community planners. University of California - Berkeley ($705,047) will (1) quantify wildfire specific fine particulate matter for fire seasons, (2) estimate magnitude of effect by wildfire PM on health outcomes, and (3) determine indoor penetration based on housing attributes data. Central California Asthma Collaboration (CCAC) ($60,000) will coordinate engagement efforts, including recruiting stakeholders, administrating surveys, and conducting focus groups. $23,100 to seven subawardees (TBD) to co-develop and implement pilot adaptation strategies.

Administrative Conditions

A. General Terms and Conditions

The recipient agrees to comply with the current EPA general terms and conditions available at: https://www.epa.gov/grants/epa-general-terms-and-conditions-effective-october-1-2022-or-later. These terms and conditions are in addition to the assurances and certifications made as a part of the award and the terms, conditions, or restrictions cited throughout the award.

The EPA repository for the general terms and conditions by year can be found at: https://www.epa.gov/grants/grant-terms-and-conditions#general.

B. Correspondence Condition

The terms and conditions of this agreement require the submittal of reports, specific requests for approval, or notifications to EPA. Unless otherwise noted, all such correspondence should be sent to the following email addresses:

- Federal Financial Reports (SF-425): rtpfc-grants@epa.gov and ***Brooks.Jennifer@EPA.gov***
- MBE/WBE reports (EPA Form 5700-52A): DBE Coordinator, Dominick Washington; **mbe.wbe@epa.gov**
- All other forms/certifications/assurances, Indirect Cost Rate Agreements, Requests for Extensions of the Budget and Project Period, Amendment Requests, Requests for other Prior Approvals, updates to recipient information (including email addresses, changes in contact information or changes in authorized representatives) and other notifications: ***Hahn.Intaek@EPA.gov***
- Payment requests (if applicable): ***Hahn.Intaek@EPA.gov***
- Quality Assurance documents, workplan revisions, equipment lists, programmatic reports and deliverables: ***Hahn.Intaek@EPA.gov***

C. Prompt Payment

In accordance with Section 2(d) of the Prompt Payment Act (P.L. 97-177), Federal funds may not be used by the recipient for the payment of interest penalties to contractors when bills are paid late nor may interest penalties be used to satisfy cost sharing requirements. Obligations to pay such interest penalties will not be obligations of the United States.

D. No Fed

The recipient understands that none of the funds for this project (including funds contributed by the recipient as cost sharing) may be used to pay for the travel of Federal employees or for other costs associated with Federal participation in this project. Except however, if a Federal agency is selected through the recipient's procurement process to carry out some of the work as a contractor to the recipient, funds may be used to allow necessary Federal travel and other costs associated with Federal participation in this project.

E. Partial Funding

EPA is funding this agreement incrementally. There is no guarantee of funding beyond the first year. The **Total Approved Assistance Amount** identified on Line 12 of the budget table of this award is contingent upon the availability of appropriated funds, EPA funding priorities, and satisfactory progress in carrying out the activities described in the scope of

work. If EPA informs the recipient that the amount on Line 12 will be reduced, the recipient agrees to provide an updated workplan and budget information, as needed, to amend the agreement.

F. Payment to Consultants

EPA participation in the salary rate (excluding overhead) paid to individual consultants retained by recipients or by a recipient's contractors or subcontractors shall be limited to the maximum daily rate for a Level IV of the Executive Schedule (formerly GS-18), to be adjusted annually. This limit applies to consultation services of designated individuals with specialized skills who are paid at a daily or hourly rate. As of January 1, 2022, the limit is $675.84 per day and $84.48 per hour. This rate does not include transportation and subsistence costs for travel performed (the recipient will pay these in accordance with their normal travel reimbursement practices). Contracts and subcontracts with firms for services which are awarded using the procurement requirements in Subpart D of 2 CFR 200, are not affected by this limitation unless the terms of the contract provide the recipient with responsibility for the selection, direction and control of the individuals who will be providing services under the contract at an hourly or daily rate of compensation. See 2 CFR 1500.10.

Programmatic Conditions

A. Standard Terms and Conditions for Research Awards

This award is subject to EPA's set of standard terms and conditions for research awards located at https://www.epa.gov/grants/grant-terms-and-conditions#office .

B. Quality Assurance

Authority: Quality Assurance applies to all assistance agreements involving environmental information as defined in 2 C.F.R. § 1500.12 Quality Assurance.

The recipient shall ensure that subawards involving environmental information issued under this agreement include appropriate quality requirements for the work. The recipient shall ensure sub-award recipients develop and implement the Quality Assurance (QA) planning documents in accordance with this term and condition; and/or ensure sub-award recipients implement all applicable approved QA planning documents.

1. Quality Management Plan (QMP)

a. Prior to beginning environmental information operations, the recipient must:

i. Develop a QMP,

ii. Prepare the QMP in accordance with the most current version of EPA QA/R-2: EPA Requirements for Quality Management Plans,

III. Submit the document to the EPA PO for EPA QA review, and

iv. Obtain EPA Director of Quality Assurance (DQA) approval prior to work start.

b. The recipient must submit the QMP within 60 days after grant award.

c. The recipient must review their approved QMP at least annually. The results of the QMP review and any revisions must be submitted to the PO and the DQA in the annual report and may also be submitted when changes

occur.

2. Quality Assurance Project Plan (QAPP)

a. Prior to beginning environmental information operations, the recipient must:

i. Develop a QAPP,

ii. Prepare QAPP in accordance with the most current version of EPA QA/R-5: EPA Requirements for Quality Assurance Project Plans,

iii. Submit the document for EPA review, and

3. Obtain EPA DQA approval prior to work start.

a. The recipient must submit the QAPP 90 days after grant award.

b. The recipient shall notify the PO and DQA when substantive changes are needed to the QAPP. EPA may require the QAPP be updated and re-submitted for approval.

c. The recipient must review their approved QAPP at least annually. The results of the QAPP review and any revisions must be submitted to the PO and the DQA in the annual report and may also be submitted when changes occur.

For Reference:

- EPA QA/R-2: *EPA Requirements for Quality Management Plans* and EPA QA/R-5: *EPA Requirements for Quality Assurance Project Plans*; contain quality specifications for EPA and non-EPA organizations and definitions applicable to these terms and conditions.
- EPA QA/G-5: *Guidance for Quality Assurance Project Plans*, Appendix C provides a QAPP Checklist.
- Quality Specifications for non-EPA Organizations to do business with EPA.
- The Office of Grants and Debarment Quality Assurance Requirements.

C. Geospatial Data Standards

All geospatial data created must be consistent with Federal Geographic Data Committee (FGDC) endorsed standards. Information on these standards may be found at www.fgdc.gov.

D. Sub-award Reporting

The recipient must report on its subaward monitoring activities under 2 CFR 200.332(d). Examples of items that must be reported if the pass-through entity has the information available are:

1. Summaries of results of reviews of financial and programmatic reports

2. Summaries of findings from site visits and/or desk reviews to ensure effective subrecipient performance

3. Environmental results the subrecipient achieved

4. Summaries of audit findings and related pass-through entity management decisions

5. Actions the pass-through entity has taken to correct deficiencies such as those specified at 2 CFR 200.332(e), 2 CFR 200.208 and 2 CFR 200.339

Note: EPA Project Officers may customize this reporting requirement based on programmatic information needs.

E. Cybersecurity Grant Condition for Other Recipients, Including Intertribal Consortia

(a) The recipient agrees that when collecting and managing environmental data under this assistance agreement, it will protect the data by following all applicable State or Tribal law cybersecurity requirements.

(b) (1) EPA must ensure that any connections between the recipient's network or information system and EPA networks used by the recipient to transfer data under this agreement, are secure. For purposes of this Section, a connection is defined as a dedicated persistent interface between an Agency IT system and an external IT system for the purpose of transferring information. Transitory, user-controlled connections such as website browsing are excluded from this definition.

If the recipient's connections as defined above do not go through the Environmental Information Exchange Network or EPA's Central Data Exchange, the recipient agrees to contact the EPA Project Officer (PO) no later than 90 days after the date of this award and work with the designated Regional/Headquarters Information Security Officer to ensure that the connections meet EPA security requirements, including entering into Interconnection Service Agreements as appropriate. This condition does not apply to manual entry of data by the recipient into systems operated and used by EPA's regulatory programs for the submission of reporting and/or compliance data.

(2) The recipient agrees that any subawards it makes under this agreement will require the subrecipient to comply with the requirements in (b)(1) if the subrecipient's network or information system is connected to EPA networks to transfer data to the Agency using systems other than the Environmental Information Exchange Network or EPA's Central Data Exchange. The recipient will be in compliance with this condition: by including this requirement in subaward agreements; and during subrecipient monitoring deemed necessary by the recipient under 2 CFR 200.332(d), by inquiring whether the subrecipient has contacted the EPA Project Officer. Nothing in this condition requires the recipient to contact the EPA Project Officer on behalf of a subrecipient or to be involved in the negotiation of an Interconnection Service Agreement between the subrecipient and EPA.

EXHIBIT E

Outlook

Notice of EPA Award: 84048101-1

From Brooks, Jennifer <Brooks.Jennifer@epa.gov>
Date Wed 6/21/2023 12:09 PM
To Thakur, Neeta <Neeta.Thakur@ucsf.edu>
Cc HQgrantsnotification <HQgrantsnotification@epa.gov>; Hahn, Intaek <hahn.intaek@epa.gov>

1 attachment (215 KB)
Assistance Amendment 84048101-1.pdf;

This Message Is From an External Sender
This message came from outside your organization.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
MISSION SUPPORT

Re: Notice of EPA Assistance Award

Dear Authorized Representative:

Attached is your Notice of Award from the U.S. Environmental Protection Agency. **Please carefully review the assistance agreement and all of the terms and conditions.**

Please make a copy for your records and provide the appropriate copies within your organization (page three of the award package intentionally left blank). The recipient's signature is not required on the enclosed agreement in order to signify acceptance. Award recipients demonstrate acceptance of the award and commitment to carry out the award by either: 1) drawing down funds within 21 calendar days after the mailing date indicated on the face page of the award; or 2) not filing a notice of disagreement with the award terms and conditions within 21 calendar days after the mailing date indicated on the face page of the award. The terms and conditions of some awards require additional signed certifications or assurances. These should be scanned and emailed to the EPA Grants Specialist listed on the face page of the award document. To file a notice of disagreement with the terms and conditions, the authorized representative of the recipient may also contact the Grants Specialist via email. Alternatively, hard copies of documents or correspondence may be sent to one of the addresses below:

For regular postal delivery: **For courier or Federal Express delivery:**

U.S. Environmental Protection Agency
Office of Grants and Debarment
1200 Pennsylvania Avenue, NW (3903R)
Fifth Floor, Room 51234
Washington, DC 20460

U.S. Environmental Protection Agency
Office of Grants and Debarment
1300 Pennsylvania Avenue, NW
Fifth Floor, Room 51234
Washington, DC 20004

Payment will be made available after any required certifications and/or assurances are received, if applicable. The Research Triangle Park Finance Center (RTPFC) will provide information about how you will receive payment and report on your financial transactions during the period of performance.

Guidance, regulations and additional forms needed throughout the life of your award are located at https://www.epa.gov/grants/grant-regulations-and-forms-new-grantees. You may refer to the terms and conditions of your award for guidance on completing and submitting all forms requested or required.

Please pay particular attention to the following items that are procedural changes contained in EPA's Online General Terms and Conditions linked directly to within the Administrative Terms and Conditions of this award. Take note of the "Award Date," also listed on the award document face page, which corresponds to a set of online conditions unique to a specific period in time that apply to your individual award:

- ***SF-425: FEDERAL FINANCIAL REPORTS (FFR) ANNUAL SUBMISSION:***
  Any monetary action (new, incremental and supplemental) issued on or after **October 6, 2015** now requires EPA grant recipients to submit the SF-425: Federal Financial Report no later than 30 days after the end of each specified reporting period for quarterly and semi-annual reports, and 90 calendar days for annual reports. Final reports are due no later than 120 calendar days after the end date of the period of performance of the award. Extension of reporting due dates may be approved by EPA upon request of the recipient. The FFR form is available on the internet at: http://www2.epa.gov/financial/forms. All FFRs and manual payment requests (if not using ASAP) must be submitted to the RTPFC via email at **rtpfc-grants@epa.gov** or mail to:

  US Environmental Protection Agency
  RTP-Finance Center (Mail Code AA216-01)
  4930 Page Rd.
  Durham, NC 27703

  Refer to the Online General Term and Condition titled: "Federal Financial Reporting" or "Final Federal Financial Report" as applicable.

- ***SUBAWARDS:***
  As of **March 29, 2016**, the Office of Grants and Debarment issued the EPA Subaward Policy for EPA Assistance Agreements Recipients. Monetary actions (new, incremental and supplemental) issued after March 29 are subject to the subaward reporting requirements provisions of 2 CFR 200 and the EPA Subaward Policy. If your work plan and budget include subawards of financial assistance as defined in 2 CFR 200.1 and 2 CFR 200.331, EPA's National Term and Condition for Subawards titled: "Establishing and Managing Subawards" will apply.

By accepting this assistance agreement your organization is certifying that it either has systems in place to comply with the regulatory or EPA policy requirements specified in the National Term and Condition for Subawards, or that it will refrain from making subawards with funding EPA provides under this agreement until the systems are designed and implemented. Should your organization decide to make a subaward(s) that was not described in the work plan and budgeted for under this agreement, you must obtain prior written approval from EPA's Award Official as provided at 2 CFR 200.308(c)(6).

If you have any questions, please contact your Grants Specialist identified on the award document. Please reference the EPA assistance number on all future correspondence regarding this assistance agreement.

Attachment (Official EPA Award Document)

Jennifer Brooks
Senior Grants Management Specialist
Environmental Protection Agency
Grants & Interagency Agreement Management Division
1200 Pennsylvania Ave., NW Mail Code 3903R
Washington, DC 20460
202-564-6374
Office Hours 6:30am – 3:00pm EST

EXHIBIT F

U.S. ENVIRONMENTAL PROTECTION AGENCY

Assistance Amendment

GRANT NUMBER (FAIN): 84048101 **MODIFICATION NUMBER:** 1 **PROGRAM CODE:** RD	**DATE OF AWARD** 06/15/2023
TYPE OF ACTION Augmentation: Increase	**MAILING DATE** 06/21/2023
PAYMENT METHOD: ASAP	**ACH#** 90202

RECIPIENT TYPE:
State Institution of Higher Learning

Send Payment Request to:
Contact EPA RTPFC at: rtpfc-grants@epa.gov

RECIPIENT:
The Regents of the University of CA - SF
1855 Folsom St. Suite 425 Box 0812
San Francisco, CA 94143-4249
EIN: 94-6036493

PAYEE:
The Regents of the University of CA - San Francisco
1855 Folsom Street, Suite 425
San Francisco, CA 94143-4249

PROJECT MANAGER	EPA PROJECT OFFICER	EPA GRANT SPECIALIST
Neeta Thakur 1001 Potrero Avenue, 228 San Francisco, CA 94143-0841 **Email:** Neeta.Thakur@ucsf.edu **Phone:** 415-476-0735	Intaek Hahn 1200 Pennsylvania Ave, NW, 8725P Washington, DC 20460 **Email:** Hahn.Intaek@epa.gov **Phone:** 202-564-4377	Jennifer Brooks 1200 Pennsylvania Ave, NW 3903R Washington, DC 20460 **Email:** Brooks.Jennifer@epa.gov **Phone:** 202-564-6374

PROJECT TITLE AND EXPLANATION OF CHANGES

Partnering for Resilient Opportunities To Eliminate Cumulative Toxic Health Effects from Wildfire

The goal of the project is to understand the cascading impacts of recurrent and prolonged wildfire smoke exposure on health and well-being of the residents in underserved communities in conjunction with other relevant environmental factors such as social adversity in low-income, minority communities in California.

Incremental Amendment; Completion of Partial Funding; This amendment provides incremental funding in the amount of $640,536.

BUDGET PERIOD	PROJECT PERIOD	TOTAL BUDGET PERIOD COST	TOTAL PROJECT PERIOD COST
12/01/2022 - 11/30/2025	12/01/2022 - 11/30/2025	$1,330,536.00	$1,330,536.00

NOTICE OF AWARD

Based on your Application dated 11/16/2021 including all modifications and amendments, the United States acting by and through the US Environmental Protection Agency (EPA) hereby awards $640,536.00. EPA agrees to cost-share 100.00% of all approved budget period costs incurred, up to and not exceeding total federal funding of $1,330,536.00. Recipient's signature is not required on this agreement. The recipient demonstrates its commitment to carry out this award by either: 1) drawing down funds within 21 days after the EPA award or amendment mailing date; or 2) not filing a notice of disagreement with the award terms and conditions within 21 days after the EPA award or amendment mailing date. If the recipient disagrees with the terms and conditions specified in this award, the authorized representative of the recipient must furnish a notice of disagreement to the EPA Award Official within 21 days after the EPA award or amendment mailing date. In case of disagreement, and until the disagreement is resolved, the recipient should not draw down on the funds provided by this award/amendment, and any costs incurred by the recipient are at its own risk. This agreement is subject to applicable EPA regulatory and statutory provisions, all terms and conditions of this agreement and any attachments.

ISSUING OFFICE (GRANTS MANAGEMENT OFFICE)	AWARD APPROVAL OFFICE
ORGANIZATION / ADDRESS	**ORGANIZATION / ADDRESS**
Environmental Protection Agency , Grants and Interagency Agreement 1200 Pennsylvania Ave, NW Mail code 3903R Washington, DC 20460	Environmental Protection Agency, OSAPE ORD - Office of Research and Development 1200 Pennsylvania Ave, NW Washington, DC 20460

THE UNITED STATES OF AMERICA BY THE U.S. ENVIRONMENTAL PROTECTION AGENCY

Digital signature applied by EPA Award Official for Jill Young - Chief - Grants Management Branch LaShaun Phillips - Award Official Delegate	**DATE** 06/15/2023

EPA Funding Information

FUNDS	FORMER AWARD	THIS ACTION	AMENDED TOTAL
EPA Amount This Action	$690,000	$640,536	$1,330,536
EPA In-Kind Amount	$0	$0	$0
Unexpended Prior Year Balance	$0	$0	$0
Other Federal Funds	$0	$0	$0
Recipient Contribution	$0	$0	$0
State Contribution	$0	$0	$0
Local Contribution	$0	$0	$0
Other Contribution	$0	$0	$0
Allowable Project Cost	$690,000	$640,536	$1,330,536

Assistance Program (CFDA)	Statutory Authority	Regulatory Authority
66.509 - Science to Achieve Results (STAR) Program	Clean Air Act: Sec. 103	2 CFR 200, 2 CFR 1500, 40 CFR 33 and 40 CFR 40

Fiscal									
Site Name	Req No	FY	Approp. Code	Budget Oganization	PRC	Object Class	Site/Project	Cost Organization	Obligation / Deobligation
-	232631M057	2324	C	2631000	000FK8XPV	4141	-	26A6A	$640,536
									$640,536

Budget Summary Page

Table A - Object Class Category (Non-Construction)	Total Approved Allowable Budget Period Cost
1. Personnel	$187,004
2. Fringe Benefits	$50,462
3. Travel	$26,751
4. Equipment	$0
5. Supplies	$0
6. Contractual	$12,480
7. Construction	$0
8. Other	$845,703
9. Total Direct Charges	$1,122,400
10. Indirect Costs: 61.50 % Base MTDC	$208,136
11. Total (Share: Recipient 0.00 % Federal 100.00 %)	$1,330,536
12. Total Approved Assistance Amount	$1,330,536
13. Program Income	$0
14. Total EPA Amount Awarded This Action	$640,536
15. Total EPA Amount Awarded To Date	$1,330,536

Administrative Conditions

A. General Terms and Conditions

The recipient agrees to comply with the current EPA general terms and conditions available at: https://www.epa.gov/grants/epa-general-terms-and-conditions-effective-october-1-2022-or-later. These terms and conditions are in addition to the assurances and certifications made as a part of the award and the terms, conditions, or restrictions cited throughout the award.

The EPA repository for the general terms and conditions by year can be found at: https://www.epa.gov/grants/grant-terms-and-conditions#general.

B. Correspondence Condition

The terms and conditions of this agreement require the submittal of reports, specific requests for approval, or notifications to EPA. Unless otherwise noted, all such correspondence should be sent to the following email addresses:

- Federal Financial Reports (SF-425): rtpfc-grants@epa.gov and **brooks.jennifer@epa.gov**
- MBE/WBE reports (EPA Form 5700-52A): DBE Coordinator, Dominick Washington; **mbe.wbe@epa.gov**
- All other forms/certifications/assurances, Indirect Cost Rate Agreements, Requests for Extensions of the Budget and Project Period, Amendment Requests, Requests for other Prior Approvals, updates to recipient information (including email addresses, changes in contact information or changes in authorized representatives) and other notifications: **hahn.intaek@epa.gov**
- Payment requests (if applicable): **hahn.intaek@epa.gov**
- Quality Assurance documents, workplan revisions, equipment lists, programmatic reports and deliverables: **hahn.intaek@epa.gov**

C. No Fed

The recipient understands that none of the funds for this project (including funds contributed by the recipient as cost sharing) may be used to pay for the travel of Federal employees or for other costs associated with Federal participation in this project. Except however, if a Federal agency is selected through the recipient's procurement process to carry out some of the work as a contractor to the recipient, funds may be used to allow necessary Federal travel and other costs associated with Federal participation in this project.

D. Payment to Consultants

EPA participation in the salary rate (excluding overhead) paid to individual consultants retained by recipients or by a recipient's contractors or subcontractors shall be limited to the maximum daily rate for a Level IV of the Executive Schedule (formerly GS-18), to be adjusted annually. This limit applies to consultation services of designated individuals with specialized skills who are paid at a daily or hourly rate. As of January 1, 2023, the limit is $703.44 per day and $87.93 per hour. This rate does not include transportation and subsistence costs for travel performed (the recipient will pay these in accordance with their normal travel reimbursement practices). Contracts and subcontracts with firms for services which are awarded using the procurement requirements in Subpart D of 2 CFR 200, are not affected by this limitation unless the terms of the contract provide the recipient with responsibility for the selection, direction and control of the individuals who will be providing services under the contract at an hourly or daily rate of compensation. See 2 CFR 1500.10.

All Other Administrative Conditions Remain the Same.

Programmatic Conditions

A. Cybersecurity Grant Condition for Other Recipients, Including Intertribal Consortia

(a) The recipient agrees that when collecting and managing environmental data under this assistance agreement, it will protect the data by following all applicable State or Tribal law cybersecurity requirements.

(b) (1) EPA must ensure that any connections between the recipient's network or information system and EPA networks used by the recipient to transfer data under this agreement, are secure. For purposes of this Section, a connection is defined as a dedicated persistent interface between an Agency IT system and an external IT system for the purpose of transferring information. Transitory, user-controlled connections such as website browsing are excluded from this definition.

If the recipient's connections as defined above do not go through the Environmental Information Exchange Network or EPA's Central Data Exchange, the recipient agrees to contact the EPA Project Officer (PO) no later than 90 days after the date of this award and work with the designated Regional/Headquarters Information Security Officer to ensure that the connections meet EPA security requirements, including entering into Interconnection Service Agreements as appropriate. This condition does not apply to manual entry of data by the recipient into systems operated and used by EPA's regulatory programs for the submission of reporting and/or compliance data.

(2) The recipient agrees that any subawards it makes under this agreement will require the subrecipient to comply with the requirements in (b)(1) if the subrecipient's network or information system is connected to EPA networks to transfer data to the Agency using systems other than the Environmental Information Exchange Network or EPA's Central Data Exchange. The recipient will be in compliance with this condition: by including this requirement in subaward agreements; and during subrecipient monitoring deemed necessary by the recipient under 2 CFR 200.332(d), by inquiring whether the subrecipient has contacted the EPA Project Officer. Nothing in this condition requires the recipient to contact the EPA Project Officer on behalf of a subrecipient or to be involved in the negotiation of an Interconnection Service Agreement between the subrecipient and EPA.

All Other Programmatic Conditions Remain the Same.

EXHIBIT G

U.S. ENVIRONMENTAL PROTECTION AGENCY

Assistance Amendment

GRANT NUMBER (FAIN): 84048101 **MODIFICATION NUMBER:** 2 **PROGRAM CODE:** RD	**DATE OF AWARD** 04/28/2025
TYPE OF ACTION No Cost Amendment	**MAILING DATE** 04/28/2025
PAYMENT METHOD: ASAP	**ACH#** 90202

RECIPIENT TYPE:
State Institution of Higher Learning

Send Payment Request to:
Contact EPA RTPFC at: rtpfc-grants@epa.gov

RECIPIENT:
REGENTS OF THE UNIVERSITY OF CALIFORNIA, SAN FRANCISCO, THE
UCSF Controller's Office
1855 FOLSOM STREET, SUITE 425 Box 0812
SAN FRANCISCO, CA 94143
EIN: 94-6036493

PAYEE:
REGENTS OF THE UNIVERSITY OF CALIFORNIA, SAN FRANCISCO, THE
1855 FOLSOM STREET, SUITE 425
SAN FRANCISCO, CA 94143-4249

PROJECT MANAGER	EPA PROJECT OFFICER	EPA GRANT SPECIALIST
Neeta Thakur 1001 Potrero Avenue, 228 San Francisco, CA 94143-0841 **Email:** Neeta.Thakur@ucsf.edu **Phone:** 415-476-0735	Intaek Hahn 1200 Pennsylvania Ave, NW, 8725P Washington, DC 20460 **Email:** Hahn.Intaek@epa.gov **Phone:** 202-564-4377	Jennifer Brooks 1200 Pennsylvania Ave, NW 3903R Washington, DC 20460 **Email:** Brooks.Jennifer@epa.gov **Phone:** 202-564-6374

PROJECT TITLE AND EXPLANATION OF CHANGES

Partnering for Resilient Opportunities To Eliminate Cumulative Toxic Health Effects from Wildfire

This amendment is to stop work; terminate the agreement; reduce performance period duration; curtail scope of work; and waive certain reporting requirements. Administrative terms and conditions are added.

Per 2 CFR 200.340 and the Termination General Terms and Conditions of this agreement, EPA is terminating this award. Your organization shall immediately stop work and take all reasonable steps to minimize the incurrence of costs otherwise allocable to the assistance agreement. See terms and conditions.

BUDGET PERIOD	PROJECT PERIOD	TOTAL BUDGET PERIOD COST	TOTAL PROJECT PERIOD COST
12/01/2022 - 04/28/2025	12/01/2022 - 04/28/2025	$ 1,330,536.00	$ 1,330,536.00

NOTICE OF AWARD

Based on your Application dated 11/16/2021 including all modifications and amendments, the United States acting by and through the US Environmental Protection Agency (EPA) hereby awards $ 0.00. EPA agrees to cost-share 100.00% of all approved budget period costs incurred, up to and not exceeding total federal funding of $ 1,330,536.00. Recipient's signature is not required on this agreement. The recipient demonstrates its commitment to carry out this award by either: 1) drawing down funds within 21 days after the EPA award or amendment mailing date; or 2) not filing a notice of disagreement with the award terms and conditions within 21 days after the EPA award or amendment mailing date. If the recipient disagrees with the terms and conditions specified in this award, the authorized representative of the recipient must furnish a notice of disagreement to the EPA Award Official within 21 days after the EPA award or amendment mailing date. In case of disagreement, and until the disagreement is resolved, the recipient should not draw down on the funds provided by this award/amendment, and any costs incurred by the recipient are at its own risk. This agreement is subject to applicable EPA regulatory and statutory provisions, all terms and conditions of this agreement and any attachments.

ISSUING OFFICE (GRANTS MANAGEMENT OFFICE)	AWARD APPROVAL OFFICE
ORGANIZATION / ADDRESS	**ORGANIZATION / ADDRESS**
Environmental Protection Agency, Grants Management & Business Operations Division 1200 Pennsylvania Ave, NW Mail code 3903R Washington, DC 20460	Environmental Protection Agency, OSAPE ORD - Office of Research and Development 1200 Pennsylvania Ave, NW Washington, DC 20460

THE UNITED STATES OF AMERICA BY THE U.S. ENVIRONMENTAL PROTECTION AGENCY

Digital signature applied by EPA Award Official LaShaun Phillips - Associate Award Official	**DATE** 04/28/2025

EPA Funding Information

FUNDS	FORMER AWARD	THIS ACTION	AMENDED TOTAL
EPA Amount This Action	$ 1,330,536	$ 0	$ 1,330,536
EPA In-Kind Amount	$ 0	$ 0	$ 0
Unexpended Prior Year Balance	$ 0	$ 0	$ 0
Other Federal Funds	$ 0	$ 0	$ 0
Recipient Contribution	$ 0	$ 0	$ 0
State Contribution	$ 0	$ 0	$ 0
Local Contribution	$ 0	$ 0	$ 0
Other Contribution	$ 0	$ 0	$ 0
Allowable Project Cost	$ 1,330,536	$ 0	$ 1,330,536

Assistance Program	Statutory Authority	Regulatory Authority
66.509 - Science to Achieve Results (STAR) Program	Clean Air Act: Sec. 103	2 CFR 200, 2 CFR 1500, 40 CFR 33 and 40 CFR 40

Budget Summary Page

Table A - Object Class Category (Non-Construction)	Total Approved Allowable Budget Period Cost
1. Personnel	$ 187,004
2. Fringe Benefits	$ 50,462
3. Travel	$ 26,751
4. Equipment	$ 0
5. Supplies	$ 0
6. Contractual	$ 12,480
7. Construction	$ 0
8. Other	$ 845,703
9. Total Direct Charges	$ 1,122,400
10. Indirect Costs: 61.50 % Base MTDC	$ 208,136
11. Total (Share: Recipient 0.00 % Federal 100.00 %)	$ 1,330,536
12. Total Approved Assistance Amount	$ 1,330,536
13. Program Income	$ 0
14. Total EPA Amount Awarded This Action	$ 0
15. Total EPA Amount Awarded To Date	$ 1,330,536

Administrative Conditions

UNILATERAL TERMINATION

1. The Agency is asserting its right under 2 CFR 200.340 and the Termination General Term and Condition of this agreement to unilaterally terminate this award. This amendment serves as required notice under 2 CFR 200.341.

2. Consistent with 2 CFR 200.343 Effect of suspension and termination, costs to the recipient or subrecipient resulting from financial obligations incurred by the recipient or subrecipient after the termination of a Federal award are not allowable. Costs after termination are allowable if:

a. The costs result from financial obligations which were properly incurred by the recipient or subrecipient before the effective date of suspension or termination, and not in anticipation of it; and

b. The costs would be allowable if the Federal award was not suspended or expired normally at the end of the period of performance in which the termination takes effect.

c. The costs are reasonable and necessary termination costs consistent with 2 CFR 200.472.

3. Federal Financial Reporting (FFR) General Terms and Conditions is still in full force and effect. EPA recipients must submit the SF-425 no later than 120 calendar days after the end date of the period of performance of the award.

4. Programmatic Terms and Conditions. Performance reporting is still in full force and effect. The recipient must submit the final report no later than 120 calendar days after the period of performance.

In accordance with 2 CFR 200.329, the recipient agrees to submit performance reports that include information on each of the following areas:

a. A comparison of accomplishments to the outputs/outcomes established in the assistance agreement work plan for the reporting period;

b. Explanations on why established outputs/outcomes were not met; and

c. Additional information, analysis, and explanation of cost overruns or high-than-expected-unit costs.

5. Waiver of Reports

The following reports are waived:

a. Utilization of Disadvantaged Business Enterprises General Terms and Conditions, EPA Form 5700-52A.

b. Tangible Personal Property Report, SF-428, General Terms and Conditions.

6. Record Retention

Access to Records, 2 CFR 200.337, is still in full force and effect. The termination of this award does not affect the right of EPA to disallow costs and recover funds on the basis of a later audit or other reviews. Information regarding record retention, property disposition in accordance with EPA regulations, and other frequently asked questions can be accessed at https://www.epa.gov/grants/frequent-questions-about-closeouts.

Programmatic Conditions

All Programmatic Conditions Remain the Same.

EXHIBIT H

OFFICE OF MISSION SUPPORT

WASHINGTON, D.C. 20460

April 28, 2025

MEMORANDUM

SUBJECT: Termination of EPA Assistance Agreement RD 84048101 under 2 CFR 200.340

FROM: EPA Award Official

TO: Shelby Mayoral, Director, Contracts and Awards
The Regents of the University of California San Francisco

The purpose of this communication is to notify you that the U.S. Environmental Protection Agency (EPA) is hereby terminating Assistance Agreement No. RD 84048101 awarded to The Regents of the University of California San Francisco. This EPA Assistance Agreement is terminated in its entirety effective immediately on the grounds that the award no longer effectuates the program goals or agency priorities. The objectives of the award are no longer consistent with EPA funding priorities.

The EPA Administrator has determined that, per the Agency's obligations to the constitutional and statutory law of the United States, this priority includes ensuring that the Agency's grants do not conflict with the Agency's policy of prioritizing merit, fairness, and excellence in performing our statutory functions. In addition to complying with the law, it is vital that the Agency assess whether all grant payments are free from fraud, abuse, waste, and duplication, as well as to assess whether current grants are in the best interests of the United States.

The grant specified above provides funding for programs that promote initiatives that conflict with the Agency's policy of prioritizing merit, fairness, and excellence in performing our statutory functions; that are not free from fraud, abuse, waste, or duplication; or that otherwise fail to serve the best interests of the United States. The grant is inconsistent with, and no longer effectuates, Agency priorities.

The process for closeout is generally outlined in 2 CFR 200.344. EPA is clarifying what reports are required and what reports are waived below. Other requirements are still in effect if applicable to your grant.

EPA is requiring the following closeout reports due within 120 days of closeout (2 CFR 200.344a:)

- Final Federal Financial Report, SF-425
- Final Technical Report
- Other programmatic reports identified in your terms and conditions

As part of this termination, EPA is waiving the following closeout reports:

- Property Report, SF-428
- Final Minority Business Enterprise/Woman Business Enterprise Utilization Under Federal Grants and Cooperative Agreements, EPA Form 5700-52A

The recipient may request payment from the Automated Standard Application Payments (ASAP) system for allowable costs incurred up to the date of this memo provided that such costs were contained in the approved workplan. Costs incurred by you after this termination are allowable only if (a) those costs were properly incurred by you before the effective date of this termination, and not in anticipation of it; and (b) those costs would be allowable if your federal award was not suspended or expired normally at the end of the period of performance in which the termination takes effect. *See* 2 C.F.R. § 200.343. You are encouraged to carefully review and discharge your closeout responsibilities set forth in 2 C.F.R. § 200.344-45 and your award agreement. Those responsibilities include, but are not limited to, your obligation to "promptly refund any unobligated funds" that have been paid out but "are not authorized to be retained." *See* 2 C.F.R. § 200.344(g).

Also, per 2 CFR 200.472, a recipient may use grant funds to properly closeout their grant including reasonable and necessary costs that might occur after the date of this memo. If the recipient drew down funds from ASAP for costs beyond the termination date or for costs that exceed the amount necessary to properly closeout their grant, the recipient must contact RTPFC at rtpfc-grants@epa.gov for instructions on how to return the excess funds.

The EPA Grants Management Office has issued an amendment to the agreement to document the termination.

If you wish to dispute this termination decision, the Disputes Decision Official (DDO), Schindel.Phillip@epa.gov, must receive the Dispute no later than 30 calendar days from the date this termination notice is electronically sent to you. Disputes must be sent electronically by email to the DDO, with a copy to the EPA Award Official, Phillips.LaShaun@epa.gov within the 30-day period stated above. The Dispute submitted to the DDO must include: (1) A copy of the disputed Agency Decision; (2) A detailed statement of the specific legal and factual grounds for the Dispute, including copies of any supporting documents; (3) The specific remedy or relief you seek under the Dispute; and (4) The name and contact information, including email address, of your designated point of contact for the Dispute. *See* 2 CFR 1500.15

The requirements on post-closeout adjustments and continuing responsibilities, including audit and record retention requirements, at 2 CFR 200.345 remain in effect.

ATTACHMENT
Amendment Document

cc: Jennifer Brooks, EPA Grant Specialist
Intaek Hahn, EPA Project Officer
Neeta Thakur, Grantee Program Manager

Erwin Chemerinsky (*pro hac vice* forthcoming)
echemerinsky@law.berkeley.edu
Claudia Polsky (CA Bar No. 185505)
cpolsky@law.berkeley.edu
U.C. BERKELEY SCHOOL OF LAW
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FARELLA BRAUN + MARTEL LLP
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San Francisco, CA 94104
Telephone: 415. 954.4400

Attorneys for Plaintiffs and the Proposed Class
[Additional counsel listed on signature page]

UNITED STATES DISTRICT COURT

NORTHERN DISTRICT OF CALIFORNIA

NEETA THAKUR, KEN ALEX, NELL GREEN NYLEN, ROBERT HIRST, CHRISTINE PHILLIOU, and JEDDA FOREMAN, on behalf of themselves and all others similarly situated,

Plaintiffs,

v.

DONALD J. TRUMP, in his official capacity as President of the United States; DEPARTMENT OF GOVERNMENT EFFICIENCY ("DOGE"); AMY GLEASON, in her official capacity as Acting Administrator of the Department of Government Efficiency; NATIONAL SCIENCE FOUNDATION;

[*caption cont'd next page*]

Case No. 3:25-cv-04737-RL

DECLARATION OF NELL GREEN NYLEN

The Honorable Rita F. Lin

BRIAN STONE, in his official capacity as Acting Director of the National Science Foundation;
NATIONAL ENDOWMENT FOR THE HUMANITIES;
MICHAEL MCDONALD, in his official capacity as Acting Chairman of the National Endowment for the Humanities;
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY;
LEE ZELDIN, in his official capacity as Administrator of the U.S. Environmental Protection Agency;
UNITED STATES DEPARTMENT OF AGRICULTURE;
BROOKE ROLLINS, in her official capacity as Secretary of the U.S. Department of Agriculture;
AMERICORPS (a.k.a. the CORPORATION FOR NATIONAL AND COMMUNITY SERVICE);
JENNIFER BASTRESS TAHMASEBI, in her official capacity as Interim Agency Head of AmeriCorps;
UNITED STATES DEPARTMENT OF DEFENSE;
PETE HEGSETH, in his official capacity as Secretary of the U.S. Department of Defense;
UNITED STATES DEPARTMENT OF EDUCATION;
LINDA MCMAHON, in her official capacity as Secretary of the U.S. Department of Education;
UNITED STATES DEPARTMENT OF ENERGY;
CHRIS WRIGHT, in his official capacity as Secretary of Energy;
UNITED STATES DEPARTMENT OF HEALTH AND HUMAN SERVICES;
ROBERT F. KENNEDY, JR., in his official capacity as Secretary of the U.S. Department of Health and Human Services;
UNITED STATES CENTERS FOR DISEASE CONTROL;
MATTHEW BUZZELLI, in his official capacity as Acting Director of the Centers for Disease Control;
UNITED STATES FOOD AND DRUG ADMINISTRATION;
MARTIN A. MAKARY, in his official capacity as Commissioner of the Food and Drug Administration;
UNITED STATES NATIONAL INSTITUTES OF HEALTH;
JAYANTA BHATTACHARYA, in his official capacity as Director of the National Institutes of

Health;
INSTITUTE OF MUSEUM AND LIBRARY SERVICES;
KEITH SONDERLING, in his official capacity as Acting Director of the Institute of Museum and Library Services;
UNITED STATES DEPARTMENT OF THE INTERIOR;
DOUG BURGUM, in his official capacity as Secretary of the Interior;
UNITED STATES DEPARTMENT OF STATE;
MARCO RUBIO, in his official capacity as Secretary of the U.S. Department of State;
DEPARTMENT OF TRANSPORTATION;
SEAN DUFFY, in his official capacity as Secretary for the U.S. Department of Transportation,

Defendants.

DECLARATION OF NELL GREEN NYLEN

I, Nell Green Nylen, declare as follows:

1. I have personal knowledge of the facts contained in this declaration and, if called as a witness, could and would testify competently to those facts.

2. In 2013, I joined the Wheeler Water Institute at the Center for Law, Energy & the Environment (CLEE)—a research center at UC Berkeley School of Law—as a Research Fellow. I became a Senior Research Fellow at CLEE in 2016. In my work at CLEE, I provide analysis and recommendations at the intersection of law, policy, and science to inform water governance and management.

3. I received a JD with a Certificate of Specialization in Environmental Law from UC Berkeley School of Law in 2012. I earned a PhD in Geological and Environmental Sciences from Stanford University in 2005 and a BS in Geological and Environmental Sciences from Stanford University in 1996.

4. Prior to joining CLEE, I clerked for Justice Gregory J. Hobbs, Jr., of the Colorado Supreme Court for one year. During law school I served as a Summer Honors Program legal intern for the Environment, Land, and Natural Resources Law Sections of the California Attorney General's Office and as a summer legal intern for the Center for Biological Diversity. Between my PhD program and law school, I worked as a Research and Curatorial Assistant at the California Academy of Sciences and as a Museum Assistant and GIS Specialist at the Peabody Museum of Natural History at Yale University. Before attending graduate school, I worked as a GIS/AutoCAD/Graphics Specialist at Stanford University and as a Geologist for the U.S. Geological Survey. My CV is attached as Exhibit A.

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5. Much of my work focuses on improving management of water resources across hydrologic extremes—from times of water scarcity to times of abundance. Critically, decisions made in one time and place can affect what water management options are available in other locations and at other times. Enhanced aquifer recharge is an important tool for managing groundwater and surface water in a more integrated way that reflects these temporal and spatial connections. This is an important topic, not just in the American West, where water shortages are an increasing challenge, but also across the nation. In many areas, even where surface water is plentiful, groundwater overuse is increasingly causing aquifer levels to decline, shallow wells to go dry, pumping costs to increase, the land surface to subside, salt water to invade freshwater aquifers, and river and stream flows to diminish. These impacts fall on farmers, small rural communities, suburbs, cities, and the natural environment. A central goal of our water team's research is to help people find ways to avoid or manage problems like these.

6. One of the ways we do this is to try to improve the information and policy environment for implementing innovative water management solutions. Some of these solutions involve water reuse—putting treated wastewater, stormwater, or another non-traditional water source to valuable uses such as drinking or agricultural irrigation. When done effectively, water reuse can help communities meet critical needs like addressing major water supply challenges or improving water quality in local rivers and streams. However, implementing a water reuse project can be challenging, especially if it involves new techniques that would require regulators to use a non-traditional approach to permitting. I was part of a team, with more than a decade of experience with research and engagement on water innovation, that collaborated with EPA to engage thought leaders from wastewater utilities, regulatory agencies, and environmental organizations to develop *A Framework for Permitting Innovation in the Wastewater Sector* (https://www.law.berkeley.edu/research/clee/research/wheeler/water-innovation/regulatory-relationships-are-a-pathway-to-innovation/synthesis-and-recommendations/) under EPA's National Water Reuse Action Plan, building on my prior work. See *Cultivating Effective Utility-Regulator Relationships Around Innovation: Lessons from Four Case Studies in the U.S. Municipal Wastewater Sector*. (https://journals.plos.org/water/article?id=10.1371/journal.pwat.0000031.)

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7. Recently, EPA unilaterally terminated two large grants I was working on that were meant to fund collaborative work with other researchers on issues at the core of my technical and legal expertise.

EPA Enhanced Aquifer Recharge Grant Application

8. In 2021, EPA's Office of Research and Development sought applications proposing research to develop cost-benefit tools to support enhanced aquifer recharge. The grant solicitation was part of EPA's Science to Achieve Results (STAR) program. A true and correct copy of solicitation EPA-G2022-STAR-C1 is attached as Exhibit B.

9. EPA's request for applications solicited research proposals that would "identify the key economic, technological, institutional, and legal factors that affect the ability to implement" enhanced aquifer recharge projects; identify best practices and tools for implementing enhanced aquifer recharge projects to achieve different purposes; and, ultimately, "improve life-cycle cost-benefits analysis to support cost-effective enhanced aquifer recharge." *Id* at 7, 8.

10. I was part of a UC Berkeley team that collaborated with a broader multi-disciplinary team of researchers from UC Davis, UC Santa Cruz, and UC Law San Francisco to develop a proposal in response to the solicitation.

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11. We submitted our proposal to EPA on January 13, 2022. It described a three-year project that would build on our team's prior work on enhanced aquifer recharge with review and synthesis of existing literature, legal research, case studies, and targeted engagement. Our project outputs were to include (a) developing guidance on screening and evaluating potential recharge sites and methods, determining what conditions and processes are necessary to effectively operate and maintain a recharge project, and ensuring that recharge projects maintain or improve aquifer water quality; (b) developing guidance on identifying and effectively navigating the applicable legal, policy, and organizational contexts for recharge; (c) developing recommendations for legal and policy changes that could facilitate more extensive, effective, and affordable implementation of enhanced aquifer recharge; (d) developing a generalized framework and tool for cost-benefit analysis of enhanced aquifer recharge projects that accounts for costs and benefits across the project lifecycle; and (e) creating a capstone “Lifecycle Map" report on enhanced aquifer recharge that reflects the interconnections among all research components. Essentially, our outputs would provide one-stop shopping for people interested in planning, evaluating, and implementing enhanced aquifer recharge projects.

12. The Grant Application proposed a cumulative budget of $2,000,000 (later adjusted to $1,999,998).

13. A true and correct copy of our grant application responsive to solicitation EPA-G2022-STAR-C1, project title *A Knowledge-to-Implementation Framework for Enhanced Aquifer Recharge*, is attached as Exhibit C.

Award of Enhanced Aquifer Recharge Grant Funding

14. On July 20, 2022, EPA notified UC Berkeley that it was awarding the grant. A true and correct copy of the Enhanced Aquifer Recharge Grant Agreement is attached as Exhibit D.

15. The grant's original end date was August 31, 2025. *Id.* at 1.

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16. A PDF of EPA's web page, *Life-Cycle Analysis to Support Cost-Effective Enhanced Aquifer Recharge Grant* (https://www.epa.gov/research-grants/life-cycle-analysis-support-cost-effective-enhanced-aquifer-recharge-grant) (saved on May 21, 2025), publicizing our grant as one of two awarded, is attached as Exhibit E.

17. On April 10, 2025, we requested a no-cost extension of the grant to better integrate results across the project pillars within the Lifecycle Map report and to allow more time for expert and stakeholder review and feedback to maximize the report's utility for decision makers who are considering whether and how to implement enhanced aquifer recharge. We received verbal approval for the no-cost extension and were awaiting formal written approval.

EPA's Termination of the Enhanced Aquifer Recharge Grant

18. On May 7, 2025, EPA sent the UC Regents a document styled as an "Assistance Amendment." A true and correct copy of the Assistance Amendment is attached as Exhibit F.

19. The Amendment instructed our research team to "stop work; terminate the [grant] agreement; reduce performance period duration; [and] curtail scope of work," while waiving certain reporting requirements. *Id.* at 1. It stated that "(EPA) hereby awards $0.00" towards any as-yet-unincurred costs of the previously awarded $1,999,998 of federal funds. *Ibid.*

20. The Assistance Amendment stated: "The Agency is asserting its right under 2 CFR 200.340 and the Termination General Term [stet] and Condition [stet] of this agreement to unilaterally terminate this award." *Id.* at 4.

21. The Amendment was accompanied by a memorandum from EPA to the Contracts and Grants Officer for the Regents of the University of California titled "Termination of EPA Assistance Agreement RD- 84046301-1 under 2 CFR 200.340." A true and correct copy of this memo is attached as Exhibit G.

22. The memo stated that EPA terminated our grant for the following reasons:

> [T]he award no longer effectuates the program goals or agency priorities. The objectives of the award are no longer consistent with EPA funding priorities.

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> The EPA Administrator has determined that, per the Agency's obligations to the constitutional and statutory law of the United States, this priority includes ensuring that the Agency's grants do not conflict with the Agency's policy of prioritizing merit, fairness, and excellence in performing our statutory functions. In additional to complying with the law, it is vital that the Agency assess whether all grant payments are free from fraud, abuse, waste, and duplication, as well as to assess whether current grants are in the best interests of the United States.
>
> The grant specified above provides funding for programs that promote initiatives that conflict with the Agency's policy of prioritizing merit, fairness, and excellence in performing our statutory functions; that are not free from fraud, abuse, waste, or duplication; or that otherwise fail to serve the best interests of the United States. The grant is inconsistent with, and no longer effectuates, Agency priorities.

Id. at 1.

23. The memo did not explain why EPA has concluded that our award is "no longer consistent with EPA funding priorities" or why EPA believes it "provides funding for programs that promote initiatives that conflict with the Agency's policy of prioritizing merit, fairness, and excellence in performing our statutory functions; that are not free from fraud, abuse, waste, or duplication; or that otherwise fail to serve the best interests of the United States."

24. Despite the memo's (very generic) claims otherwise, we believe our enhanced aquifer recharge research is entirely consistent with EPA's priorities. Those priorities are defined partly by governing statutes, and federal statutes specifically identify EAR research as an EPA funding priority and mandate. See 33 U.S.C § 1276. Our research is also consistent with the priority pillars EPA Administrator Lee Zeldin has identified. See *EPA Administrator Lee Zeldin Announces EPA's "Powering the Great American Comeback" Initiative* (https://www.epa.gov/newsreleases/epa-administrator-lee-zeldin-announces-epas-powering-great-american-comeback) (accessed May 27, 2025). Those pillars include ensuring that "[e]very American . . . [has] access to clean air, land, and water" and prioritizing permitting reform. *Id.* The core purpose of our research is promoting access to clean water, and a key component of our grant project is identifying better ways to review and approve enhanced aquifer recharge projects to help communities meet their water needs. Due to the nature of enhanced aquifer recharge, most applications will be in rural, agricultural areas, serving core constituencies that depend directly on long-term, reliable water supply to support economic development, and for their livelihoods.

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EPA Water Reuse Grant Application

25. In 2021, EPA's Office of Research and Development sought applications proposing research designed to "accelerate water innovation, information availability, and engagement to advance clean and safe water reuse goals, promote better understanding of the Nation's water and wastewater treatment and infrastructure, and enhance the availability and efficient use of water resources through water reuse." A true and correct copy of solicitation EPA-G2021-ORD-E1 is attached as Exhibit H.

26. In response to the solicitation, the Director of the Wheeler Water Institute at CLEE and I collaborated with a multi-disciplinary team of researchers from Iowa State University and the University of Rhode Island to develop a research proposal aimed at facilitating the convergence of technical, informational, social, and institutional innovation to accelerate technical and community readiness for water reuse in small water systems across the nation.

27. The lead Principal Investigator at Iowa State University submitted our grant proposal to EPA on September 29, 2021. It described a four-year project with six central objectives. Objective 1 focused on developing geospatial analytical methods to quantify and inventory potential sources of water for beneficial reuse across the nation. Objective 2 involved identifying, validating, and producing guidance on water source / treatment technology / end-use combinations that may be appropriate for small communities, which often have more limited resources and capacities than larger communities. Objective 3 focused on developing cost curves to support cost-benefit analysis of water reuse options in small communities. Objective 4 focused on surveying small communities to assess public attitudes towards and willingness to pay for different water reuse options. Objective 5 included several strands of research aimed at identifying and producing guidance on opportunities for fostering institutional innovation to overcome barriers to water reuse in small communities. Finally, Objective 6 focused on constructing community implementation roadmaps centered around identifying windows of opportunity for water reuse for several case-study communities.

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28. The Grant Application proposed a total budget of $4,057,500, combining a request for $3,246,000 of federal funds under the grant with a commitment from our research team to provide a $811,500 cost share from other sources. The budget included (a) personnel and personnel travel costs; (b) participant support costs; (c) laboratory supplies and laboratory user fees to support validation of water source / treatment technology / end-use combinations; (d) support for engineering and other expert consultants; (e) tuition remission for graduate students to cover their time on the project; and (f) indirect costs. This included a subaward of $559,941 to support our UC Berkeley team's work under the grant, which would be focused on Objective 5 (institutional innovation) and Objective 6 (community implementation roadmaps).

29. A true and correct copy of our grant application responsive to solicitation EPA-G2021-ORD-E1, project title *Accelerating Technical and Community Readiness for Water Reuse in Small Systems*, is attached as Exhibit I.

Award of Water Reuse Grant Funding

30. On August 8, 2022, EPA notified Iowa State University that it was awarding the grant, and Iowa State University notified the subrecipients, including UC Berkeley.

31. A true and correct copy of the grant agreement is attached as Exhibit J.

32. A PDF of EPA's web page, *National Priorities: Water Innovation, Science and Engagement to Advance Water Reuse Grants* (https://www.epa.gov/research-grants/national-priorities-water-innovation-science-and-engagement-advance-water-reuse-1) (saved on May 21, 2025), publicizing our grant as one of two awarded, is attached as Exhibit K.

EPA's Termination of the Water Reuse Grant

33. On May 12, 2025, EPA sent Iowa State University a document styled as an "Assistance Amendment." A true and correct copy of the Assistance Amendment is attached as Exhibit L.

34. The Amendment instructed our research team to "stop work; terminate the [grant] agreement; reduce performance period duration; [and] curtail scope of work," while waiving certain reporting requirements. *Id.* at 1. It stated that "(EPA) hereby awards $0.00" towards any as-yet-unincurred costs of the previously awarded $3,246,000 of federal funds. *Ibid.*

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35. The Assistance Amendment stated: "The Agency is asserting its right under 2 CFR 200.340 and the Termination General Term [stet] and Condition [stet] of this agreement to unilaterally terminate this award." *Id*. at 4.

36. The Amendment was accompanied by a memorandum from EPA to the Pre-Award Administrator at Iowa State University titled "Termination of EPA Assistance Agreement CR-84046101 under 2 CFR 200.340." A true and correct copy of this memo is attached as Exhibit M.

37. The memo stated that EPA terminated our grant for the following reasons:

> [T]he award no longer effectuates the program goals or agency priorities. The objectives of the award are no longer consistent with EPA funding priorities.
>
> The EPA Administrator has determined that, per the Agency's obligations to the constitutional and statutory law of the United States, this priority includes ensuring that the Agency's grants do not conflict with the Agency's policy of prioritizing merit, fairness, and excellence in performing our statutory functions. In additional to complying with the law, it is vital that the Agency assess whether all grant payments are free from fraud, abuse, waste, and duplication, as well as to assess whether current grants are in the best interests of the United States.
>
> The grant specified above provides funding for programs that promote initiatives that conflict with the Agency's policy of prioritizing merit, fairness, and excellence in performing our statutory functions; that are not free from fraud, abuse, waste, or duplication; or that otherwise fail to serve the best interests of the United States. The grant is inconsistent with, and no longer effectuates, Agency priorities.

Id. at 1.

38. The text describing the reasons for termination in the Assistance Amendment and the termination memorandum for the EPA Water Reuse Grant was identical to the text describing the reasons for termination in the parallel documents for the EPA Enhanced Aquifer Recharge Grant.

39. As with the EPA Enhanced Aquifer Recharge Grant, the termination memo for the EPA Water Reuse Grant did not explain why EPA has concluded that our award is "no longer consistent with EPA funding priorities" or why EPA believes it "provides funding for programs that promote initiatives that conflict with the Agency's policy of prioritizing merit, fairness, and excellence in performing our statutory functions; that are not free from fraud, abuse, waste, or duplication; or that otherwise fail to serve the best interests of the United States."

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40. Again, despite the termination memo's generic and unsupported assertions, we believe our water reuse research is entirely consistent with EPA's priorities. It is clear that addressing the wastewater challenges of small, rural communities remains one of EPA's ongoing priorities. A PDF of EPA's April 29, 2025, news release webpage, *EPA Announces $49 Million in Technical Assistance to Help Rural, Small, and Tribal Communities Address Wastewater Challenges* (https://www.epa.gov/newsreleases/epa-announces-49-million-technical-assistance-help-rural-small-and-tribal-0) (saved on May 21, 2025), is attached as Exhibit N. Our research squarely addressed these issues.

Harm from the Grant Terminations

41. I, and the larger project teams for both grant projects, have suffered immediate harm as a result of the cancellation of these grants. Specifically:

For the Enhanced Aquifer Recharge Grant:

a) I have been unable to proceed with the basic work of refining our team's analysis of the legal and policy context for enhanced aquifer recharge and distilling that information into useful content for our capstone Lifecycle Map report.

b) Our research team has been unable to continue to work together to complete the capstone report and the accompanying cost-benefit analysis decision support tool, or to seek and incorporate feedback from key experts and stakeholders on preliminary versions of the report and tool.

c) I, and the rest of the project team, care deeply about putting our expertise to work to make a positive difference in how people manage water. We have dedicated our careers to it. The prospect of not being able to finish this project—of leaving our efforts to create integrated guidance for those interested in planning, evaluating, and implementing recharge projects to wither—is, frankly, crushing (as is thinking about the utter waste of taxpayer money and government resources this and all the other federal grant terminations represent).

d) Even if we are eventually able to find replacement funding so that we can complete this project in some form, the delay and uncertainty in the interim would preclude full recovery of the project. We have assembled an incredible team of experts with complementary experience and expertise. The current team, which includes a postdoc who was entirely supported by this grant, is unlikely to be able to stay together over a prolonged period of delay. Furthermore, time we spend searching for replacement funding has considerable opportunity and financial costs (as well as societal costs), since this is time we would otherwise allocate to work on other water-related research projects that confer public benefit.

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For the Water Reuse Grant:

a) I have been unable to proceed with the basic work of the project. For example, I should be coordinating with a partner organization to identify and interview community members from small, under-resourced communities about the water-related challenges their communities face; the degree of trust they have in their water and wastewater systems/providers; whether and how they think some form of water reuse could play a role in addressing their community's challenges; and their ideas for building trust and accountability where it is currently lacking. We had planned to co-develop a report with our partner organization to share the results of this research—including key takeaways and recommendations for building trust in and accountability for water reuse—in ways that are accessible and useful to communities.

b) I have also been unable to continue assisting my CLEE colleague and a consultant partner who are taking the lead on interview-based research to clarify key intervention points in small communities' water planning and decision-making processes where water reuse can be considered. We had already interviewed a number of local water managers and consultants for small communities around the country, and we had many outstanding interview requests at the time this grant was terminated. Many of those we interviewed wore multiple hats and were stretched thin trying to serve their communities to the best of their abilities, yet they took the time to talk with us because they hoped the perspectives and information they shared could help others. If we are unable to find an alternative source of funding, I fear their contributions and insights will go to waste. We will also have compromised the trust we have been begun to build with these local actors, making it more difficult for us to reengage with them in the future.

c) As for the Enhanced Aquifer Recharge Grant, I am heartbroken by the prospect of not being able to finish this project and by the waste of time, effort, and resources that represents for us, for our partners, for the federal government, and for taxpayers.

d) Also, as for the Enhanced Aquifer Recharge Grant, even if we are eventually able to find replacement funding that would allow us to complete this project, the delay and uncertainty in the interim would preclude full recovery of the project, and the search for replacement funding would itself involve substantial time/money/productivity costs to all involved in such fundraising.

For both grants:

a) The job of every member of our water team at CLEE is currently threatened by these grant terminations. We are a self-funded entity within UC Berkeley that does not receive general salary support from the University. Instead, we subsist primarily on grants and contracts. Without that funding, we won't get paid, and we could lose our jobs. Absent the reinstatement of these grants or the development of other funding sources to replace them, we may need to lay off members of our team in the coming months.

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b) This is a worst-case scenario for us—being committed to deliver work and then having the funding suddenly and unexpectedly disappear without cause—because the nature of our funding means it is not possible for us to prepare an effective contingency plan. Recovering from an instantaneous loss of promised funding is far different than our usual mode of operation, in which we spend small amounts of time pursuing grant opportunities while dedicating most of our time and resources to existing funded projects.

c) Grant terminations represent sunk costs to our institution in other important ways. For example, we depend on our record of performance under past grants and contracts to help us win new ones. Unless we succeed in finding replacement funding that allows us to complete our key products, we will not have that record to show. This threatens not only the specific teams that worked on these specific grants, but (through no fault of our own) the capacity of our entire organization to persist.

d) These harms are ongoing.

Appeal of EPA Enhanced Aquifer Recharge Grant Termination

42. The EPA memo regarding termination of the Enhanced Aquifer Recharge Grant provided that UC Berkeley could submit a "Dispute" to a named Disputes Decision Official at EPA within 30 days from the date EPA transmitted the termination notice.

43. The termination memo provides no concrete information about why our grant was terminated and, therefore, provides no information to support the development of a responsive appeal. The memo also provides no commitment to the timely resolution of a dispute, and the 6-month period generally provided for in 2 C.F.R. 1500.17(b) would extend several months past the original end date of this grant.

44. Our Lead PI (Michael Kiparsky) for the Enhanced Aquifer Recharge Grant has indicated to our Sponsored Projects Office (SPO) at UC Berkeley that our team would like to appeal this grant termination and has provided relevant information. My understanding is that the SPO is currently considering whether to appeal.

45. Regardless of the UC Berkeley SPO's next steps, the grant funding would remain unavailable to our project (whether pending the outcome of an appeal or in the absence of one), making it impossible for us to take the logical next steps in the project and make the commitments necessary to retain staff and keep partners engaged.

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Appeal of EPA Water Reuse Grant Termination

46. The EPA memo regarding termination of the Water Reuse Grant provided that Iowa State University could submit a "Dispute" to a named Disputes Decision Official at EPA within 30 days from the date EPA transmitted the termination notice.

47. Again, the termination memo provides no concrete information about why our grant was terminated (and, therefore, provides no information to support the development of a responsive appeal), and it does not provide a commitment to the timely resolution of a dispute.

48. Our project team, including the Lead PI for the Water Reuse Grant at Iowa State University, has indicated to Iowa State's SPO that we would like to appeal this grant termination and has provided relevant information to their SPO. However, my understanding is that Iowa State University does not currently plan to appeal the termination.

49. If Iowa State University changes course and decides to appeal, the grant funding would remain unavailable to our project pending the outcome of that appeal, with the same consequences as for our Enhance Aquifer Recharge Grant.

Role of Class Representative

50. I am ready to assume the responsibilities of serving as a class representative. I understand that I must stay informed regarding developments in the lawsuit, communicate regularly with my attorneys, and act in the best interests of the class. I have no conflicts that would prevent me from assuming this responsibility.

51. I have been in communication with other UC researchers, who would be members of the class, who have suffered the same general type of harm as I describe above, from the abrupt termination of their previously approved research grants. This harm is widespread and I believe it will only increase in scope and impact if classwide relief is not granted.

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I declare under penalty of perjury under the laws of the State of California and the United States that the foregoing is true and correct.

Executed this 28 day of May, 2025.

Signed by:
Nell Green Nylen
2200DE50FD64477...

Nell Green Nylen

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EXHIBIT A

Nell Green Nylen

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Employment

Oct. 2013–Present **WHEELER WATER INSTITUTE | CENTER FOR LAW, ENERGY & THE ENVIRONMENT (CLEE), UNIVERSITY OF CALIFORNIA, BERKELEY, SCHOOL OF LAW** *Berkeley, CA*

Senior Research Fellow (Dec. 2016–present)
Research Fellow (Oct. 2013–Dec. 2016)
Research and write about California water law and policy, including sustainable groundwater management, groundwater recharge, governance and funding of regional monitoring programs, water rights administration and oversight, water innovation, the intersection of regulation and innovation in the wastewater sector, drinking water access and affordability, stormwater management, and citizen enforcement of the Clean Water Act. Engage with a range of governmental and non-governmental stakeholders.

Aug. 2012–Aug. 2013 **COLORADO SUPREME COURT** *Denver, CO*

Judicial Law Clerk for Justice Gregory J. Hobbs, Jr.
Researched and drafted opinions. Researched petitions and wrote recommendation memoranda. Reviewed proposed opinions. Edited co-clerks' and interns' writing. Provided interns with guidance and oversight. Dealt with a variety of civil and criminal cases and issues of state and federal law.

June 2011–Dec. 2011 **UNIVERSITY OF CALIFORNIA, BERKELEY, SCHOOL OF LAW** *Berkeley, CA*

Teaching Assistant (Part-time)
Helped students formulate independent theses and explore research options. Read and edited drafts of papers and memoranda, providing personalized feedback in individual conferences. Courses: *Legal Research and Writing, LL.M. Summer Program; Environmental Law Writing Seminar.*

May 2011–Aug. 2011 **CALIFORNIA ATTORNEY GENERAL'S OFFICE** *Oakland, CA*

Summer Honors Program Legal Intern, Environment, Land, and Natural Resources Law Sections
Researched and wrote legal memoranda on the California Air Resources Board's authority, remedies for spoliation of evidence, and the potential utility of a state Food Policy Council. Contributed to a brief opposing a jury trial in an enforcement action seeking injunctive relief and civil penalties for strict liability Health & Safety Code violations. Assisted deposition preparation for an archaeological resources enforcement case. Attended a case management conference, a motion hearing, an interview with a potential expert witness, depositions, and oral arguments.

May 2010–Aug. 2010 **CENTER FOR BIOLOGICAL DIVERSITY** *San Francisco, CA*

Legal Intern, Oceans and Urban Wildlands Programs
Drafted a complaint addressing inadequate lead-based paint cleanup on Midway Atoll. Researched and wrote a comment letter on a proposed residential development in the Santa Monica Mountains. Contributed to California condor section of Tejon Mountain Village Project opening brief. Researched and wrote legal memoranda. Engaged with CEQA, MBTA, ESA, RCRA, and California Coastal Act.

Jan. 2009–June 2009 **CALIFORNIA ACADEMY OF SCIENCES** *San Francisco, CA*

Research and Curatorial Assistant, Department of Invertebrate Zoology & Geology
Researched environmental preferences and food web associations and developed trophic guilds for animals from San Francisco Bay and an Indo-Pacific coral reef. Modeled food webs and extinction scenarios. Helped develop and maintain a comprehensive diatom taxon bibliography. Updated content and format of paleontology lab website.

Nov. 2006–Aug. 2008 **YALE PEABODY MUSEUM OF NATURAL HISTORY** *New Haven, CT*
Museum Assistant and GIS Specialist (Part-time)
Gathered and prepared georeferenced climatic/environmental data for Madagascar; modeled plant species distributions; prepared visual and tabular summaries of results to aid field research. Digitized herbarium (plant) specimens for online database.

Oct. 2006–Aug. 2008 **YALE UNIVERSITY** *New Haven, CT*
Assistant to Michael Donoghue, Professor of Ecology and Evolutionary Biology (Part-Time)
Provided research, graphics, website, and clerical support for professor who also served as the Director of the Yale Peabody Museum of Natural History through June of 2008.

Sept. 1995–Aug. 2001 **STANFORD UNIVERSITY** *Stanford, CA*
Undergraduate Teaching Assistant (Part-time) (Sept. 1995–June 1996)
Graduate Teaching Assistant (Part-time) (Sept. 1998–Aug. 2001)
Held office hours and review sessions; corrected assignments and exams; coordinated field trips and guest lectures; taught labs. Courses*: The Oceans: An Introduction to the Marine Environment; Statistical Methods for Earth and Environmental Sciences; Theories of the Origin of the Earth, Solar System, and Universe; The Coastal Zone Environment; Fundamentals of Geology Laboratory; Sophomore College: Geologic Hazards*.

July 1997–Aug. 1998 **MAPS AND RECORDS, STANFORD UNIVERSITY** *Stanford, CA*
GIS/CAD/Graphics Specialist (Sept. 1997–Aug. 1998)
GIS/Graphics Intern (July 1997–Sept. 1997)
Produced thematic maps for campus clients.

June 1996–June 1997 **UNITED STATES GEOLOGICAL SURVEY** *Menlo Park, CA*
Geologist
Mapped field geology. Digitized and edited geologic maps using ArcInfo GIS. Analyzed earthquake hazards, regional deformation, and landslide susceptibility in the San Francisco Bay area. Created web page for the International Lithosphere Program's Global Geoscience Transect (GGT) project.

Other Practical Legal Experience

Feb. 2011–May 2012 **ENVIRONMENTAL LAW SOCIETY** *Berkeley, CA*
Administrative Action Comment Team Member
Coordinated/contributed to public comments regarding Delaware River Basin Commission (DRBC) Draft Natural Gas Development Regulations (2011) and Drakes Bay Oyster Company (DBOC) Special Use Permit Draft Environmental Impact Statement (2011–12). Co-presented DRBC work at conference in Boston. Converted DBOC comment into Ecology Law Currents article.

Aug. 2011–Dec. 2011 **ENVIRONMENTAL JUSTICE PRACTICE PROJECT** *Berkeley, CA*
Tooleville Working Group Member
Served unincorporated Central Valley communities in practicum linked with California Rural Legal Assistance's Community Equity Initiative. Participated in Matheny Tract community survey. Attended Tooleville community meeting; researched and presented on Tooleville's relationship with special water districts to further residents' long-term goal of improving water quality and availability.

Aug. 2009–Mar. 2010 **CALIFORNIA ASYLUM REPRESENTATION CLINIC** *Berkeley, CA*
Volunteer Advocate
Interviewed client and helped prepare client's application for asylum. Represented client at asylum interview.

Education

May 2012 **UNIVERSITY OF CALIFORNIA, BERKELEY, SCHOOL OF LAW** *Berkeley, CA*
J.D. with Certificate of Specialization in Environmental Law

Honors
- Ellis J. Harmon Prize in Environmental Law & Policy (2012)
- Professor Joseph Sax Fellowship (2011)
- Public Interest/Public Sector Summer Fellowship (2010)
- Best Brief, Written and Oral Advocacy Section (2010)

Activities
- *Ecology Law Quarterly* (Articles Editor, 2011–2012; Currents Publishing Editor, 2010–2011)
- California Water Law Symposium (Symposium Co-chair, 2012)
- Environmental Law Society (Vice President–Internal Programming, 2010–2012)
- Students for Economic & Environmental Justice (Symposium Co-Organizer, 2010–2012)
- Animal Law Society (Secretary, 2010–2012)

June 2005 **STANFORD UNIVERSITY** *Stanford, CA*
Ph.D. in Geological & Environmental Sciences
Dissertation: A Multi-Proxy Approach to Understanding Plio-Pleistocene Climatic and Environmental Change Along the Coast of Northern California

Honors
- National Science Foundation Graduate Research Fellowship (1999–2002)
- McGee Fund Grants (1999, 2002)

June 1996 **STANFORD UNIVERSITY** *Stanford, CA*
B.S. with Departmental Honors in Geological & Environmental Sciences

Honors
- Departmental honors for thesis analyzing the paleoenvironmental history of a portion of the Merced Formation, San Francisco Peninsula, California (1996)
- Association of Women Geoscientists Outstanding Woman Student for Stanford University (1996)
- Undergraduate Research Opportunities Grant (1996)
- McGee Fund Grant (1996)

Publications

Journal Articles:

Hackett, L., **N. Green Nylen**, E.M. Bruno, A. Ayres, M. Kiparsky, J. Medellín-Azuara, & S. Null. "Estimating the Gains from Water Trade: A Systematic Evaluation of Modeling Considerations" (Submitted to *Review of Environmental Economics and Policy*).

Green Nylen, N., M. Kiparsky, and A. Milman. 2022. "Cultivating Effective Utility-Regulator Relationships Around Innovation: Lessons from Four Case Studies in the U.S. Municipal Wastewater Sector" *PLOS Water* 1(8): e0000031.

Cano Pecharroman, L., C. Williams, **N. Green Nylen**, and M. Kiparsky. 2021. "How Can We Govern Large-Scale Green Infrastructure for Multiple Water Security Benefits?" *Blue Green Systems* 3(1): 62–80.

Green Nylen, N. 2021. "Surface Water Quality Regulation as a Driver for Groundwater Recharge: The Case of Virginia's Sustainable Water Initiative for Tomorrow." *Case Studies in the Environment* 5(1): 1124592.

Owen, D., A. Cantor, **N. Green Nylen**, T. Harter, and M. Kiparsky. 2019. "California Groundwater Management, Science-Policy Interfaces, and the Legacies of Artificial Legal Distinctions." *Environmental Research Letters* 14(4): 045016.

Green Nylen, N. 2013. "Why Federal Dietary Guidelines Should Acknowledge the Food-Choice / Environment Nexus: Examining the Recommendation to Eat More Seafood." *Ecology Law Quarterly* 40: 759–794.

Green Nylen, N., E. Long, M. Loum, H. Welles, D. Carlin, B. Cook, & S. Adams. 2012. "Will the Wilderness Act Be Diluted in Drakes Estero?" *Ecology Law Currents* 39: 46–99.

Green Nylen, N. 2011. "To Achieve Biodiversity Goals, the New Forest Service Planning Rule Needs Effective Mandates for Best Available Science and Adaptive Management." *Ecology Law Quarterly* 38: 241–291.

Green Nylen, N. 2010. "Washington v. Chu: A Positive Sign for Hanford Cleanup?" *Ecology Law Quarterly* 37: 743–750.

Reports, Policy Papers, and Issue Briefs:

Kiparsky, M., D. Smith, F. Marcus, J. Mattingly, C. Mummert, and **N. Green Nylen**. 2024. *A Framework for Permitting Innovation in the Wastewater Sector*. U.S. Environmental Protection Agency Report: EPA 820R24006, 28 pp.

Bruce, M., N. Green Nylen, M. Kiparsky, H.E. Dahlke, R. Grimm, S. Null, E. Bruno, S. Khan, S. Naumes, J. Viers. 2024. *Information Needs for Water Markets: Fair and Fair and Effective Water Markets Require Adequate Measurement and Reporting of Diversion and Use*. Center for Law, Energy & the Environment, UC Berkeley School of Law, Berkeley, CA, 45 pp.

Marcus, F., **N. Green Nylen**, D. Owen, and M. Kiparsky. 2024. *Five Guiding Principles for Effective Voluntary Agreements: A Case Study on VAs for Water and Habitat in California's Bay-Delta Watershed*. Center for Law, Energy & the Environment, UC Berkeley School of Law. Berkeley, CA, 53 pp.

Fisher, A.T., **N. Green Nylen**, J. Pensky, M. Bruce, M. Kiparsky, V. Bautista, E. Kam, N. Santos, J. Viers, A. Rallings, and G. Fogg. 2023. *Pre-Feasibility Study for a Flood-MAR Program in the Santa Clara Valley Water District Service Area, Santa Clara County*. Water Resources Innovation Partnership. 78 pp.

Green Nylen, N., D. Owen, J. Harder, M. Kiparsky, and M. Hanemann. 2023. *Managing Water Scarcity: A Framework for Fair and Effective Water Right Curtailment in California*. Center for Law, Energy & the Environment, UC Berkeley School of Law. Berkeley, CA. 143 pp.

California State Water Resources Control Board and UCLA Luskin Center for Innovation. 2020. *Recommendations for Implementation of a Statewide Low-Income Water Rate Assistance Program*, 49 pp. (**Contributed legal analysis**).

California State Water Resources Control Board and UCLA Luskin Center for Innovation. 2020. *Recommendations for Implementation of a Statewide Low-Income Water Rate Assistance Program: Appendices*, 93 pp. (**Contributed legal analysis**).

Green Nylen, N., M. Kiparsky, D. Owen, H. Doremus, and M. Hanemann. 2018. *Addressing Institutional Vulnerabilities in California's Drought Water Allocation, Part 2: Improving Water Rights Administration and Oversight for Future Droughts*. California's Fourth Climate Change Assessment, California Natural Resources Agency, Publication number: CCCA4-CNRA-2018-010. 67 pp.

Green Nylen, N., M. Kiparsky, D. Owen, H. Doremus, and M. Hanemann. 2018. *Addressing Institutional Vulnerabilities in California's Drought Water Allocation, Part 1: Water Rights Administration and Oversight During Major Statewide Droughts, 1976–2016*. California's Fourth Climate Change Assessment, California Natural Resources Agency, Publication number: CCCA4-CNRA-2018-009. 172 pp.

Miller, K., **N. Green Nylen**, H. Doremus, D. Owen, and A. Fisher. 2018. Issue Brief: When Is Groundwater Recharge a Beneficial Use of Surface Water in California?. Center for Law, Energy & the Environment, University of California, Berkeley. Berkeley, CA. 8 pp.

Green Nylen, N., C. Pannu, and M. Kiparsky. 2018. *Learning from California's Experience with Small Water System Consolidations: A Workshop Synthesis*. Center for Law, Energy & the Environment, University of California, Berkeley. Berkeley, CA. 28 pp.

Miller, K., **N. Green Nylen**, H. Doremus, A. Fisher, G. Fogg, D. Owen, S. Sandoval Solis, J. Viers, and M. Kiparsky. 2018. Issue Brief: California's Stream Flow Monitoring System is Essential for Water Decision Making. Center for Law, Energy & the Environment, University of California, Berkeley. Berkeley, CA. 4 pp.

Cantor, A., D. Owen, T. Harter, **N. Green Nylen**, and M. Kiparsky. 2018. *Navigating Groundwater-Surface Water Interactions Under the Sustainable Groundwater Management Act*. Center for Law, Energy & the Environment, University of California, Berkeley. Berkeley, CA. 50 pp.

Green Nylen, N., M. Kiparsky, K. Archer, K. Schnier, H. Doremus. 2017. *Trading Sustainably: Critical Considerations for Local Groundwater Markets Under the Sustainable Groundwater Management Act*. Center for Law, Energy & the Environment, University of California, Berkeley. Berkeley, CA. 90 pp.

Green Nylen, N., L. Sherman, M. Kiparsky, and H. Doremus. 2016. *Citizen Enforcement and Sanitary Sewer Overflows in California*. Center for Law, Energy & the Environment, University of California, Berkeley. Berkeley, CA. 200 pp.

Kiparsky, M., D. Owen, **N. Green Nylen**, J. Christian-Smith, B. Cosens, H. Doremus, A. Fisher, and A. Milman. 2016. *Designing Effective Groundwater Sustainability Agencies: Criteria for Evaluation of Local Governance Options*. Center for Law, Energy & the Environment, University of California, Berkeley. Berkeley, CA. 63 pp.

Green Nylen, N. and M. Kiparsky. 2015. *Accelerating Cost-Effective Green Stormwater Infrastructure: Learning from Local Implementation*. Center for Law, Energy & the Environment, University of California, Berkeley. Berkeley, CA. 47 pp.

Blog Posts:

Green Nylen, N. and M. Bruce, "Meeting information needs for water markets: Understanding water diversion and use," *Legal Planet* (November 14, 2024).

Green Nylen, N., F. Marcus, D. Owen, and M. Kiparsky, "Evaluating Voluntary Agreements in the Bay-Delta Watershed," *Legal Planet* (January 26, 2024).

Green Nylen, N., M. Kiparsky, and A. Milman. "The Role of Regulatory Relationships in Wastewater Innovation." *Legal Planet* (May 23, 2023).

Green Nylen, N., D. Owen, J. Harder, M. Kiparsky, and M. Hanemann, "To Manage Water Scarcity, California Needs a Framework for Fair and Effective Water Right Curtailment," *Legal Planet* (April 24, 2023).

Kiparsky, M., D. Smith, **N. Green Nylen**, L. Sherman, A. Cantor, A. Milman, F. Marcus, D. Sedlak, B. Truffer, C. Binz, S. Harris-Lovett, J. Lape, J. Mattingly, D. Owen, L. Tummers, B. Thompson, "A decade of unraveling the effects of regulation on water innovation," *Legal Planet* (May 24, 2023).

Cano Pecharroman, L., C. Williams, **N. Green Nylen**, and M. Kiparsky, "Can we govern large-scale green infrastructure for multiple water benefits?" *Legal Planet* (February 22, 2022).

Green Nylen, N., "Losing Justice Hobbs, Western Water Expert and Valued Mentor," *Legal Planet* (December 15, 2021).

Lamm, T., K. Alex, L. Bedsworth, J. Diamond, **N. Green Nylen**, and K. Segal, "California's Recall Election Has Serious Climate and Environmental Implications: A new governor wouldn't disrupt core mandates but could redirect spending and priorities," Legal Planet (August 31, 2021).

Fritz, K. and **N. Green Nylen**, "When does a groundwater recharge project NOT need a water right?" *Legal Planet* (August 3, 2020).

Fritz, K. and **N. Green Nylen**, "Water Right Permitting Options for Groundwater Recharge: Avoiding Unintended Consequences," *Legal Planet* (July 27, 2020).

Green Nylen, N., "Making Key Policy Decisions in Advance of Droughts: Part 6 in a Series on Improving California Water Rights Administration and Oversight for Future Droughts," *Legal Planet* (May 24, 2019).

Green Nylen, N., "Developing a Decision-Support Framework for Curtailment: Part 5 in a Series on Improving California Water Rights Administration and Oversight for Future Droughts," *Legal Planet* (May 13, 2019).

Green Nylen, N., "A Contingency-Based Framework to Support Drought Decision Making: Part 4 in a Series on Improving California Water Rights Administration and Oversight for Future Droughts," *Legal Planet* (April 8, 2019).

Green Nylen, N., "Actions to Improve California Water Rights Administration and Oversight for Future Droughts: Part 3 in a Series on Improving California Water Rights Administration and Oversight for Future Droughts," *Legal Planet* (Mar. 29, 2019).

Green Nylen, N., "Water Rights Administration and Oversight During Past California Droughts: Part 2 in a Series on Improving California Water Rights Administration and Oversight for Future Droughts," *Legal Planet* (March 15, 2019).

Green Nylen, N., "Why It's Important to Prepare for Drought During a Deluge: Part 1 in a Series on Improving California Water Rights Administration and Oversight for Future Droughts," *Legal Planet* (March 7, 2019).

Green Nylen, N., "When Are Markets Appropriate Tools for Sustainably Managing Groundwater?" *Legal Planet* (August 7, 2017).

Doremus, H., **N. Green Nylen**, and M. Kiparsky, "Of Sewage Spills and Citizen Suits," *Legal Planet* (April 12, 2016).

Green Nylen, N., "Accelerating Cost-Effective Green Stormwater Infrastructure: Learning from Local Implementation," *Legal Planet* (February 25, 2015).

Green Nylen, N., "California's New Groundwater Law: An Interactive Timeline," *Legal Planet* (October 8, 2014).

Green Nylen, N., "California's Proposed Drinking Water Program Reorganization: A Primer," *Legal Planet* (January 21, 2014).

Green Nylen, N., H. Welles, D. Carlin, E. Long, and M. Loum, "Contextualizing Secretary Salazar's Recent Decision on Oyster Farming at Point Reyes." *Legal Planet* (December 10, 2012).

Service

University Service:

- Worked with 17 U.C. Berkeley student research assistants (10 undergraduate students through the Undergraduate Research Apprentice Program (URAP), 5 JD students, and 2 LLM students), *2014–Present*
- Hiring Committee Member, 2023, 2017, 2016, 2015, 2014
- Mentored undergraduate honors theses for two students, 2021–2022

Volunteer Board, Committee, and Advisory Group Service:

- Wastewater Needs Assessment Advisory Group Member, 2024–Present
  (group convened by the State Water Resources Control Board and UCLA Luskin Center for Innovation to aid evaluation of California's wastewater infrastructure baseline conditions and needs to inform opportunities for advancing equitable access to sanitation.

- Environmental Law Section Executive Committee, California Lawyers Association
  (Advisor, 2023–Present; Yosemite Conference Water Subcommittee Lead or Co-Lead, 2022–Present; Law School Outreach Committee Chair, 2022–Present; Voting Member, 2020–2023; Yosemite Conference Planning Co-Chair, 2021)
- California Water Law Symposium Board of Directors, 2019–Present
  (Secretary, 2021–Present; Writing Prize Coordinator, 2019–Present)
- NGO Groundwater Collaborative Member, 2015–Present
- County Drought Advisory Group Member, 2018–2020
  (group convened by the California Department of Water Resources to aid AB 1668 implementation)
- Oversight Committee Member for the Holland Tract Pilot, 2020
  (the pilot is a joint project of the Office of the Delta Watermaster and the State Water Resources Control Board's Division of Water Rights)
- Judging Committee Member, California Water Law Writing Prize, 2016–2017

Bar Admissions

California Bar, 2013 *(Inactive)*

EXHIBIT B

COVID-19 Update: EPA is providing flexibilities to applicants experiencing challenges related to COVID-19. Please see the **Flexibilities Available to Organizations Impacted by COVID-19** clause in Section IV of EPA's Solicitation Clauses.

OVERVIEW INFORMATION

U.S. Environmental Protection Agency
Office of Science Advisor, Policy and Engagement
Office of Research and Development
Science to Achieve Results (STAR) Program

LIFE-CYCLE ANALYSIS TO SUPPORT COST-EFFECTIVE ENHANCED AQUIFER RECHARGE

This is the initial announcement of this funding opportunity.

Funding Opportunity Number: EPA-G2022-STAR-C1

Catalog of Federal Domestic Assistance (CFDA) Number: 66.509

Solicitation Opening Date: ***October 27, 2021***
Solicitation Closing Date: ***January 13, 2022*****: 11:59:59 pm Eastern Time**

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For Updates and Additional Information (https://www.epa.gov/research-grants/research-funding-opportunities)
Access Standard STAR Forms (https://www.epa.gov/research-grants/research-funding-opportunities-how-apply-and-required-forms)
View research awarded under previous solicitations (https://www.epa.gov/research-grants/research-grant-areas)

SUMMARY OF PROGRAM REQUIREMENTS

Synopsis of Program:
The U.S. Environmental Protection Agency (EPA), as part of its Science to Achieve Results (STAR) program, is seeking applications proposing research to develop cost-benefit tools to support Enhanced Aquifer Recharge (EAR) as a viable, safe, and cost-effective water management strategy. Specifically, the proposed project should address the following research areas: (1) Identification of Priority Research and Development Needs to Support EAR, and (2) Development of Tools, Models, and Frameworks to Support EAR Implementation.

This solicitation provides the opportunity for the submission of applications for projects that may involve human subjects research. Human subjects research supported by the EPA is governed by EPA Regulation 40 CFR Part 26 (Protection of Human Subjects). This includes the Common Rule at subpart A and prohibitions and additional protections for pregnant women and fetuses, nursing women, and children at subparts B, C, and D. Research meeting the regulatory definition of intentional exposure research found in subpart B is prohibited by that subpart in pregnant women, nursing women, and children. Research meeting the regulatory definition of

observational research found in subparts C and D is subject to the additional protections found in those subparts for pregnant women and fetuses (subpart C) and children (subpart D). All applications must include a Human Subjects Research Statement (HSRS, as described in Section IV.C.6.c of this solicitation), and if the project involves human subjects research, it will be subject to an additional level of review prior to funding decisions being made as described in Sections V.D and V.F of this solicitation.

Guidance and training for investigators conducting EPA-funded research involving human subjects may be obtained here:
https://www.epa.gov/osa/basic-information-about-human-subjects-research-0
https://www.ecfr.gov/cgi-bin/text-idx?tpl=/ecfrbrowse/Title40/40cfr26_main_02.tpl

Award Information:
Anticipated Type of Award: Cooperative agreement
Estimated Number of Awards: 1 award
Anticipated Funding Amount: Approximately $2 million total
Potential Funding per Award: Up to a total of $2 million, including direct and indirect costs, with a maximum duration of 3 years. Cost-sharing is not required. Applications with budgets exceeding the total award limits will not be considered.

Eligibility Information:
Public and private nonprofit institutions/organizations, public and private institutions of higher education, and hospitals located in the U.S. and its territories or possessions; state and local governments; Federally Recognized Indian Tribal Governments; and U.S. territories or possessions are eligible to apply. See full announcement for more details.

Application Materials:
To apply under this solicitation, use the application package available at Grants.gov (for further submission information see Section IV.F. "Submission Instructions and other Submission Requirements"). Note: With the exception of the current and pending support form (available at https://www.epa.gov/research-grants/research-funding-opportunities-how-apply-and-required-forms), all necessary forms are included in the electronic application package. Make sure to include the current and pending support form in your Grants.gov submission.

If your organization is not currently registered with Grants.gov, you need to allow approximately one month to complete the registration process. Please note that the registration process also requires that your organization have a DUNS number and a current registration with the System for Award Management (SAM) and the process of obtaining both could take a month or more. Applicants must ensure that all registration requirements are met in order to apply for this opportunity through Grants.gov and should ensure that all such requirements have been met well in advance of the submission deadline. This registration, and electronic submission of your application, must be performed by an authorized representative of your organization.

If you do not have the appropriate internet access to utilize the Grants.gov application submission process for this solicitation, see Section IV.A below for additional guidance and instructions.

Agency Contacts:
Technical Contact: Jacquelyn Bell; phone: 202-564-4811; email: bell.jacquelyn@epa.gov
Eligibility Contact: Ron Josephson; phone: 202-564-7823; email: josephson.ron@epa.gov
Electronic Submissions Contact: Debra M. Jones; phone: 202-564-7839; email: jones.debram@epa.gov

I. FUNDING OPPORTUNITY DESCRIPTION

A. Introduction

One of the high-priority research areas identified by the Environmental Protection Agency's (EPA) Office of Research and Development (ORD) and Office of Water (OW) is to establish best practices for enhanced aquifer recharge and decentralized stormwater reuse. Under the 1996 Amendments to the Safe Drinking Water Act (SDWA), the responsibility for ensuring public water systems provide safe drinking water is divided among EPA, states, tribal nations, water systems and the public (U.S. EPA, 2020a). In addition, the National Water Reuse Action Plan (WRAP) was established in 2020 with federal, state, tribal, local, and water sector partners to build technical, financial, and institutional capacity for communities to pursue water reuse practices. This research is relevant to WRAP action 7.4 on increasing the understanding of current aquifer storage and recovery practices.

Overdraft of groundwater can lead to many issues that impact water quality and water security. Enhanced aquifer recharge (EAR) can be an important strategy to improve water security by restoring overdrawn or saline aquifers and enhancing water quality and supplies (Ross and Hasnain 2018). Research is needed to assist communities throughout the United States in evaluating whether to invest in EAR strategies that can improve water management and security in multiple ways. EPA is issuing this Request for Applications (RFA) to support research to develop cost-benefit tools to support EAR as a viable, safe, and cost-effective water management strategy.

The Science to Achieve Results (STAR) Program's goal is to stimulate and support scientific and engineering research that advances EPA's mission to protect human health and the environment. It is a competitive, peer-reviewed, extramural research program that provides access to the nation's best scientists and engineers in academic and other nonprofit research institutions. STAR funds research on the environmental and public health effects of air quality, environmental changes, water quality and quantity, hazardous waste, toxic substances, and pesticides.

EPA recognizes that it is important to engage all available minds to address the environmental challenges the Nation faces. At the same time, EPA seeks to expand the environmental

conversation by including members of communities which may have not previously participated in such dialogues to participate in EPA programs. For this reason, EPA strongly encourages all eligible applicants identified in Section III, including minority serving institutions (MSIs), to apply under this opportunity.

For purposes of this solicitation, the following are considered MSIs:

1. Historically Black Colleges and Universities, as defined by the Higher Education Act (20 U.S.C. § 1061(2)). A list of these schools can be found at Historically Black Colleges and Universities;

2. Tribal Colleges and Universities (TCUs), as defined by the Higher Education Act (20 U.S.C. § 1059c(b)(3) and (d)(1)). A list of these schools can be found at American Indian Tribally Controlled Colleges and Universities;

3. Hispanic-Serving Institutions (HSIs), as defined by the Higher Education Act (20 U.S.C. § 1101a(a)(5)). A list of these schools can be found at Hispanic-Serving Institutions;

4. Asian American and Native American Pacific Islander-Serving Institutions; (AANAPISIs), as defined by the Higher Education Act (20 U.S.C. § 1059g(b)(2)). A list of these schools can be found at Asian American and Native American Pacific Islander-Serving Institutions; and

5. Predominately Black Institutions (PBIs), as defined by the Higher Education Act of 2008, 20 U.S.C. 1059e(b)(6). A list of these schools can be found at Predominately Black Institutions.

B. Background

In many locations, EAR can be a cost-effective way to augment water supplies and increase water security. Since the 1960s, the implementation of EAR has increased at an accelerated rate with more than 544 EAR active wells across the United States (Payne 2014). However, the rate of adoption is not keeping pace with increasing groundwater extraction (Dillon et al. 2019). According to recent data, an estimated 20 percent of the world's aquifers are being over-exploited, as many people depend on aquifers for their water supply (Ross and Hasnain, 2018). The overuse of groundwater can lead to many issues that impact water quality and water security. Additionally, climate variability may exacerbate the need for aquifer recharge in areas experiencing increased intensity, frequency and duration of drought and extreme heat (Taylor, Richard G., et al. 2013). Wildland fires are also expected to increase in severity with drier and warmer climate patterns resulting in decreased water infiltration through post-burn hydrophobic soil (Parise and Cannon 2012).

EAR can be employed to augment water resources directly, or indirectly, for a variety of end uses. For the purpose of this RFA, EAR is defined as the intentional recharge of aquifers, including managed aquifer recharge (MAR), artificial recharge, aquifer storage and recovery (ASR) and related practices (NRC 2008). Examples include infiltration basins, dry wells,

injection wells, and other engineered structures and practices. As defined here, EAR does not include distributed green infrastructure (e.g., urban raingardens or swales) designed primarily for stormwater management (this was addressed in a previous RFA). EAR can increase water resource resiliency to mitigate the impacts of drought exacerbated by climate change, provide ways to combat saltwater intrusion near coastal communities, provide potable water where native groundwater has high mineral or metals content, help minimize land subsidence and aquifer compaction due to over consumption of existing groundwater supplies, aid in addressing surface water quality issues, and yield other benefits. In some cases, EAR can also be implemented to reduce demand on drinking water utilities by supplying water for irrigation and industrial uses (Jakeman et al. 2016).

Water managers need to integrate seasonal and long-term increases and decreases in precipitation patterns into planning efforts. In addition to accounting for increasing climatic spatiotemporal variability, EAR can be used as a risk management tool to provide inflows to surface water during droughts, or to store excess water when surface water levels are unusually high. Although currently less utilized in northeastern and midwestern states, EAR is a popular and reliable water supply option in southeast, southwest, and western states, and could become an essential tool to meet future water requirements in other regions (U.S. EPA, 2021).

The Arbuckle Simpson aquifer, a single-source, karst aquifer in Oklahoma is of particular relevance to this RFA. The aquifer provides drinking water to 39,000 people, including the Chickasaw Nation, and the Chickasaw National Recreation Area, which receives approximately 3.4 million visitors per year. Aquifer overdraft concerns resulted in extensive studies starting in 2002 to characterize the Arbuckle Simpson aquifer. While the results from these studies have provided better understanding about the subsurface movement of water and water quality, the Arbuckle Simpson case illustrates current difficulties of implementing EAR, such as the lack of comprehensive economic analyses to characterize potential infrastructure and treatment investments (Maliva, 2014).

Water sources for EAR operations can include highly treated municipal wastewater, captured stormwater, agricultural irrigation water runoff, and surface water (e.g., stream diversion). While treated wastewater and stormwater can be tightly controlled based on the types and degree of treatment used, water quality can vary widely for untreated stormwater and surface water. The use of treated wastewater for EAR has been implemented in the United States for decades (Dillon et al. 2019) and research has focused mainly on technical aspects. Fewer studies target life-cycle costs and benefits, including economic externalities, along with other economic, legal/regulatory, and institutional/planning level issues affecting the implementation of EAR, although these are also recognized as important potential challenges to implementation (Ross and Hasnain 2018, Dillon et al. 2009, Dillon et al. 2020, Miller et al. 2021). In addition to technical resources, water resource managers need cost/benefit tools and frameworks to guide navigation of legal/regulatory, planning, and organizational/institutional challenges to help with decisions on EAR options (Dillon et al. 2009, Miller et al. 2021). Additional research is needed to develop

tools and methods to determine where EAR would be a cost-effective water management strategy (Dillon et al. 2019).

EAR operations around the world vary widely (Ross and Hasnain 2018). Most of the EAR operations studies targeted augmentation of drinking/municipal water supplies. In general, infiltration/spreading basins using untreated water are relatively inexpensive, while operations using injection wells with highly treated water are more expensive. This RFA aims to identify the key economic, technological, institutional, and legal factors that affect the ability to implement EAR projects. For example, funding may support work to evaluate the costs and benefits of a variety of EAR systems in the U.S. from a life-cycle perspective, including capital, operations and maintenance costs, while quantifying the benefits with comparisons to other alternative water supply strategies. The RFA also seeks to identify best practices, including various fit-for-purpose uses of EAR and ancillary benefits (e.g., reduced stormwater discharges, flood mitigation, saline aquifer quality improvement, etc.).

Priorities for developing new tools, frameworks, and models to assist planning and implementation of EAR should be based on the results of a literature review, and also take into account current studies including experience with existing projects, and engagement with key stakeholders and water managers working on EAR. Additional information from EPA related to EAR can be found in EPA's recently published technical literature review (EPA, 2021) and through the Water Reuse Action Plan.

C. Authority and Regulations

The authorities for this RFA and resulting awards are contained in the Safe Drinking Water Act, 42 U.S.C. 300j-1, Section 1442, and the Clean Water Act, 33 U.S.C. 1254, Section 104(b)(3).

For research with an international aspect, the above statutes are supplemented, as appropriate, by the National Environmental Policy Act, Section 102(2)(F).

Note that a project's focus is to consist of activities within the statutory terms of EPA's financial assistance authorities; specifically, the statute(s) listed above. Generally, a project must address the causes, effects, extent, prevention, reduction and elimination of air pollution, water pollution, solid/hazardous waste pollution, toxic substances control or pesticide control depending on which statute(s) is listed above. Further note applications dealing with any aspect of or related to hydraulic fracking will not be funded by EPA through this program.

Additional applicable regulations include: 2 CFR Part 200, 2 CFR Part 1500, and 40 CFR Part 40 (Research and Demonstration Grants).

D. Specific Areas of Interest/Expected Outputs and Outcomes

Note to applicant: The term "output" means an environmental activity, effort, and/or associated work products related to an environmental goal or objective, that will be produced or provided

over a period of time or by a specified date. The term "outcome" means the result, effect or consequence that will occur from carrying out an environmental program or activity that is related to an environmental or programmatic goal or objective.

The activities to be funded under this announcement support EPA's FY 2018-22 Strategic Plan (https://www.epa.gov/planandbudget/strategicplan). Activities to be funded under this announcement support Goal 3: Greater Certainty, Compliance, and Effectiveness, Objective 3.3: Prioritize Robust Science, of EPA's FY 2018-22 Strategic Plan. All applications must be for projects that support the goal and objective identified above. Awards made under this announcement will further EPA's priorities supporting robust science for Safe and Sustainable Water Resources. The proposed research awards support the STAR Program's goal of stimulating and supporting scientific and engineering research that advances EPA's mission to protect human health and the environment in the area of Safe and Sustainable Water Resources by promoting quality research to support cost-effective EAR and improving access to clean and safe drinking water.

EPA also requires that grant applicants adequately describe environmental outputs and outcomes to be achieved under assistance agreements (see EPA Order 5700.7A1, Environmental Results under Assistance Agreements, https://www.epa.gov/grants/epa-order-57007a1-epas-policy-environmental-results-under-epa-assistance-agreements). Applicants must include specific statements describing the environmental results of the proposed project in terms of well-defined outputs and, to the maximum extent practicable, well-defined outcomes that will demonstrate how the project will contribute to the priorities described above.

The Agency is soliciting research that will improve life-cycle cost-benefits analysis to support cost-effective enhanced aquifer recharge. Applications under this solicitation should address both of the following research areas. Applications that do not address both research areas may not be rated as highly as those that do. Bulleted topics are listed under each research area for applicants to consider in shaping their research project. Applicants are not required to respond to all of the bulleted topics or limit the research scope to these bulleted topics.

Research Areas

Research Area 1: Identification of Priority Research and Development Needs to Support EAR

- Literature review.
    - Summarize available methodologies for quantifying costs and benefits of different water management and supply options.
    - Identify and characterize costs and treatment needs associated with different methods of EAR such as injection and spreading grounds using sources of water and different hydrological settings.
    - Identify costs associated with EAR conveyance and treatment needs to protect groundwater quality. This can include both conveyance to a treatment facility before injection/infiltration as well as conveyance to an injection or infiltration site.
    - Summarize methods for quantifying full life-cycle costs and benefits of EAR, taking into account energy costs and other environmental costs and benefits.

  - Evaluate and summarize regulatory and organizational/institutional approaches and issues associated with EAR in the U.S.
  - Evaluate and summarize the state of understanding of geochemical and physical considerations for EAR.
- EAR Stakeholder/Proponent Engagement
  Design and implement a process to engage water managers, EAR stakeholders, including tribes, and project proponents to identify the highest research priorities and frameworks for EAR implementation.
- Based on the literature review and EAR stakeholder/proponent engagement, develop a research framework for identified data gaps.

Research Area 2: Development of Tools, Models, and Frameworks to Support EAR Implementation

- Develop methods for addressing priority needs identified under Research Area 1, including, for example, economic models, and/or life-cycle cost frameworks to assist in planning and comparing/contrasting different EAR operations in different settings, including varying source water quality, subsurface conditions, impacts to the receiving aquifer, recharge rates, operation and maintenance, and end-uses. Potential regulatory, legal, and/or institutional barriers should be identified and, where feasible, be addressed in developed frameworks (e.g., recharge wells are regulated as Class V injection wells by EPA and state regulations vary) (EPA/CDM, 2017). Economic models should incorporate environmental benefits (e.g., elimination or reduction of stormwater/wastewater discharges) and other environmental and social factors.
- Develop tools to help water resource managers identify and implement planning strategies and best management practices for EAR to address the following end user goals to ultimately provide secure and clean sources of drinking water. Examples may include:
  - Clean drinking water
  - Municipal water supply
  - Saline water intrusion barriers
  - Ecological restoration
  - Other end user goals that supply water for non-potable uses to conserve other sources and help ensure access to drinking water such as:
    - Agricultural or landscape irrigation
    - Livestock water
    - Industrial uses
- Develop relevant cost and benefit tools that include different drivers and co-benefits of EAR. Examples may include:
  - Water supply augmentation and resiliency
  - Potential impacts to groundwater quality
  - Protection of existing water supplies (e.g., through a saline water intrusion barrier)
  - Management of stormwater and/or wastewater discharges and associated water quality benefits

  - Co-benefits of multiple benefit project approaches
  - Energy use and greenhouse gas emissions
  - Aquifer recharge credits
- Case Studies: The development of tools should incorporate the use of case studies to validate the research approach and demonstrate how the tools can be used by utilities and other regional water management entities in a practical scenario.

Expected Outputs and Outcomes

Outputs: Outputs expected from the award under this solicitation may include publications of research results in peer-reviewed journals, guidance documents, decision support tools, models, demonstrations and case studies, reports, and presentations related to EAR analysis and strategies.

These tools, models, and frameworks should be transferable to different regions of the United States, account for regional variations in costs, and be applicable in different physical/site and hydroclimatic settings, including consideration of extreme weather events and climate change. They should allow individual communities to insert place-specific data on capital costs; labor costs; hydrogeochemical conditions; historical, current and projected weather conditions; and other local factors that contribute to variations in life-cycle costs.

These methods, approaches, and models should help users to estimate the life-cycle costs of EAR projects in a simple and understandable manner. Furthermore, methods, approaches, and models should be scientifically robust and transparently convey uncertainties in the analyses. Models should be non-proprietary, open-source and based on open-access data. Principal investigators should describe how they intend to develop their life-cycle analysis models in a manner that can be shared with the general public in a programming language that is generally accessible. Moreover, they should describe how they intend to share data in an open, machine-readable format. They should also describe how they intend to document the metadata so that any secondary user will understand the data sources, consistent with the best practices articulated by EPA's data quality guidelines. Tools, models, and frameworks developed as part of this research should be user-friendly, transparent, and provide actionable information for local decision-makers.

Outcomes: The expected outcomes from the award include an improved understanding of the life-cycle analysis of EAR so that state, local and other decision-makers understand the costs and benefits of pursuing EAR strategies. The economic models and/or life-cycle cost frameworks, planning strategies, and best management practices developed under this award should:

- Empower decision-makers to make informed water management decisions that incorporate the environmental and social costs and benefits of different EAR applications.
- Include climate change considerations, such as atmospheric influences on groundwater levels and how changes in surface temperature can impact groundwater chemistry and water quality.

- Enable adaptive decision-making to account for how increasing demand will combine with decreased supply exacerbated by drier and warmer climate patterns.

Innovation and Sustainability

To the maximum extent practicable, research applications must embody innovation and sustainability. Innovation for the purposes of this RFA is defined as the process of making changes; a new method, custom or device. Innovative research can take the form of wholly new applications or applications that build on existing knowledge and approaches for new uses. Research applications must include a discussion on how the proposed research is innovative (see Section IV.C.6.a). The goal of sustainability, derived from the U.S. National Environmental Policy Act of 1969 (NEPA), is to "create and maintain conditions, under which humans and nature can exist in productive harmony, that permit fulfilling the social, economic and other requirements of present and future generations." Research applications must include a discussion on how the proposed research will seek sustainable solutions that protect the environment and strengthen our communities (see Section IV.C.6.a). Reviewers will draw from all of the above-mentioned innovation and sustainability definitions in the review/evaluation process of research applications (see Section V.A).

Community Engagement Plan

Collaboration and cooperative partnerships are strongly encouraged in the design and execution of the proposed research. Therefore, applications must include a Community Engagement Plan. Applications should, at minimum, describe how: a) applicants will work in partnership with appropriate partners (states, tribes, academia, industry groups, utilities, non-profit organizations, associations, and local communities/community-based organizations) to effectively design and implement the proposed project; b) to the extent possible, coordinate with and/or complement other projects or activities being performed by others that will result in a greater positive impact; and c) demonstrate how the proposed project will address the needs and concerns of local communities including how community-based organizations (as defined below) and/or other appropriate parties will be engaged to enhance the project's effectiveness and/or efficiency.

For the purpose of this announcement, a "community-based organization" generally means a nongovernmental organization that has demonstrated effectiveness as a representative of a community or a significant segment of a community and that helps members of that community obtain environmental, educational, or other social services. A community-based organization must be a nonprofit or not for profit corporation in good standing under state or Tribal law with authority to enter into binding legal agreements. The community-based organization need not be tax exempt under the Internal Revenue Code but may use documentation of tax-exempt status to demonstrate that it is a nonprofit.

The community engagement plan should:

- Describe the type of collaboration/engagement proposed and what role it will play in the overall project including the degree of partner and/or community input or engagement in the conceptualization, hypothesis/question development, design, methods, analyses and implementation of the research.

- Describe how the collaboration/engagement will enhance the overall impact of the project such that the project results are useable by state/local agencies, utilities, and impacted communities. This includes the capacity of the project to more effectively communicate risk and translate scientific results into easily understandable outreach and education materials.
- Describe how activities of the project will be coordinated with related or complementary projects and studies.
- Describe how the collaboration/engagement will materialize during project performance. Describe the partner(s)' intent to participate in the proposed research including evidence of support of an active partnership with states, tribes, academia, industry groups, utilities, non-profit organizations, associations, and/or local communities/community-based organizations (e.g., letter(s) of intent or support from community-based organizations, community leaders, state or local government agencies, non-government organizations, industry-based organizations, water utility managers, site managers or operators). Any letters demonstrating evidence of collaboration and support should be included as part of section IV.C.10.a. Letters of Intent/Letters of Support.

Applicants that do not plan on collaborating/engaging with other groups in project performance must still include a community engagement plan in their application describing how they will be able to effectively perform and complete the project without such collaboration/engagement.

E. References

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F. Special Requirements

It is EPA Policy to ensure that the results of EPA-funded extramural scientific research are accessible to the public to the greatest extent feasible consistent with applicable law; policies and Orders; the Agency’s mission; resource constraints; and U.S. national, homeland and economic security. This entails maximizing, at no charge, access by the public to peer-reviewed, scientific research journal publications or associated author manuscripts, and their underlying digital research data, created in whole or in part with EPA funds, while protecting personal privacy; recognizing proprietary interests, confidential business information and intellectual property rights; and avoiding significant negative impact on intellectual property rights, innovation and U.S. competitiveness. EPA’s *Policy for Increasing Access to Results of EPA-Funded Extramural Scientific Research* may be accessed at: https://www.epa.gov/research/non-epa-researcher-requirements. Terms and conditions implementing this policy may be accessed at: https://www.epa.gov/research/non-epa-researcher-requirements.

Applications submitted under this announcement shall include a Scientific Data Management Plan (SDMP) that addresses public access to EPA-funded scientific research data. See the SDMP clause in Section IV for details on the content of an SDMP. Applicants will also be asked to provide past performance information on whether journal publications or associated author manuscripts, and the associated underlying scientific research data and metadata, under prior assistance agreements were made publicly accessible. These items will be evaluated prior to award.

Reasonable, necessary and allocable costs for data management and public access as discussed in EPA's *Policy for Increasing Access to Results of EPA-Funded Extramural Scientific Research*, may be included in extramural research applications and detailed in the budget justification described in Section IV.

Agency policy and ethical considerations prevent EPA technical staff and managers from providing applicants with information that may create an unfair competitive advantage. Consequently, EPA employees will not review, comment, advise and/or provide technical assistance to applicants preparing applications in response to EPA RFAs. EPA employees cannot endorse any particular application.

Multiple Investigator applications may be submitted as: (1) a single Lead Principal Investigator (PI) application with Co-PI(s) or (2) a Multiple PI application (with a single Contact PI). If you choose to submit a Multiple PI application, you must follow the specific instructions provided in Sections IV. and V. of this RFA. For further information, please see the EPA Implementation Plan for Policy on Multiple Principal Investigators (https://www.epa.gov/research-grants/research-grants-guidance-and-policies).

This solicitation provides the opportunity for the submission of applications for projects that may involve human subjects research. All applications must include a Human Subjects Research Statement (HSRS; described in Section IV.C.6.c of this solicitation). If the project involves human subjects research, it will be subject to an additional level of review prior to funding decisions being made as described in Sections V.D and V.F of this solicitation.

Groups of two or more eligible applicants may choose to form a consortium and submit a single application for this assistance agreement. The application must identify which organization will be the recipient of the assistance agreement and which organizations(s) will be subawardees of the recipient.

These awards may involve the collection of "Geospatial Information," which includes information that identifies the geographic location and characteristics of natural or constructed features or boundaries on the Earth or applications, tools, and hardware associated with the generation, maintenance, or distribution of such information. This information may be derived from, among other things, a Geographic Positioning System (GPS), remote sensing, mapping, charting, and surveying technologies, or statistical data.

II. AWARD INFORMATION

It is anticipated that a total of approximately $2,000,000 will be awarded under this announcement, depending on the availability of funds, quality of applications received and other applicable considerations. The EPA anticipates funding approximately one award under this RFA. Requests for amounts in excess of a total of $2,000,000, including direct and indirect costs, will not be considered. The total project period requested in an application submitted for this RFA may not exceed 3 years.

The EPA reserves the right to reject all applications and make no awards, or make fewer awards than anticipated, under this RFA. The EPA reserves the right to make additional awards under this announcement, consistent with Agency policy, if additional funding becomes available after the original selections are made. Any additional selections for awards will be made no later than six months after the original selection decisions.

In appropriate circumstances, EPA reserves the right to partially fund applications by funding discrete portions or phases of proposed projects. If EPA decides to partially fund an application, it will do so in a manner that does not prejudice any applicants or affect the basis upon which the application, or portion thereof, was evaluated and selected for award, and therefore maintains the integrity of the competition and selection process.

EPA will award a *cooperative agreement* under this announcement. When addressing a research question/problem of common interest, collaborations between EPA scientists and the institution's principal investigators are permitted under a cooperative agreement. These collaborations may include data and information exchange, providing technical input to experimental design and theoretical development, coordinating extramural research with in-house activities, the refinement of valuation endpoints, and joint authorship of journal articles on these activities. **Applications may not identify EPA cooperators, specific interactions between EPA's investigators and those of the prospective recipient for cooperative agreements will be negotiated at the time of award.**

Cooperative agreements permit substantial involvement between the EPA and the selected applicants in the performance of the work supported. Although EPA will negotiate precise terms and conditions relating to substantial involvement as part of the award process, the anticipated Federal involvement proposed by EPA for this project may include:

- Coordination with the National Water Reuse Action Plan to share information as well as coordinate with ongoing projects being developed on enhanced aquifer recharge.
- Sharing EPA data from related projects.
- Quality assurance support including guidance on refining the applicants' Quality Assurance Project Plan (QAPP) to be written after award.
- Assistance in coordinating with other Federal Agencies and states to help grantees gain access to state and other agency/state/utility information.
- Assisting with data analysis and interpretation

- Sharing EPA research findings
- Joint authorship of journal articles
- Facilitating meetings between researchers and cities and/or state agencies
- Coordinating with researchers on public outreach
- Coordinating communication regarding STEM activities with researchers
- Identifying EPA regional experts that could provide information, research sharing, and other technical assistance to researchers

Potential applicants should contact Jacquelyn Bell; phone: 202-564-4811; email: bell.jacquelyn@epa.gov regarding questions pertaining to EPA's substantial involvement.

III. ELIGIBILITY INFORMATION

A. Eligible Applicants

Public and private nonprofit institutions/organizations, public and private institutions of higher education (IHEs), and hospitals located in the U.S. and its territories or possessions; state and local governments; Federally Recognized Indian Tribal Governments; and U.S. territories or possessions are eligible to apply. Profit-making firms and individuals are not eligible to apply.

Non-profit organization, as defined by 2 CFR 200.1, means any corporation, trust, association, cooperative or other organization, not including IHEs, that: (1) is operated primarily for scientific, educational, service, charitable or similar purposes in the public interest; (2) is not organized primarily for profit; and (3) uses net proceeds to maintain, improve, or expand the operations of the organization. Note that 2 CFR 200.1 specifically excludes Institutions of Higher Education from the definition of non-profit organization because they are separately defined in the regulation. While not considered to be a non-profit organization(s) as defined by 2 CFR 200.1, public or nonprofit Institutions of Higher Education are, nevertheless, eligible to submit applications under this RFA. Hospitals operated by state, tribal, or local governments or that meet the definition of nonprofit at 2 CFR 200.1 are also eligible to apply as nonprofits or as instrumentalities of the unit of government depending on the applicable law. For-profit colleges, universities, trade schools, and hospitals are ineligible. Nonprofit organizations described in Section 501(c) (4) of the Internal Revenue Code that lobby are not eligible to apply.

Foreign governments, international organizations, and non-governmental international organizations/institutions are not eligible to apply.

National laboratories funded by Federal Agencies (Federally-Funded Research and Development Centers, "FFRDCs") may not apply. FFRDC employees may cooperate or collaborate with eligible applicants within the limits imposed by applicable legislation and regulations. They may participate in planning, conducting, and analyzing the research directed by the applicant, but may not direct projects on behalf of the applicant organization. The institution, organization, or governance receiving the award may provide funds through its assistance agreement from the

EPA to an FFRDC for research personnel, supplies, equipment, and other expenses directly related to the research. However, salaries for permanent FFRDC employees may not be provided through this mechanism.

Federal Agencies may not apply. Federal employees are not eligible to serve in a principal leadership role on an assistance agreement. Federal employees may not receive salaries or augment their Agency's appropriations through awards made under this program unless authorized by law to receive such funding.

The applicant institution may enter into an agreement with a Federal Agency to purchase or utilize unique supplies or services unavailable in the private sector to the extent authorized by law. Examples are purchase of satellite data, chemical reference standards, analyses, or use of instrumentation or other facilities not available elsewhere. A written justification for federal involvement must be included in the application. In addition, an appropriate form of assurance that documents the commitment, such as a letter of intent from the Federal Agency involved, should be included.

Potential applicants who are uncertain of their eligibility should contact Ron Josephson in ORD, phone: 202-564-7823, email: josephson.ron@epa.gov.

B. Cost sharing

Institutional cost-sharing is not required.

C. Other

Applications must substantially comply with the application submission instructions and requirements set forth in Section IV of this announcement or they will be rejected. In addition, where a page limitation is expressed in Section IV with respect to parts of the application, pages in excess of the page limit will not be reviewed. In addition, applications must be submitted through Grants.gov as stated in Section IV of this announcement (except in the limited circumstances where another mode of submission is specifically allowed for as explained in Section IV) on or before the application submission deadline published in Section IV of this announcement. Applicants are responsible for following the submission instructions in Section IV of this announcement (see Section IV.F. "Submission Instructions and Other Submission Requirements" for further information) to ensure that their application is submitted timely. Applications submitted after the submission deadline will be considered late and deemed ineligible without further consideration unless the applicant can clearly demonstrate that it was late due to EPA mishandling or because of technical problems associated with Grants.gov or relevant SAM.gov system issues. An applicant's failure to timely submit their application through Grants.gov because they did not timely or properly register in SAM.gov or Grants.gov will not be considered an acceptable reason to consider a late submission.

In order to be deemed eligible, the application must include a Community Engagement Plan (see Section IV.C.6.e.) that demonstrates collaboration/engagement with partners in the design and

execution of the proposed research or how the applicant will be able to effectively perform and complete the project without such collaboration/engagement.

Also, applications exceeding the funding limits or project period term described herein will be rejected without review. Further, applications that fail to demonstrate a public purpose of support or stimulation (e.g., by proposing research which primarily benefits a Federal program or provides a service for a Federal agency) will not be funded.

Applications deemed ineligible for funding consideration will be notified within fifteen calendar days of the ineligibility determination.

IV. APPLICATION AND SUBMISSION INFORMATION

Additional provisions that apply to this solicitation and/or awards made under this solicitation, including but not limited to those related to confidential business information, contracts and subawards under grants, and proposal assistance and communications, can be found at https://www2.epa.gov/grants/epa-solicitation-clauses.

These, and the other provisions that can be found at the website link, are important, and applicants must review them when preparing applications for this solicitation. If you are unable to access these provisions electronically at the website above, please communicate with the EPA contact listed in this solicitation to obtain the provisions.

Formal instructions for submission through Grants.gov are in Section F.

A. Grants.gov Submittal Requirements and Limited Exception Procedures

Applicants must apply electronically through Grants.gov under this funding opportunity based on the grants.gov instructions in this announcement. If your organization has no access to the internet or access is very limited, you may request an exception for the remainder of this calendar year by following the procedures outlined here. Please note that your request must be received at least 15 calendar days before the application due date to allow enough time to negotiate alternative submission methods. Issues with submissions with respect to this opportunity only are addressed in section *F. Submission Instructions and Other Submission Requirements* below.

B. Application Package Information

Use the application package available at Grants.gov (see Section IV.F. "Submission Instructions and Other Submission Requirements"). Note: With the exception of the current and pending support form (available at https://www.epa.gov/research-grants/research-funding-opportunities-how-apply-and-required-forms), all necessary forms are included in the electronic application package. Make sure to include the current and pending support form in your Grants.gov submission.

An email will be sent by ORD to the Lead/Contact PI and the Administrative Contact (see below) to acknowledge receipt of the application and transmit other important information. The email will be sent from receipt.application@epa.gov; emails to this address will not be accepted. *If you do not receive an email acknowledgement within 10 calendar days of the submission closing date, immediately inform the Electronic Submissions Contact shown in this solicitation. Failure to do so may result in your application not being reviewed.* See Section IV.F. "Submission Instructions and Other Submission Requirements" for additional information regarding the application receipt acknowledgment.

C. Content and Form of Application Submission

The application is made by submitting the materials described below. **Applications must contain all information requested and be submitted in the formats described.**

1. Standard Form 424

The applicant must complete Standard Form 424. Instructions for completion of the SF424 are included with the form. However, note that EPA requires that the entire requested dollar amount appear on the SF424, not simply the proposed first year expenses. The form must contain the signature of an authorized representative of the applying organization.

Applicants are required to provide a DUNS number when applying for federal grants or cooperative agreements. Organizations may receive a DUNS number, at no cost, by calling the dedicated toll-free request line at 1-866-705-5711, or visiting the website at: https://www.dnb.com.

This program is eligible for coverage under E.O. 12372, "Intergovernmental Review of Federal Programs." An applicant should consult the office or official designated as the single point of contact in his or her State for more information on the process the State requires to be followed in applying for assistance, if the State has selected the program for review. EPA financial assistance programs and activities subject to intergovernmental review that have been selected for review under State single point of contact procedures are identified at https://www.epa.gov/grants/epa-financial-assistance-programs-subject-executive-order-12372-and-section-204-demonstration. Applicants for programs or activities subject to Intergovernmental Review that have not been selected for State single point of contact review must provide directly affected State, areawide, regional, and local entities at least 60 days to review their application following notification by EPA that the application has been selected for funding as provided by 40 CFR 29.8(a) and (c).

2. Key Contacts

The applicant must complete the "Key Contacts" form found in the Grants.gov application package. An "Additional Key Contacts" form is also available at https://www.epa.gov/research-grants/research-funding-opportunities-how-apply-and-required-forms. The Key Contacts form should also be completed for major sub-agreements (i.e., primary investigators). Do not include

information for consultants or other contractors. Please make certain that all contact information is accurate.

For Multiple PI applications: The Additional Key Contacts form ***must*** be completed (see Section I.F. for further information). *Note: The Contact PI must be affiliated with the institution submitting the application. EPA will direct all communications related to scientific, technical, and budgetary aspects of the project to the Contact PI; however, any information regarding an application will be shared with any PI upon request.* The Contact PI is to be listed on the Key Contact Form as the Project Manager/Principal Investigator (the term Project Manager is used on the Grants.gov form, the term Principal Investigator is used on the form located at https://www.epa.gov/research-grants/research-funding-opportunities-how-apply-and-required-forms). For additional PIs, complete the Major Co-Investigator fields and identify PI status next to the name (e.g., "Name: John Smith, Principal Investigator").

3. EPA Form 4700-4, Preaward Compliance Review Report for All Applicants and Recipients Requesting EPA Financial Assistance (available at https://www.epa.gov/research-grants/research-funding-opportunities-how-apply-and-required-forms).

4. Table of Contents
Provide a list of the major subdivisions of the application indicating the page number on which each section begins.

5. Abstract (1 page)

The abstract is a very important document in the review process. Therefore, it is critical that the abstract accurately describes the research being proposed and conveys all the essential elements of the research. Also, the abstracts of applications that receive funding will be posted on EPA's Research Grants website.

The abstract must include the information described below (a-h). Examples of abstracts for current grants may be found on EPA's Research Grants website.

a. Funding Opportunity Title and Number for this application.

b. Project Title: Use the exact title of your project as it appears in the application. The title must be brief yet represent the major thrust of the project. Because the title will be used by those not familiar with the project, use more commonly understood terminology. Do not use general phrases such as "research on."

c. Investigators: For applications with multiple investigators, state whether this is a single Lead PI (with co-PIs) or Multiple PI application (see Section I.F.). For Lead PI applications, list the Lead PI, then the name(s) of each co-PI who will significantly contribute to the project. For Multiple PI applications, list the Contact PI, then the name(s) of each additional PI. Provide a website URL or an email contact address for additional information.

d. Institution(s): In the same order as the list of investigators, list the name, city and state of each participating university or other applicant institution. The institution applying for assistance must be clearly identified.

e. Project Period and Location: Show the proposed project beginning and ending dates and the performance site(s)/geographical location(s) where the work will be conducted.

f. Project Cost: Show the total funding requested from the EPA (include direct and indirect costs for all years).

g. Project Summary: Provide three subsections addressing: (1) the objectives of the study (including any hypotheses that will be tested), (2) the experimental approach to be used (a description of the proposed project) and (3) the expected results (outputs/outcomes) of the project and how it addresses the research needs identified in the solicitation, including the estimated improvement in risk assessment or risk management that will result from successful completion of the proposed work.

h. Supplemental Keywords: Without duplicating terms already used in the text of the abstract, list keywords to assist database searchers in finding your research. A list of suggested keywords may be found at: https://www.epa.gov/research-grants/research-funding-opportunities-how-apply-and-required-forms.

6. Research Plan, Quality Assurance Statement, Human Subjects Research Statement, Scientific Data Management Plan, Community Engagement Plan, and References

a. Research Plan (15 pages)

Applications should focus on a limited number of research objectives that adequately and clearly demonstrate that they meet the RFA requirements. Explicitly state the main hypotheses that you will investigate, the data you will create or use, the analytical tools you will use to investigate these hypotheses or analyze these data and the results you expect to achieve. Research methods must be clearly stated so that reviewers can evaluate the appropriateness of your approach and the tools you intend to use. A statement such as: “we will evaluate the data using the usual statistical methods” is not specific enough for peer reviewers.

This description must not exceed fifteen (15) consecutively numbered (bottom center), 8.5x11-inch pages of single-spaced, standard 12-point type with 1-inch margins. While these guidelines on page size, point type and margins establish the minimum type size requirements, applicants are advised that readability is of paramount importance and should take precedence in selection of an appropriate font for use in the application.

The description must provide the following information:

(1) Objectives: List the objectives of the proposed research and the hypotheses being tested during the project, and briefly state why the intended research is important, how it supports the Agency's research priorities and how it fulfills the requirements of the solicitation. This section should also include any background or introductory information that would help explain the objectives of the study. If this application is to expand upon research supported by an existing or former assistance agreement awarded under the STAR program, indicate the number of the agreement and provide a brief report of progress and results achieved under it.

(2) Approach/Activities: Outline the research design, methods and techniques that you intend to use in meeting the objectives stated above.

(3) a. Innovation: Describe how your project shifts current research or engineering paradigms by using innovative theoretical concepts, approaches or methodologies, instrumentation or interventions applicable to one or more fields of research.
b. Sustainability: Describe how your project embodies the principles of sustainability and seeks sustainable solutions that protect the environment and strengthen our communities. The sustainability primer (https://www.epa.gov/sites/production/files/2015-05/documents/sustainability_primer_v9.pdf) provides examples of research activities that promote and incorporate sustainability principles.

(4) Expected Results, Benefits, Outputs and Outcomes: Describe the expected outputs and outcomes resulting from the project. This section should also discuss how the research results will lead to solutions to environmental problems and improve the public's ability to protect the environment and human health. A clear, concise description will help ORD and peer reviewers understand the merits of the research.

(5) Project Management: Discuss other information relevant to the potential success of the project. This should include facilities, personnel expertise/experience, project schedules with associated milestones and target dates, proposed management, interactions with other institutions, etc. Describe the approach, procedures and controls for ensuring that awarded grant funds will be expended in a timely and efficient manner and detail how project objectives will be successfully achieved within the grant period. Describe how progress toward achieving the expected results (outputs and outcomes) of the research will be tracked and measured. Applications for multi-investigator projects must identify project management and the functions of each investigator in each team and describe plans to communicate and share data.

(6) Appendices may be included but must remain within the 15-page limit.

b. Quality Assurance Statement (3 pages)
For projects involving environmental data collection or processing, conducting surveys, modeling, method development or the development of environmental technology (whether hardware-based or via new techniques), provide a Quality Assurance Statement (QAS) regarding the plans for processes that will be used to ensure that the products of the research satisfy the

intended project objectives. Follow the guidelines provided below to ensure that the QAS describes a system that complies with EPA Quality Standards found at: https://www.epa.gov/quality/agency-wide-quality-program-documents. Do not exceed three consecutively numbered, 8.5x11-inch pages of single-spaced, standard 12-point type with 1-inch margins.

NOTE: If selected for award, applicants will be expected to provide additional quality assurance documentation.

Address each applicable section below by including the required information, referencing the specific location of the information in the Research Plan or explaining why the section does not apply to the proposed research. (Not all will apply)

(1) Identify the individual who will be responsible for the quality assurance (QA) and quality control (QC) aspects of the research along with a brief description of this person's functions, experience and authority within the research organization. Describe the schedule and type of assessments to be conducted along with the corrective action process for each assessment proposed. Describe the organization's general approach for conducting quality research. *(QA is a system of management activities to ensure that a process or item is of the type and quality needed for the project. QC is a system of activities that measures the attributes and performance of a process or item against the standards defined in the project documentation to verify that they meet those stated requirements).*

(2) Discuss project objectives, including quality objectives, any hypotheses to be tested, and the quantitative and/or qualitative procedures that will be used to evaluate the success of the project. Include any plans for peer or other reviews of the study design or analytical methods.

(3) Address each of the following project elements as applicable:

(a) Collection of new/primary data:
*(**Note:** In this case the word "sample" is intended to mean any finite part of a statistical population whose properties are studied to gain information about the whole. If certain attributes listed below do not apply to the type of samples to be used in your research, simply explain why those attributes are not applicable).*

(i) Discuss the plan for sample collection and analysis. As applicable, include sample type(s), frequency, locations, sample sizes, sampling procedures and the criteria for determining acceptable data quality (e.g., precision, accuracy, representativeness, completeness, comparability or data quality objectives).

(ii) Describe the procedures for the handling and custody of samples including sample collection, identification, preservation, transportation and storage, and how the accuracy of test measurements will be verified.

(iii) Describe or reference each analytical method to be used, any QA or QC checks or procedures with the associated acceptance criteria and any procedures that will be used in the calibration and performance evaluation of the analytical instrumentation.

(iv) Discuss the procedures for overall data reduction, analysis and reporting. Include a description of all statistical methods to make inferences and conclusions, acceptable error rates and/or power, and any statistical software to be used.

(b) Use of existing/secondary data (i.e., data previously collected for other purposes or from other sources):

(i) Identify the types of secondary data needed to satisfy the project objectives. Specify requirements relating to the type of data, the age of data, geographical representation, temporal representation and technological representation, as applicable.

(ii) Specify the source(s) of the secondary data and discuss the rationale for selection.

(iii) Establish a plan to identify the sources of the secondary data in all deliverables/products.

(iv) Specify quality requirements and discuss the appropriateness for their intended use. Accuracy, precision, representativeness, completeness and comparability need to be addressed, if applicable.

(v) Describe the procedures for determining the quality of the secondary data.

(vi) Describe the plan for data management/integrity.

(c) Method development:

*(**Note:** The data collected for use in method development or evaluation should be described in the QAS as per the guidance in section 3A and/or 3B above).*

Describe the scope and application of the method, any tests (and measurements) to be conducted to support the method development, the type of instrumentation that will be used and any required instrument conditions (e.g., calibration frequency), planned QC checks and associated criteria (e.g., spikes, replicates, blanks) and tests to verify the method's performance.

(d) Development or refinement of models:

*(**Note:** The data collected for use in the development or refinement of models should be described in the QAS as per the guidance in section 3A and/or 3B above).*

(i) Discuss the scope and purpose of the model, key assumptions to be made during development/refinement, requirements for code development and how the model will be documented.

(ii) Discuss verification techniques to ensure the source code implements the model correctly.

(iii) Discuss validation techniques to determine that the model (assumptions and algorithms) captures the essential phenomena with adequate fidelity.

(iv) Discuss plans for long-term maintenance of the model and associated data.

(e) Development or operation of environmental technology:
*(**Note:** The data collected for use in the development or evaluation of the technology should be described in the QAS as per the guidance in section 3A and/or 3B above).*

(i) Describe the overall purpose and anticipated impact of the technology.

(ii) Describe the technical and quality specifications of each technology component or process that is to be designed, fabricated, constructed and/or operated.

(iii) Discuss the procedure to be used for documenting and controlling design changes.

(iv) Discuss the procedure to be used for documenting the acceptability of processes and components and discuss how the technology will be benchmarked and its effectiveness determined.

(v) Discuss the documentation requirements for operating instructions/guides for maintenance and use of the system(s) and/or process(s).

(f) Conducting surveys:
(Note: The data to be collected in the survey and any supporting data should be described in the QAS as per the guidance in section 3A and/or 3B above).

Discuss the justification for the size of the proposed sample for both the overall project and all subsamples for specific treatments or tests. Identify and explain the rational for the proposed statistical techniques (e.g., evaluation of statistical power).

(4) Discuss data management activities (e.g., record-keeping procedures, data-handling procedures and the approach used for data storage and retrieval on electronic media). Include any required computer hardware and software and address any specific performance requirements for the hardware/software configuration used.

c. EPA Human Subjects Research Statement (HSRS) (4 pages)

Human subjects research supported by the EPA is governed by EPA Regulation 40 CFR Part 26 (Protection of Human Subjects). This includes the Common Rule at subpart A and prohibitions and additional protections for pregnant women and fetuses, nursing women and children at

subparts B, C and D. While retaining the same notation, subparts B, C and D are substantively different in 40 CFR Part 26 than in the more commonly cited 45 CFR 46. Particularly noteworthy is that research meeting the regulatory definition of intentional exposure research found in subpart B is prohibited by that subpart in pregnant women, nursing women and children. Research meeting the regulatory definition of observational research (any research that is not intentional exposure research) found in subparts C and D is subject to the additional protections found in those subparts for pregnant women and fetuses (subpart C) and children (subpart D). These subparts also differ markedly from the language in 45 CFR 46. For more information, please see: https://www.epa.gov/osa/basic-information-about-human-subjects-research-0.

Procedures for the review and oversight of human research subject to 40 CFR Part 26 are also provided in EPA Order 1000.17A (https://www.epa.gov/osa/epa-order-100017-policy-and-procedures-protection-human-research-subjects-epa-conducted-or). These include review of projects for EPA-supported human research by the EPA Human Subjects Research Review Official (HSRRO). Additional requirements must be met and final approval must be received from the HSRRO before the human subjects' portion of the research can begin. When reviewing human observational exposure studies, EPA Order 1000.17A requires the HSRRO to apply the principles described in the SEAOES document (https://nepis.epa.gov/Exe/ZyPDF.cgi/P10012LY.PDF?Dockey=P10012LY.PDF) and grant approval only to studies that adhere to those principles.

All applications submitted under this solicitation must include a HSRS as described below. For more information about what constitutes human subjects research, please see: https://www.epa.gov/osa/basic-information-about-human-subjects-research-0. For information on the prohibition on the inclusion of vulnerable subjects in intentional exposure research, please see: https://www.epa.gov/osa/basic-information-about-human-subjects-research-0.

Human Subjects Research Statement (HSRS) Requirements

If the proposed research **does not** involve human subjects as defined above, provide the following statement in your application package as your HSRS: "The proposed research does not involve human subjects." Applicants should provide a clear justification about how the proposed research does not meet the definition (for example, all samples come from deceased individuals OR samples are purchased from a commercial source and provided without identifiers, etc.).

If the proposed research **does** involve human subjects, then include in your application package a HSRS that addresses each applicable section listed below, referencing the specific location of the information in the Research Plan, providing the information in the HSRS or explaining why the section does not apply to the proposed research. (Not all will apply). Please note that even research that has been determined to be exempt from the human subjects regulations by an IRB must be reviewed by the EPA HSRRO. Therefore, consider exempt research to include human subjects work for this EPA solicitation. Do not exceed **four** consecutively numbered, 8.5x11-inch pages of single-spaced, standard 12-point type with 1-inch margins. The factors below are not intended to be exhaustive of all those needed for the HSRRO to provide the final approval

necessary for research to be conducted but provide a basis upon which the human subjects oversight review may begin.

NOTE: Researchers must provide evidence of an assurance on file with the U.S. Department of Health and Human Services (HHS) or other Federal Agency that it will comply with regulatory provisions in the Common Rule. In special circumstances where there is no such assurance, EPA will work with investigators to obtain an assurance from HHS or another source.

Complete all items below for studies involving human subjects.
Protection of Human Subjects (*Adapted from National Institutes of Health Supplemental Instructions for PHS 398 and SF424 (R&R) II-10)

1. Risks to Human Subjects

a. Human Subjects Involvement, Characteristics and Design

- Describe and justify the proposed involvement of human subjects in the work outlined in the Research Strategy section.
- Describe the characteristics of the subject population, including their anticipated number, age range and health status, if relevant.
- Describe and justify the sampling plan, including retention strategies and the criteria for inclusion or exclusion of any subpopulation.
- Explain the rationale for the involvement of special vulnerable populations, such as pregnant women, children or others who may be considered vulnerable populations.
- If relevant to the proposed research, describe procedures for assignment to a study group. As related to human subject's protection, describe and justify the selection of an intervention's dose, frequency and administration.
- List any collaborating sites where human subjects research will be performed and describe the role of those sites and collaborating investigators in performing the proposed research. Explain how data from the site(s) will be obtained, managed and protected.

b. Sources of Materials

- Describe the research material obtained from living individuals in the form of specimens, records or data.
- Describe any data that will be collected from human subjects for the project(s) described in the application.
- Indicate who will have access to individually identifiable private information about human subjects.
- Provide information about how the specimens, records and/or data are collected, managed and protected as well as whether material or data that include individually identifiable private information will be collected specifically for the proposed research project.

c. Potential Risks

- Describe all the potential risks to subjects posed by participation in the research (physical, psychological, financial, legal or other), and assess their likelihood and seriousness to the human subjects.

• Where appropriate, describe alternative treatments and procedures, including the risks and potential benefits of the alternative treatments and procedures, to participants in the proposed research.

2. Adequacy of Protection Against Risks

a. Recruitment and Informed Consent

• Describe plans for the recruitment of subjects (where appropriate) and the process for obtaining informed consent. If the proposed studies will include children, describe the process for meeting requirements for parental permission and child assent.

• Include a description of the circumstances under which consent will be sought and obtained, who will seek it, the nature of the information to be provided to prospective subjects and the method of documenting consent. If a waiver of some or all of the elements of informed consent will be sought, provide justification for the waiver.

b. Protections Against Risk

• Describe planned procedures for protecting against or minimizing potential risks, including risks to privacy of individuals or confidentiality of data and assess their likely effectiveness.

• Research involving vulnerable populations, as described in the EPA regulations, Subparts B-D, must include additional protections. Refer to EPA guidance:

- Prohibition of Research Conducted or Supported by EPA Involving Intentional Exposure of Human Subjects who are Children or Pregnant or Nursing Women https://www.epa.gov/osa/basic-information-about-human-subjects-research-0

- Additional Protections for Pregnant Women and Fetuses Involved as Subjects in Observational Research Conducted or Supported by EPA https://www.epa.gov/osa/basic-information-about-human-subjects-research-0

- Additional Protections for Children Involved as Subjects in Observational Research Conducted or Supported by EPA https://www.epa.gov/osa/basic-information-about-human-subjects-research-0

• Where appropriate, discuss plans for ensuring necessary medical or professional intervention in the event of adverse effects to the subjects. Studies that involve clinical trials must include a general description of the plan for data and safety monitoring of the clinical trials and adverse event reporting to the IRB, the DSMB (if one has been established for the trial), the EPA and others, as appropriate, to ensure the safety of subjects.

3. Potential Benefits of the Proposed Research to Human Subjects and Others

• Discuss the potential benefits of the research to research participants and others.

• Discuss why the risks to subjects are reasonable in relation to the anticipated benefits to research participants and others.
• Please note that financial compensation of subjects is not considered to be a benefit of participation in research.

4. Importance of the Knowledge to be Gained
• Discuss the importance of the knowledge to be gained as a result of the proposed research.
• Discuss why the risks to subjects are reasonable in relation to the importance of the knowledge that reasonably may be expected to result.

Note that an Interventional Study (or Clinical Trial) is a clinical study in which participants are assigned to receive one or more interventions (or no intervention) so that researchers can evaluate the effects of the interventions on biomedical or health-related outcomes; the assignments are determined by the study protocol.

d. Scientific Data Management Plan (2 pages)

Applications submitted in response to this solicitation must include a Scientific Data Management Plan (SDMP) that addresses public access to EPA-funded scientific research data by including the information below:

(1) If the proposed research described in the application is expected to result in the generation of scientific research data, the application must include a Scientific Data Management Plan (SDMP) of up to two single-spaced pages (this is in addition to any application page limits described in Section IV of this solicitation that apply to other parts of the application package) describing plans for providing long-term preservation of, and public access to, the scientific research data and accompanying metadata created and/or collected under the award (including data generated under subawards and contracts) funded in whole or in part by EPA. The SDMP should indicate that recipients will make accessible, at a minimum, scientific research data and associated metadata underlying their scientific research journal publications funded in whole or in part by EPA. SDMPs should reflect relevant standards and community best practices for data and metadata and make use of community-accepted repositories whenever practicable. The contents of the SDMP (or absence thereof) will be considered as part of the application review process for selected applicants as described in Section V and must be deemed acceptable for the applicant to receive an award. The SDMP should include the following elements (Note: If any of the items listed below do not apply, please explain why):

i. Types of scientific research data and metadata expected to be generated and/or collected under the award.
ii. The location where the data will be publicly accessible.
iii. The standards to be used for data/metadata format and content.
iv. Policies for accessing and sharing data including provisions for appropriate protection of privacy, security, intellectual property, and other rights or requirements consistent with applicable laws, regulations, rules, and policies.

v. Plans for digital data storage, archiving, and long-term preservation that address the relative value of long-term preservation and access along with the associated costs and administrative burden.
vi. Description of how data accessibility and preservation will enable validation of published results or how such results could be validated if data are not shared or preserved.
vii. Roles and responsibilities for ensuring SDMP implementation and management (including contingency plans in case key personnel leave the project).
viii. Resources and capabilities (equipment, connections, systems, software, expertise, etc.) requested in the research application that are needed to meet the stated goals for accessibility and preservation (reference can be made to the relevant section of the research application's budget justification).
ix. If appropriate, an explanation as to why data accessibility and/or preservation are not possible.

(2) If the proposed research is not expected to result in the generation of scientific research data, provide the following statement (not subject to any application page limits described in Section IV of this solicitation) in your application as the SDMP: "The proposed research is not expected to result in the generation of scientific research data." If scientific research data are generated after award, the recipient agrees to update the statement by providing EPA with a revised SDMP (see content of SDMP described above) describing how scientific research data and accompanying metadata created and/or collected under the award (including data generated under subawards and contracts) will be preserved and, as appropriate, made publicly accessible.

e. Community Engagement Plan (5 pages, not including letters of intent/support)

Provide a plan to detail strategies for promoting and/or obtaining collaboration/engagement and support from appropriate partners such as MSIs, states, tribes, academia, industry groups, non-profit organizations, utilities, associations, and local communities/community-based organizations. Applicants should document the following:

- Describe the type of collaboration/engagement proposed and what role it will play in the overall project including the degree of partner and/or community input or engagement in the conceptualization, hypothesis/question development, design, methods, analyses and implementation of the research.
- Describe how the collaboration/engagement will enhance the overall impact of the project such that the project results are useable by state/local agencies, utilities, and impacted communities. This includes the capacity of the project to more effectively communicate risk and translate scientific results into easily understandable outreach and education materials.
- Describe how activities of the project will be coordinated with related or complementary projects and studies.
- Describe how the collaboration/engagement will materialize during project performance. Describe the partner(s)' intent to participate in the proposed research including evidence of support of an active partnership with MSIs, states, tribes, academia, industry groups, non-profit organizations, utilities, associations, and/or local communities/community-based organizations (e.g., letter(s) of intent or support from MSIs, community-based

organizations, community leaders, state or local government agencies, non-government organizations, utilities, industry, water utility managers, site managers or operators). Any letters demonstrating evidence of collaboration and support should be included as part of section IV.C.10.a. Letters of Intent/Letters of Support.

- Applicants that do not plan on collaborating/engaging with other groups in project performance should describe how they will be able to effectively perform and complete the project without such collaboration/engagement.
- Allocate appropriate resources as needed to the research partners to ensure success of the collaboration, e.g., delineating funds under the project's budget for community participation. Examples include:
    i. travel/stipends for partners and community members to participate in advisory group meetings, workshops, and focus groups,
    ii. subawards to eligible organizations for their involvement in the proposed research.

EPA requires that estimated amounts for subawards and individual participant support costs be classified as "Other" for the purposes of the budget table (aka SF-424A). Please see (EPA Solicitation Clauses) for EPA guidance on competition for contractors (including consulting contracts) and acceptable noncompetitive subawards. Applicants may provide subawards to partners to enhance project effectiveness and/or efficiency. Note that applicants, not EPA, will select their subawardees and the applicants must demonstrate in their application that the organization(s) or other groups are willing to accept the subaward and have the capacity to effectively administer and perform the agreement. The selected applicant who proposes to make subawards, including those to partners must follow proper procedures in making subawards and will be expected to make the subawards consistent with their application.

f. References: References cited are in addition to other page limits (e.g., research plan, quality assurance statement).

7. Budget and Budget Justification

a. Budget

Prepare a master budget table using "SF-424A Budget Information for Non-Construction Programs" (aka SF-424A), available in the Grants.gov electronic application package and also at https://www.epa.gov/research-grants/research-funding-opportunities-how-apply-and-required-forms. Only complete "Section B-Budget Categories". Provide the object class budget category (a. - k.) amounts for each budget year under the "Grant Program, Function or Activity" heading. Each column reflects a separate budget year. For example, Column (1) reflects budget year 1. The total budget will be automatically tabulated in column (5).

Applicants may not use subagreements to transfer or delegate their responsibility for successful completion of their EPA assistance agreement. Please refer to https://www2.epa.gov/grants/epa-solicitation-clauses#Contracts and Subawards if your organization intends to identify specific contractors, including consultants, or subrecipients in your application.

Please note that institutional cost-sharing is not required.

b. Budget Justification *[3 pages in addition to the Section IV.C.6 page limitations]*

Identify the amount requested for each budget category and describe the basis for calculating the personnel, fringe benefits, travel, equipment, supplies, contractual support and other costs identified in the SF-424A. The budget justification should not exceed three consecutively numbered (bottom center), 8.5x11-inch pages of single-spaced, standard 12-point type with 1-inch margins. EPA provides detailed guidance on preparing budgets and budget justifications in the Agency's Interim General Budget Development Guidance for Applicants and Recipients of EPA Financial Assistance.

Budget information must be supported at the level of detail described below:

(1) Personnel: List all staff positions by title. Give annual salary, percentage of time assigned to the project, total cost for the budget period, project role and specify any annual cost of living adjustments. Compensation paid for employees engaged in grant activities must be consistent with payments for similar work within the applicant organization. Note that for salaries to be allowable as a direct charge to the award, a justification of how that person will be directly involved in the project must be provided. General administrative duties such as answering telephones, filing, typing or accounting duties are not considered acceptable.

Below is a sample computation for Personnel:

Position/Title	**Annual Salary**	**% of Time Assigned to Project**	**Year 1**	**Year 2***	**Year 3***	**Total**
Project Manager	$70,000	50%	$35,000	$36,050	$37,132	$108,182
Env. Specialist	$60,000	100%	$60,000	$61,800	$63,654	$185,454
Env. Health Tech	$45,000	100%	$45,000	$46,350	$47,741	$139,091
Total Personnel			**$140,000**	**$144,200**	**$148,527**	**$432,727**

***There is a 3% increase after Year 1 for all personnel for cost of living adjustments**

Note this budget category is limited to persons employed by the applicant organization ONLY. Those employed elsewhere are classified as subawardees, program participants, contractors or consultants. Contractors and consultants should be listed under the "Contractual" budget heading. Subawards made to eligible subrecipients are listed under the "Other" budget heading. Participant support costs such as stipends or travel assistance for trainees (e.g. interns or fellows) are listed under the "Other" budget heading.

(2) Fringe Benefits: Identify the percentage used and the basis for its computation. Fringe benefits are for the personnel listed in budget category (1) above and only for the percentage of time devoted to the project. Fringe benefits include but are not limited to the cost of leave, employee insurance, pensions and unemployment benefit plans. The applicant should not combine the fringe benefit costs with direct salaries and wages in the personnel category.

Below is a sample computation for Fringe Benefits:

Position/Title	**Base Fringe % Rate**	**Costs**			**Total**
		Year 1	***Year 2***	***Year 3***	
Project Manager	47.22%	$16,527	$17,022	$17,533	$51,082
Env. Specialist	50.83%	$30,498	$31,413	$32,355	$94,266
Total Fringe Benefits					$145,348
***An annual inflation rate of 3% has been factored into years 2 and 3 of the fringe benefits.**					

(3) Travel: In a table format, specify the estimated number of trips, purpose of each trip, number of travelers per trip, destinations and other costs for each type of travel for applicant employees. Travel costs for program participants should be specified in the "Other" budget category. Explain the need for any travel, paying particular attention to travel outside the United States. Foreign travel includes trips to Mexico and Canada but does not include trips to Puerto Rico, the U.S. territories or possessions. **If EPA funds will not be used for foreign travel, the budget justification must expressly state that the applicant will not use EPA funds for foreign travel without approval by EPA.** Include travel funds for annual STAR program progress reviews (estimate for two days in Washington, D.C.) and a final workshop to report on results.

Below is a sample computation for Travel:

Purpose of Travel	**Location**	**Item**	**Computation**	**Cost**
EPA STAR Progress Review	Washington DC	Lodging	4 people x $100 per night x 2 nights	$800
		Airfare	4 people x $500 round trip	$2,000
		Per Diem	4 people x 50 per day x 2 days	$400
Total Travel				**$3,200**

(4) Equipment: Identify all tangible, non-expendable personal property to be purchased that has an acquisition cost of $5,000 or more per unit and a useful life of more than one year. Equipment also includes accessories and services included with the purchase price necessary for the equipment to be operational. It does not include: (1) equipment planned

to be leased/rented; or (2) separate equipment service or maintenance contracts. Details such as the type of equipment, cost and a brief narrative on the intended use of the equipment for project objectives are required. Each item of equipment must be identified with the corresponding cost. Particular brands of equipment should not be identified. General-purpose equipment (office equipment, etc.) must be justified as to how it will be used on the project. (Property items with a unit cost of less than $5,000 are considered supplies).

(5) Supplies: "Supplies" are tangible property other than "equipment" with a per item acquisition cost of less than $5,000. Include a brief description of the supplies required to perform the work. Costs should be categorized by major supply categories (e.g. office supplies, computing devices, monitoring equipment) and include the estimated costs by category.

(6) Contractual: List the proposed contractual activities along with a brief description of the scope of work or services to be provided, the proposed duration of the contract/procurement, the estimated cost and the proposed procurement method (competitive or non-competitive). **Any procurement of services from individual consultants or commercial firms (including space for workshops) must comply with the competitive procurement requirements of 2 CFR Part 200.317-200.326. Please see https://www2.epa.gov/grants/epa-solicitation-clauses#Contracts and Subawards for more details.** EPA provides detailed guidance on procurement requirements in the Agency's Best Practice Guide for Procuring Services, Supplies, and Equipment Under EPA Assistance Agreements.

Examples of Contractual costs include:

i. Consultants – Consultants are individuals with specialized skills who are paid at a daily or hourly rate. EPA's participation in the salary rate (excluding overhead) paid to individual consultants retained by recipients or by a recipient's contractors or subcontractors is limited to the maximum daily rate for a Level IV of the Executive Schedule (formerly GS-18), to be adjusted annually.

ii. Speaker/Trainer Fees – Information on speakers should include the fee and a description of the services they are providing.

(7) Other: List each item in sufficient detail for the EPA to determine the reasonableness of its cost relative to the research to be undertaken. "Other" items may include equipment rental, telephone service and utilities and photocopying costs. Note that subawards, such as those with other universities or nonprofit research institutions for members of the research team, are included in this category. **Provide the total costs proposed for subawards as a separate line item in the budget justification and brief description of the activities to be supported for each subaward or types of subawards if the subrecipients have not been identified.** Subawards may not be used to acquire services from consultants or commercial firms. Please see https://www2.epa.gov/grants/epa-solicitation-clauses#Contracts and Subawards for more details. The "Other" budget category also includes participant support costs such as stipends or travel assistance for

trainees (e.g. interns or fellows). **Provide the total costs proposed for participant support costs as a separate line item in the budget justification and brief description of the costs. If EPA funds will not be used for foreign travel by program participants, the budget justification must expressly state that the applicant will not use EPA funds for foreign travel without approval by EPA.**

(8) Indirect Costs: For additional information pertaining to indirect costs, please see the IDC Competition Clause at Additional Provisions for Applicants Incorporated into the Solicitation.

8. Resumes

Provide resumes for each investigator and important co-worker. You may include resumes from staff of subawardees such as universities. Do not include resumes of consultants or other contractors. The resume is not limited to traditional materials but should provide materials to clearly and appropriately demonstrate that the investigator has the knowledge needed to perform their component of the proposed research. The resume for each individual must not exceed two consecutively numbered (bottom center), 8.5x11-inch pages of single-spaced, standard 12-point type with 1-inch margins.

Alternative to a standard resume, you may use a profile such as an NIH BioSketch that can be generated in SciENcv (see https://grants.nih.gov/grants/forms/biosketch.htm for information on the BioSketch; also see https://www.nlm.nih.gov/pubs/techbull/so13/so13_sciencv.html for information on SciENcv). These materials should generally conform to the requirements for a resume (e.g., content and page number).

9. Current and Pending Support

Complete a current and pending support form (provided at https://www.epa.gov/research-grants/research-funding-opportunities-how-apply-and-required-forms) for each investigator and important co-worker. Do not include current and pending support for consultants or other contractors. Include all current and pending research regardless of source.

Note to all prospective applicants requiring multiple Current and Pending Support Form pages: Due to a limitation in Adobe Acrobat's forms functionality, additional pages cannot be directly inserted into the original PDF form and preserve the form data on the subsequent pages. Multiple page form submissions can be created in Acrobat 8 and later using the "PDF Package" option in the "Create PDF from Multiple Files" function. If you have an earlier version of Adobe Standard or Professional, applicants will need to convert each PDF page of the form to an EPS (Encapsulated Post Script) file before creating the PDF for submission. The following steps will allow applicants with earlier versions of Adobe Standard or Professional to create a PDF package:

1. Populate the first page of the PDF and save it as an EPS (Encapsulated Post Script) file.
2. Reopen the form and populate it with the data for page 2. Save this page as a different EPS file. Repeat for as many pages as necessary.

3. Use Acrobat Distiller to convert the EPS files back to PDF.
4. Open Acrobat Professional and combine the individual pages into a combined PDF file.

10. Guidelines, Limitations, and Additional Requirements

a. Letters of Intent/Letters of Support

Letters of intent to provide resources for the proposed research or to document intended interactions are limited to one brief paragraph committing the availability of a resource (e.g., use of a person's time or equipment) or intended interaction (e.g., sharing of data, as-needed consultation) that is described in the Research Plan. Letters of intent are to be included as an addition to the budget justification documents. EPA employees are not permitted to provide letters of intent for any application.

Letters of support do not commit a resource vital to the success of the application. A letter of support is written by businesses, organizations or community members stating their support of the applicant's proposed project. EPA employees are not permitted to provide letters of support for any application.

Note: Letters of intent or support must be part of the application; letters submitted separately will not be accepted. Any letter of intent or support that exceeds one brief paragraph (excluding letterhead and salutations), is considered part of the Research Plan and is included in the 15-page Research Plan limit. Any transactions between the successful applicant and parties providing letters of intent or support financed with EPA grant funds are subject to the contract and subaward requirements described here https://www2.epa.gov/grants/epa-solicitation-clauses#Contracts and Subawards.

b. Funding Opportunity Number(s) (FON)
At various places in the application, applicants are asked to identify the FON.

The Funding Opportunity Number for this RFA is:
EPA-G2022-STAR-C1, Life-Cycle Analysis to Support Cost-Effective Enhanced Aquifer Recharge

c. Confidentiality

By submitting an application in response to this solicitation, the applicant grants the EPA permission to make limited disclosures of the application to technical reviewers both within and outside the Agency for the express purpose of assisting the Agency with evaluating the application. Information from a pending or unsuccessful application will be kept confidential to the fullest extent allowed under law; information from a successful application may be publicly disclosed to the extent permitted by law.

D. Submission Dates and Times

Applications **must be transferred to Grants.gov no later than 11:59:59 pm Eastern Time** on the solicitation closing date. Applications transferred after the closing date and time will be returned to the sender without further consideration. EPA will not accept any changes to applications after the closing date.

It should be noted that this schedule may be changed without prior notification because of factors not anticipated at the time of announcement. In the case of a change in the solicitation closing date, a new date will be posted on EPA's Research Grants website (https://www.epa.gov/research-grants) and a modification posted on Grants.gov.

Solicitation Closing Date: **January 13, 2022** 11:59:59 pm Eastern Time (applications ***must*** be submitted to Grants.gov by this time, see Section IV.F "Submission Instructions and Other Submission Requirements" for further information).

NOTE: Customarily, applicants are notified about evaluation decisions within six months of the solicitation closing date. Awards are generally made 9-12 months after the solicitation closing date.

E. Funding Restrictions

The funding mechanism for all awards issued under STAR solicitations will consist of assistance agreements from the EPA. All award decisions are subject to the availability of funds. In accordance with the Federal Grant and Cooperative Agreement Act, 31 U.S.C. 6301 et seq., the primary purpose of an assistance agreement is to accomplish a public purpose of support or stimulation authorized by federal statute, rather than acquisition for the direct benefit or use of the Agency. The EPA will monitor research progress through annual reports provided by grantees and other contacts, including site visits (as needed), with the Principal Investigator(s).

EPA award recipients may incur allowable project costs 90 calendar days before the Federal awarding agency makes the Federal award. Expenses more than 90 calendar days pre-award require prior approval of EPA. All costs incurred before EPA makes the award are at the recipient's risk. EPA is under no obligation to reimburse such costs if for any reason the recipient does not receive a Federal award or if the Federal award is less than anticipated and inadequate to cover such costs.

If you wish to submit applications for more than one STAR funding opportunity you must ensure that the research proposed in each application is significantly different from any other that has been submitted to the EPA or from any other financial assistance you are currently receiving from the EPA or other federal government agency.

Collaborative applications involving more than one institution must be submitted as a single administrative package from one of the institutions involved.

Each proposed project must be able to be completed within the project period and with the initial award of funds. Applicants should request the entire amount of money needed to complete the project. Recipients should not anticipate additional funding beyond the initial award of funds for a specific project.

F. Submission Instructions and Other Submission Requirements

Please read this entire section before attempting an electronic submission through Grants.gov.

If you do not have the appropriate internet access to utilize the Grants.gov application submission process for this solicitation, see Section IV.A above for additional guidance and instructions.

Note: Grants.gov submission instructions are updated on an as-needed basis. Please provide your Authorized Organizational Representative (AOR) with a copy of the following instructions to avoid submission delays that may occur from the use of outdated instructions.

1. Preparing for Submission: The electronic submission of your application must be made by an official representative of your institution who is registered with Grants.gov and is authorized to sign applications for Federal assistance. For more information on the registration requirements that must be completed in order to submit an application through Grants.gov, go to https://www.grants.gov/ and click on "Register" at the top right corner of the page. If your organization is not currently registered with Grants.gov, please encourage your office to designate an Authorized Organization Representative (AOR) and ask that individual to begin the registration process as soon as possible. Please note that the registration process also requires that your organization have a DUNS number and a current registration with the System for Award Management (SAM) and the process of obtaining both could take a month or more. Applicants must ensure that all registration requirements are met in order to apply for this opportunity through Grants.gov and should ensure that all such requirements have been met well in advance of the submission deadline. Registration on Grants.gov, SAM.gov and DUNS number assignment is FREE. Please see RAIN-2021-G01 for information about EPA's implementation of the upcoming Government-wide transition from DUNS to Unique Entity Identifier (UEI).

Applicants need to ensure that the AOR who submits the application through Grants.gov and whose DUNS number is listed on the application is an AOR for the applicant listed on the application. Additionally, the DUNS number listed on the application must be registered to the applicant organization's SAM account. If not, the application may be deemed ineligible.

To begin the application process under this grant announcement, go to https://www.grants.gov/ and click on "Applicants" on the top of the page and then "How to Apply for Grants" from the drop-down menu and then follow the instructions accordingly. Please note: To apply through Grants.gov, you must use Adobe Reader software and download the compatible Adobe Reader version. For more information about Adobe Reader, to verify compatibility, or to download the free software, please visit https://www.grants.gov/web/grants/applicants/adobe-software-compatibility.html.

You may also be able to access the application package for this announcement by searching for the opportunity on https://www.grants.gov/. Go to https://www.grants.gov/ and click "Search Grants" at the top of the page and enter the Funding Opportunity Number, EPA-G2022-STAR-C1, or the CFDA number that applies to the announcement (66.509), in the appropriate field under "Basic Search Criteria" and click the Search button.

Note: All applications must now be submitted through Grants.gov using the "Workspace" feature. Information on the Workspace feature can be found at the Grants.gov Workspace Overview Page.

2. Acknowledgement of Receipt: The complete application must be transferred to Grants.gov no later than 11:59:59 pm Eastern Time on the solicitation closing date (see "Submission Dates and Times"). Applications submitted through Grants.gov will be time and date stamped electronically. Grants.gov provides an on-screen notification of successful initial transfer as well as an email notification of successful transfer from Grants.gov to EPA. While it is advisable to retain copies of these Grants.gov acknowledgements to document submission, *the only official documentation that the application has been received by ORD is the email acknowledgement sent by ORD to the Lead/Contact PI and the Administrative Contact.* This email will be sent from receipt.application@epa.gov; emails to this address will not be accepted. ***If an email acknowledgment from*** receipt.application@epa.gov ***has not been received within 10 calendar days of the solicitation closing date, immediately inform the Electronic Submissions Contact shown in this solicitation. Failure to do so may result in your application not being reviewed.***

3. Application Package Preparation: Your organization's AOR must submit your complete application package electronically to EPA through Grants.gov (https://www.grants.gov/) no later than **January 13, 2022**, 11:59:59 pm Eastern Time. Please allow for enough time to successfully submit your application and allow for unexpected errors that may require you to resubmit.

Please submit all of the application materials described below using the Grants.gov application package accessed using the instructions above.

The application package consists of the following mandatory documents.

(a) Application for Federal Assistance (SF 424): Complete the form except for the "competition ID" field.

(b) EPA Key Contacts Form 5700-54: Complete the form. If additional pages are needed, see (e) below.

(c) EPA Form 4700-4, Preaward Compliance Review Report for All Applicants and Recipients Requesting EPA Financial Assistance: Complete the form.

(d) SF-424A, Budget Information for Non-Construction Programs: Only complete "Section B-Budget Categories". Provide the object class budget category (a. - k.)

amounts for each budget year under the "Grant Program, Function or Activity" heading. Each column reflects a separate budget year.

(e) Project Narrative Attachment Form (click on "Add Mandatory Project Narrative"): Attach a single electronic PDF file labeled "Application" that contains the items described in Section IV.C.4. through IV.C.10.a [Table of Contents, Abstract, Research Plan, Quality Assurance Statement, Human Subjects Research Statement, Scientific Data Management Plan, Community Engagement Plan, References, Budget Justification, Resumes, Current and Pending Support, and Letters of Intent/Support] of this solicitation. *In order to maintain format integrity, this file must be submitted in Adobe Acrobat PDF.* Please review the PDF file for conversion errors prior to including it in the electronic application package; requests to rectify conversion errors will not be accepted if made after the solicitation closing date and time. If Key Contacts Continuation pages (see https://www.epa.gov/research-grants/research-funding-opportunities-how-apply-and-required-forms) are needed, place them before the EPA Form 4700-4, Preaward Compliance Review Report for All Applicants and Recipients Requesting EPA Financial Assistance (Section IV.C.3.).

Once the application package has been completed, the "Submit" button should be enabled. If the "Submit" button is not active, please call Grants.gov for assistance at 1-800-518-4726. Applicants who are outside the U.S. at the time of submittal and are not able to access the toll-free number may reach a Grants.gov representative by calling 606-545-5035. Investigators should save the completed application package with two different file names before providing it to the AOR to avoid having to re-create the package should submission problems happen, or a revised application needs to be submitted. Note: Revised applications must be submitted before the solicitation closing date and time.

4. Submitting the application: The application package must be transferred to Grants.gov by an AOR. The AOR should close all other software before attempting to submit the application package. Click the "submit" button of the application package. Your Internet browser will launch and a sign-in page will appear. ***Note: Minor problems are not uncommon with transfers to Grants.gov. It is essential to allow sufficient time to ensure that your application is submitted to Grants.gov BEFORE 11:59:59 pm Eastern Time on the solicitation closing date.*** The Grants.gov support desk operates 24 hours a day, seven days a week, except Federal Holidays.

A successful transfer will end with an on-screen acknowledgement. For documentation purposes, print or screen capture this acknowledgement. If a submission problem occurs, reboot the computer – turning the power off may be necessary – and re-attempt the submission.

Note: Grants.gov issues a "case number" upon a request for assistance.

5. Transmission Difficulties: If transmission difficulties that result in a late transmission, no transmission or rejection of the transmitted application are experienced and following the above instructions do not resolve the problem so that the application is submitted to Grants.gov by the deadline date and time, follow the guidance below. The Agency will make a decision concerning

each late submission on a case-by-case basis as to whether it should be forwarded for peer review. All emails, as described below, are to be sent to jones.debram@epa.gov with the FON in the subject line.

Be aware that EPA will only consider accepting applications that were unable to transmit due to Grants.gov or relevant www.Sam.gov system issues or for unforeseen exigent circumstances, such as extreme weather interfering with internet access. Failure of an applicant to submit timely because they did not properly or timely register in SAM.gov or Grants.gov is not an acceptable reason to justify acceptance of a late submittal.

Please note that if the application you are submitting is greater than 70 MB in size, please call or send an email message to the Electronic Submissions Contact listed for this RFA. The Agency may experience technical difficulty downloading files of this size from Grants.gov. Therefore, it is important that the Agency verify that the file can be downloaded. The Agency will provide alternate submission instructions if the file cannot be downloaded.

(a) If you are experiencing problems resulting in an inability to upload the application to Grants.gov, it is essential to call Grants.gov for assistance at 1-800-518-4726 before the application deadline. Applicants who are outside the U.S. at the time of submittal and are not able to access the toll-free number may reach a Grants.gov representative by calling 606-545-5035. Be *sure* to obtain a case number from Grants.gov. If the problems stem from unforeseen exigent circumstances unrelated to Grants.gov, such as extreme weather interfering with internet access, contact Debra M. Jones (jones.debram@epa.gov).

(b) Unsuccessful transfer of the application package: If a successful transfer of the application cannot be accomplished even with assistance from Grants.gov due to electronic submission issues or unforeseen exigent circumstances, send an email message to Debra M. Jones (jones.debram@epa.gov) by 11:59:59 pm Eastern Time on the solicitation closing date. The email message must document the problem and include the Grants.gov case number as well as the entire application in PDF format as an attachment.

(c) Grants.gov rejection of the application package: If a notification is received from Grants.gov stating that the application has been rejected for reasons other than late submittal, promptly send an email to Debra M. Jones (jones.debram@epa.gov) with the FON in the subject line within one business day of the closing date of this solicitation. The email should include any materials provided by Grants.gov and attach the entire application in PDF format.

Please note that successful submission through Grants.gov or via email does not necessarily mean your application is eligible for award.

V. APPLICATION REVIEW INFORMATION

A. Peer Review

All eligible grant applications are reviewed by appropriate external technical peer reviewers based on the criteria and process described below. This review is designed to evaluate each application according to its scientific merit. The individual external peer reviewers include non-EPA scientists, engineers, social scientists and/or economists who are accomplished in their respective disciplines and proficient in the technical subjects they are reviewing.

Prior to the external technical peer review panel meeting, all reviewers will receive access to electronic copies of all applications. Each application will be assigned to a minimum of three primary peer reviewers, one of whom will be assigned the role of Rapporteur. Each reviewer will be assigned up to approximately 10 applications on which to serve as a primary reviewer. During the review period leading up to the panel meeting, primary reviewers read the entire application package for each application they are assigned. The primary reviewers will also prepare a written individual evaluation for each assigned application that addresses the peer review criteria described below and rate the application with a score of excellent, very good, good, fair or poor. To promote a better panel discussion, all reviewers must, at a minimum, read the abstracts of all applications.

At the beginning of the panel meeting, each primary reviewer will report their ratings for the applications they reviewed. Those applications receiving at least two ratings of *Very Good* or one rating of *Excellent* from among the primary reviewers will then be further discussed by the entire panel in terms of the peer review criteria below. In addition, if there is one *Very Good* rating among the primary reviewers of an application, the primary reviewer, whose initial rating is the *Very Good*, may request discussion of the application by the peer review panel. All other applications will be declined for further consideration.

After the discussion of an application by the panel, the primary reviewers may revise their initial ratings and if they do so, this will also be documented. The final ratings of the primary reviewers will then be translated by EPA into the final peer review score (excellent, very good, good, fair or poor) for the application. This is reflected in a peer review results document developed by the Rapporteur which combines the individual initial and final evaluations of the primary reviewers and captures any substantive comments from the panel discussion. This score will be used to determine which applications undergo the internal relevancy and past performance review discussed below. A peer review results document is also developed for applications that are not discussed. However, this document is a consolidation of the individual primary reviewer initial evaluations, with an average of the scores assigned by the primary reviewers.

Peer reviewers consider an application's merit based on the extent to which the application demonstrates the criteria below. Criteria are listed in descending order of importance (i.e., Criteria 1 has the heaviest weight).

1. Research Merits (subcriteria are in descending order of importance):

    a. The degree to which the application demonstrates that the research is original and contributes to the scientific knowledge in the topic area. And the degree to which the

application demonstrates that the project (and its approach) is defensible and technically feasible, and uses appropriate and adequate research methods.

b. The degree to which the application demonstrates that the project results will produce benefits to the public (such as improvements to the environment or human health) and will be disseminated to enhance scientific and technological understanding.

2. Responsiveness: The degree to which the application demonstrates that the research is responsive to the objectives, research needs and special considerations specified by the RFA.

3. Project Management (subcriteria are equally weighted):

a. Investigators: The degree to which the application demonstrates that the Principal Investigator(s) and other key personnel have the appropriate qualifications (including research training, demonstrated knowledge of pertinent literature, experience and publication records).

b. Management: The degree to which the application demonstrates that the project will be adequately managed to ensure the timely and successful achievement of objectives using appropriate project schedules and milestones. And the degree to which the application demonstrates the applicant will adequately track and measure progress toward achieving expected results (outputs and outcomes).

c. Quality Assurance (QA): The degree to which the application includes an appropriate and adequate QA Statement.

d. Resources and Cost Controls: The degree to which the application demonstrates that the facilities, equipment and budget are appropriate, adequate and available. And the degree to which the application demonstrates that well-defined and acceptable approaches, procedures and controls are used to ensure timely and efficient expenditure of awarded grant funds.

4. Community Engagement Plan (subcriteria are equally weighted):

a. The degree to which the Plan clearly describes the type of collaboration/engagement proposed, and what role it will play in the overall project including the degree of partner and/or community input or engagement in the conceptualization, hypothesis/question development, design, methods, analyses and implementation of the research. If an applicant does not plan on collaborating/engaging with other groups in project performance, the degree to which the Plan clearly describes how the applicant will be able to effectively perform and complete the project without such collaboration/engagement will be evaluated.

b. The degree to which the Plan clearly describes how the collaboration/engagement will: 1) enhance the overall impact of the project such that project results are useable by state/local agencies, utilities, and impacted communities; and 2) effectively communicate risk and translate scientific results into easily understandable outreach and education materials. If an applicant does not plan on collaborating/engaging with other groups in project performance, the degree to which the Plan clearly describes how the aforementioned activities will be effectively performed and completed without such collaboration/engagement will be evaluated.

c. The degree to which the Plan clearly describes how project activities will be coordinated with related or complementary projects and studies.

d. The degree to which the Plan clearly describes how the proposed collaboration/engagement will materialize during the project along with evidence of the partner(s)' intent to participate. If an applicant does not intend to collaborate/engage with respect to the project, then the applicant will be evaluated based on how well it demonstrates that it can effectively perform and complete the project without such collaboration/engagement.

5. Other Factors (subcriteria are equally weighted):

(a) Innovation: The degree to which the application demonstrates that the research will challenge and seek to shift current research or engineering paradigms by using innovative theoretical concepts, approaches or methodologies, instrumentation or interventions applicable to one or more fields of research.

(b) Sustainability: The degree to which the application demonstrates that the research will embody the principles of sustainability and seek sustainable solutions that protect the environment and strengthen our communities. The sustainability primer (see link) provides examples of research activities that promote and incorporate sustainability principles (https://www.epa.gov/sites/production/files/2015-05/documents/sustainability_primer_v9.pdf).

B. Relevancy Review

Applications receiving final peer review scores of excellent or very good will then undergo an internal relevancy review, as described below, conducted by experts from the EPA, including individuals from the Office of Research and Development (ORD) and program and regional offices involved with the science or engineering proposed. All other applications are

automatically declined. The purpose of the relevancy review is to ensure an integrated research portfolio for the Agency and help determine which applications to recommend for award.

Prior to the relevancy review panel meeting, all relevancy reviewers will receive electronic copies of all applications that passed peer review as well as a full set of abstracts for the applications. Each application will be assigned to a minimum of three primary relevancy reviewers, one of whom will be assigned the role of Rapporteur. Each reviewer will be assigned up to approximately 10 applications on which to serve as a primary relevancy reviewer. During the review period leading up to the relevancy review panel meeting, all reviewers will be instructed to read the full set of abstracts and the entire application package for each application they are assigned. They will also prepare a written individual evaluation for each assigned application that addresses the relevancy review criteria described below and rate the application with a score of A, high relevance to EPA mission; B, relevant to EPA mission; C, moderately relevant to EPA mission; D, possibly relevant to EPA mission; or E, not relevant to EPA mission.

All applications that pass peer review will be discussed by the relevancy review panel with the Rapporteur initiating the discussion. If the primary relevancy reviewers revise their initial scores after the discussion by the panel they will document the reasons for the revisions. After the discussion, the primary relevancy reviewers will provide their final score for the applications they are assigned. The final ratings of the primary reviewers will then be translated by EPA into the final relevancy review score (A, B, C, D, or E) for the application.

The final relevancy review score (A, B, C, D, or E) and final peer review score (Excellent or Very Good) will be used to place each application in one of 6 ranking tiers: Tier 1 = A/Excellent; Tier 2 = A/Very Good or B/Excellent; Tier 3 = B/Very Good or C/Excellent; Tier 4 = C/Very Good or D/Excellent; Tier 5 = D/Very Good; Tier 6 = E/Excellent or E/Very Good.

The internal relevancy review panel will assess the relevancy of the proposed research to the EPA's mission and priorities based on the following criteria that are listed in descending order of importance (i.e., Criteria 1 has the heaviest weight):

1. The degree to which the proposed research is relevant to EPA's priorities (as described in Goal 3: Greater Certainty, Compliance, and Effectiveness, Objective 3.3: Prioritize Robust Science, of the EPA's FY2018-2022 Strategic Plan) supporting robust science for Safe and Sustainable Water Resources.

2. The degree to which results (i.e., outputs/outcomes) of the research have broad application or affect large segments of society.

3. The degree to which the research is designed to produce data and methods that can immediately and/or with little to no translation be utilized by the public, states and tribes to better assess or manage environmental problems.

C. Past Performance History Review

Those applicants who received final scores of excellent or very good as a result of the peer review process will also be asked to provide additional information for the past performance history review pertaining to the proposed Lead PI's (in the case of Multiple-PI applications, the Contact PI's) "Past Performance and Reporting History." The applicant must provide the EPA with information on the proposed Lead/Contact PI's past performance and reporting history under prior Federal agency assistance agreements (assistance agreements include grants and cooperative agreements but not contracts) in terms of: (i) the level of success in managing and completing each agreement, (ii) history of meeting the reporting requirements and documenting progress towards achieving the expected results (outputs/outcomes) under each agreement and (iii) whether journal publications or author manuscripts associated with the journal publications, and the associated underlying scientific research data and metadata, resulting from those agreements were made publicly accessible.

This information is required only for the proposed Lead/Contact PI's performance under Federal assistance agreements performed within the last five years.

Past performance history review scores are satisfactory (S), nothing to report (NTR) or unsatisfactory (U). For purposes of consideration of an award, scores of S will be considered favorable, NTR will be considered neither favorable nor unfavorable and scores of U will be considered unfavorable and unlikely to result in an award recommendation. Scores of S and U must be justified by the reviewer, with scores of U clearly documented to explain why past performance history cannot be considered satisfactory.

The specific information required for each agreement is shown below and must be provided within one week of EPA's request. A maximum of three pages will be permitted for the response; excess pages will not be reviewed. **Note: If no prior past performance information and/or reporting history exists, you will be asked to so state.**

1. Name of Granting Agency
2. Grant/Cooperative agreement number
3. Grant/Cooperative agreement title
4. Grantee Institution
5. Brief description of the grant/cooperative agreement
6. A discussion on whether the agreement was successfully managed and completed; if not successfully managed and completed, provide an explanation
7. Information relating to the proposed Lead/Contact PI's past performance in reporting on progress towards achieving the expected results (outputs/outcomes) under the agreement and meeting reporting requirements under the agreement. Include the history of submitting acceptable and timely progress/final technical reports, describe how progress towards achieving the expected results was reported/documented and if such progress was not being made, provide an explanation of whether and how this was reported
8. Information relating to whether journal publications or author manuscripts associated with the journal publications, and the associated underlying scientific research data and metadata, resulting from those agreements were made publicly accessible (and if not, explain why not; or

explain why this requirement does not apply) to the extent permissible under applicable laws and regulations
9. Total (all years) grant/cooperative agreement dollar value
10. Project period
11. Technical contact (project officer), telephone number and Email address (if available)

In evaluating applicants under the past performance history factor, EPA will consider the information provided by the applicant and may also consider relevant information from other sources, including information from EPA files and from current/prior grantors (e.g., to verify and/or supplement the information provided by the applicant). **If you do not have any relevant or available past performance or past reporting information, please indicate this in your response and you will receive a nothing to report (NTR) score for these factors. If you do not provide any response for these items, you may receive an unsatisfactory (U) score for these factors.**

The past performance history review will be conducted by the EPA and will assess the following criteria which are of equal weight:

1. History of successfully managing and completing these prior Federal assistance agreements, including whether there is a satisfactory explanation for any lack of success.

2. History in meeting reporting requirements under the prior agreements and reporting progress toward achieving results (outputs/outcomes) under these agreements, including the proposed Lead/Contact PI's history of submitting acceptable and timely progress/final technical reports that adequately describe the progress toward achieving the expected results under the agreements. Any explanation of why progress toward achieving the results was not made will also be considered.

3. History of whether journal publications or author manuscripts associated with the journal publications, and the associated underlying scientific research data and metadata, resulting from these prior assistance agreements were made publicly accessible, and if not whether the Lead/Contact PI adequately explained why not, or the Lead/Contact PI explained why the requirement does not apply.

D. Human Subjects Research Statement (HSRS) Review

Applications being considered for funding after the Relevancy and Past Performance Review that involve human subjects research studies will have their HSRS reviewed prior to award. The local EPA Human Subjects Officer (HSO) will review the information provided in the HSRS and the Research Plan to determine if the ethical treatment of human subjects is described in a manner appropriate for the project to move forward. The HSO may consult with the EPA Human Subjects Research Review Official (HSRRO) as appropriate. The HSRRO may determine that an application cannot be funded if it is inconsistent with EPA’s regulations at 40 CFR Part 26.

E. Evaluation of the Scientific Data Management Plan

EPA will evaluate the merits of the SDMPs for those applications recommended for award. The SDMPs for those applications not recommended for award will not be reviewed. The SDMPs of all applications recommended for award will be evaluated to ensure they are appropriate and adequate (e.g., describe the types of scientific research data and metadata to be collected and/or generated under the proposed research award and include plans for providing long-term preservation of, and public access to, the scientific research data and metadata). SDMPs that indicate the proposed research will not result in the generation and/or collection of scientific research data will also be evaluated to ensure the proposed research will not result in the generation and/or collection of scientific research data and therefore not require a more comprehensive SDMP. Applicants may be contacted regarding their SDMP if additional information is needed or if revisions are required prior to award. If upon review of the SDMP, EPA identifies any issues with the plan, EPA will raise these issues to the applicant, so they may be addressed. Applicants with an unsatisfactory SDMP will not receive an award.

F. Funding Decisions

Final funding decisions are made by the ORD selection official based on the ranking tier, the past-performance history review, the evaluation of the SDMP, and, where applicable, the assessment of the applicant's human subjects research (see Section IV.C.6.c). In addition, in making the final funding decisions, the ORD selection official may also consider program balance and available funds. Applicants selected for funding will be required to provide additional information listed below under "Award Notices." The application will then be forwarded to EPA's Grants and Interagency Agreement Management Division for award in accordance with the EPA's procedures.

G. Additional Provisions for Applicants Incorporated into the Solicitation

Additional provisions that apply to this solicitation and/or awards made under this solicitation including the clause on Reporting and Use of Information Concerning Recipient Integrity and Performance can be found at EPA Solicitation Clauses. These, and the other provisions that can be found at the website link, are important, and applicants must review them when preparing applications for this solicitation. If you are unable to access these provisions electronically at the website above, please communicate with the EPA contact listed in this solicitation to obtain *the provisions*.

VI. AWARD ADMINISTRATION INFORMATION

A. Award Notices

Customarily, applicants are notified about evaluation decisions within six months of the solicitation closing date. Applicants to be recommended for funding will be required to submit additional certifications and an electronic version of the revised project abstract. They may also be asked to provide responses to comments or suggestions offered by the peer reviewers and/or submit a revised budget. EPA Project Officers will contact the Lead PI/Contact PI to obtain these

materials. Before or after an award, applicants may be required to provide additional quality assurance documentation.

The official notification of an award will be made by the Agency's Grants and Interagency Agreement Management Division. Applicants are cautioned that only a grants officer is authorized to bind the Government to the expenditure of funds; preliminary selection by the ORD selection official does not guarantee an award will be made. For example, statutory authorization, funding or other issues discovered during the award process may affect the ability of EPA to make an award to an applicant. The award notice, signed by an EPA grants officer, is the authorizing document and will be provided through electronic or postal mail.

B. Disputes

Assistance agreement competition-related disputes will be resolved in accordance with the dispute resolution procedures published in 70 FR (Federal Register) 3629, 3630 (January 26, 2005) which can be found at Grant Competition Dispute Resolution Procedures. Copies of these procedures may also be requested by contacting the person listed in Section VII of the announcement. Note, the FR notice references regulations at 40 CFR Parts 30 and 31 that have been superseded by regulations in 2 CFR parts 200 and 1500. Notwithstanding the regulatory changes, the procedures for competition-related disputes remains unchanged from the procedures described at 70 FR 3629, 3630, as indicated in 2 CFR Part 1500, Subpart E.

C. Administrative and National Policy Requirements

Additional provisions that apply to this solicitation and/or awards made under this solicitation, including but not limited to those related to DUNS number assignment, SAM, copyrights, disputes, and administrative capability, can be found at https://www2.epa.gov/grants/epa-solicitation-clauses.

These, and the other provisions that can be found at the website link, are important, and applicants must review them when preparing applications for this solicitation. If you are unable to access these provisions electronically at the website above, please communicate with the EPA contact listed in this solicitation to obtain the provisions.

Expectations and responsibilities of ORD grantees and cooperative agreement recipients are summarized in this section, although the terms grants and cooperative agreements are used interchangeably.

1. Meetings: Principal Investigators will be expected to budget for, and participate in, All-Investigators Meetings (also known as progress reviews) approximately once per year with EPA scientists and other grantees to report on research activities and discuss issues of mutual interest.

2. Approval of Changes after Award: Prior written approval of changes may be required from EPA. Examples of these changes are contained in 2 CFR 200.308. Note: prior written approval is

also required from the EPA Award Official for incurring costs more than 90 calendar days prior to award.

3. Human Subjects: A grant applicant must agree to comply with all applicable provisions of EPA Regulation 40 CFR Part 26 (Protection of Human Subjects). In addition, grant applicants must agree to comply with EPA's procedures for oversight of the recipient's compliance with 40 CFR Part 26, as given in EPA Order 1000.17A (Policy and Procedures on Protection of Human Research Subjects in EPA Conducted or Supported Research). As per this Order, no human subject may be involved in any research conducted under this assistance agreement, including recruitment, until the research has been approved or determined to be exempt by the EPA Human Subjects Research Review Official (HSRRO) after review of the approval or exemption determination of the Institutional Review Board(s) (IRB(s)) with jurisdiction over the research under 40 CFR Part 26. Following the initial approvals indicated above, the recipient must, as part of the annual report(s), provide evidence of continuing review and approval of the research by the IRB(s) with jurisdiction, as required by 40 CFR 26.109(e).

Guidance for investigators conducting EPA-funded research involving human subjects may be obtained here:
https://www.epa.gov/osa/basic-information-about-human-subjects-research-0
https://www.ecfr.gov/cgi-bin/text-idx?tpl=/ecfrbrowse/Title40/40cfr26_main_02.tpl

4. Data Access and Information Release: EPA's requirements associated with data access and information release as well as copyrights, may be accessed here:
https://www.epa.gov/grants/epa-solicitation-clauses.

Congress, through OMB, has instructed each federal agency to implement Information Quality Guidelines designed to "provide policy and procedural guidance...for ensuring and maximizing the quality, objectivity, utility, and integrity of information, including statistical information, disseminated by Federal agencies." The EPA's implementation may be found at https://www.epa.gov/quality/guidelines-ensuring-and-maximizing-quality-objectivity-utility-and-integrity-information. These procedures may apply to data generated by grant recipients if those data are disseminated as described in the Guidelines.

5. Reporting: A grant recipient must agree to provide annual performance progress reports, with associated summaries, and a final report with an executive summary. The summaries will be posted on EPA's Research Grants website. The reports and summaries should be submitted electronically to the Technical Contact named in Section VII of this announcement.

A grant recipient must agree to provide copies of, or acceptable alternate access to (e.g., web link), any peer reviewed journal article(s) resulting from the research during the project period. In addition, the recipient should notify the ORD Project Officer of any papers published after completion of the grant that were based on research supported by the grant. ORD posts references to all publications resulting from a grant on EPA's Research Grants website.

6. Acknowledgement of EPA Support: EPA's full or partial support must be acknowledged in journal articles, oral or poster presentations, news releases, interviews with reporters and other communications. The acknowledgement to be included in any documents developed under this agreement that are intended for distribution to the public or inclusion in a scientific, technical or other journal will be provided in the award's terms and conditions.

VII. AGENCY CONTACTS

Further information, if needed, may be obtained from the EPA contacts indicated below. Information regarding this RFA obtained from sources other than these Agency Contacts may not be accurate. Email inquiries are preferred.

Technical Contact: Jacquelyn Bell; phone: 202-564-4811; email: bell.jacquelyn@epa.gov
Eligibility Contact: Ron Josephson; phone: 202-564-7823; email: josephson.ron@epa.gov
Electronic Submissions Contact: Debra M. Jones; phone: 202-564-7839; email: jones.debram@epa.gov

EXHIBIT C

OMB Number: 4040-0004
Expiration Date: 12/31/2022

Application for Federal Assistance SF-424

* 1. Type of Submission:	* 2. Type of Application:	* If Revision, select appropriate letter(s):
☐ Preapplication	☒ New	
☒ Application	☐ Continuation	* Other (Specify):
☐ Changed/Corrected Application	☐ Revision	

* 3. Date Received:	4. Applicant Identifier:
01/13/2022	

5a. Federal Entity Identifier:	5b. Federal Award Identifier:

State Use Only:

6. Date Received by State:	7. State Application Identifier:
	Choose State...

8. APPLICANT INFORMATION:

* a. Legal Name:	Regents of the University of California

* b. Employer/Taxpayer Identification Number (EIN/TIN):	* c. Organizational DUNS:
94-6002123	1247267250000

d. Address:

* Street1:	1608 Fourth Street, Suite 220
Street2:	Mail Code 5940
* City:	Berkeley
County/Parish:	Choose State...
* State:	CA: California
Province:	
* Country:	USA: UNITED STATES
* Zip / Postal Code:	94710-1749

e. Organizational Unit:

Department Name:	Division Name:
School of Law	

f. Name and contact information of person to be contacted on matters involving this application:

Prefix:	Miss	* First Name:	Margaret
Middle Name:			
* Last Name:	Nguyen		
Suffix:			

Title:	Contract and Grant Officer
Organizational Affiliation:	Regents of the University of California
* Telephone Number:	(510) 664-7489
Fax Number:	
* Email:	nguyen_m@berkeley.edu

Application for Federal Assistance SF-424

*** 9. Type of Applicant 1: Select Applicant Type:**

H: Public/State Controlled Institution of Higher Education

Type of Applicant 2: Select Applicant Type:

Type of Applicant 3: Select Applicant Type:

* Other (specify):

*** 10. Name of Federal Agency:**

Environmental Protection Agency

11. Catalog of Federal Domestic Assistance Number:

66.509

CFDA Title:

Science To Achieve Results (STAR) Research Program

*** 12. Funding Opportunity Number:**

EPA-G2022-STAR-C1

* Title:

LIFE-CYCLE ANALYSIS TO SUPPORT COST-EFFECTIVE ENHANCED AQUIFER RECHARGE

13. Competition Identification Number:

Title:

14. Areas Affected by Project (Cities, Counties, States, etc.):

Add Attachment | Delete Attachment | View Attachment

*** 15. Descriptive Title of Applicant's Project:**

Developing tools and resources to enable economic, institutional, and technical clarity in support of Enhanced Aquifer Recharge implementation

Attach supporting documents as specified in agency instructions.

Add Attachments | Delete Attachments | View Attachments

Application for Federal Assistance SF-424

16. Congressional Districts Of:

* a. Applicant: CA-013 * b. Program/Project: CA-013

Attach an additional list of Program/Project Congressional Districts if needed.

Add Attachment | Delete Attachment | View Attachment

17. Proposed Project:

* a. Start Date: 07/01/2022 * b. End Date: 06/30/2025

18. Estimated Funding ($):

* a. Federal	2,000,000.00
* b. Applicant	0.00
* c. State	0.00
* d. Local	0.00
* e. Other	0.00
* f. Program Income	0.00
* g. TOTAL	2,000,000.00

*** 19. Is Application Subject to Review By State Under Executive Order 12372 Process?**

☒ a. This application was made available to the State under the Executive Order 12372 Process for review on 01/12/2022.

☐ b. Program is subject to E.O. 12372 but has not been selected by the State for review.

☐ c. Program is not covered by E.O. 12372.

*** 20. Is the Applicant Delinquent On Any Federal Debt? (If "Yes," provide explanation in attachment.)**

☐ Yes ☒ No

If "Yes", provide explanation and attach

Add Attachment | Delete Attachment | View Attachment

21. *By signing this application, I certify (1) to the statements contained in the list of certifications and (2) that the statements herein are true, complete and accurate to the best of my knowledge. I also provide the required assurances** and agree to comply with any resulting terms if I accept an award. I am aware that any false, fictitious, or fraudulent statements or claims may subject me to criminal, civil, or administrative penalties. (U.S. Code, Title 218, Section 1001)**

☒ ** I AGREE

** The list of certifications and assurances, or an internet site where you may obtain this list, is contained in the announcement or agency specific instructions.

Authorized Representative:

Prefix: Ms. * First Name: Margaret

Middle Name:

* Last Name: Nguyen

Suffix:

* Title: Contracts and Grants Officer

* Telephone Number: 510-664-7489 Fax Number:

* Email: spo_grants_gov@lists.berkeley.edu

* Signature of Authorized Representative: Margaret Nguyen * Date Signed: 01/13/2022

EPA KEY CONTACTS FORM

OMB Number: 2030-0020
Expiration Date: 06/30/2024

Authorized Representative: *Original awards and amendments will be sent to this individual for review and acceptance, unless otherwise indicated.*

Name: Prefix: Ms. First Name: Margaret Middle Name:
Last Name: Nguyen Suffix:
Title: Contracts and Grants Officer

Complete Address:

Street1: 1608 Fourth Street, Suite 220
Street2: Mail Code 5940
City: Berkeley State: CA: California
Zip / Postal Code: 94710-1749 Country: USA: UNITED STATES
Phone Number: 510-664-7489 **Fax Number:**
E-mail Address: spo_grants_gov@lists.berkeley.edu

Payee: *Individual authorized to accept payments.*

Name: Prefix: Ms. First Name: Elizabeth Middle Name:
Last Name: Chavez Suffix:
Title: Director

Complete Address:

Street1: 2195 Hearst Avenue, Room 130
Street2: Mail Code 1103
City: Berkeley State: CA: California
Zip / Postal Code: 94720-1103 Country: USA: UNITED STATES
Phone Number: 510-643-4246 **Fax Number:**
E-mail Address: CGAawards@berkeley.edu

Administrative Contact: *Individual from Sponsored Programs Office to contact concerning administrative matters (i.e., indirect cost rate computation, rebudgeting requests etc).*

Name: Prefix: Ms. First Name: Margaret Middle Name:
Last Name: Nguyen Suffix:
Title: Contracts and Grants Analyst

Complete Address:

Street1: 1608 Fourth Street, Suite 220
Street2: Mail Code 5940
City: Berkeley State: CA: California
Zip / Postal Code: 94710-1749 Country: USA: UNITED STATES
Phone Number: 510-664-7489 **Fax Number:**
E-mail Address: nguyen_m@berkeley.edu

EPA KEY CONTACTS FORM

Project Manager: *Individual responsible for the technical completion of the proposed work.*

Name: Prefix: Dr. First Name: Michael Middle Name:
Last Name: Kiparsky Suffix:

Title: Director

Complete Address:

Street1: 391 Simon Hall
Street2:
City: Berkeley State: CA: California
Zip / Postal Code: 94720 Country: USA: UNITED STATES

Phone Number: (510) 643-6044 **Fax Number:**

E-mail Address: kiparsky@berkeley.edu

OMB Number: 2030-0020
Expiration Date: 06/30/2024

Preaward Compliance Review Report for All Applicants and Recipients Requesting EPA Financial Assistance

Note: Read Instructions before completing form.

I. A. Applicant/Recipient (Name, Address, City, State, Zip Code)

Name: Regents of the University of California

Address: Sponsored Projects Office, 1608 Fourth Street, Suite #220, University of California

City: Berkeley

State: CA: California Zip Code: 94710-1749

B. DUNS No. 124726725

II. Is the applicant currently receiving EPA Assistance? ☒ Yes ☐ No

III. List all civil rights lawsuits and administrative complaints pending against the applicant/recipient that allege discrimination based on race, color, national origin, sex, age, or disability. (Do not include employment complaints not covered by 40 C.F.R. Parts 5 and 7.)

UC Berkeley's Office for the Prevention of Harassment and Discrimination has 27 pending investigations of administrative complaints as of 8/3/19. No lawsuits have been decided against UC Berkeley.

IV. List all civil rights lawsuits and administrative complaints decided against the applicant/recipient within the last year that allege discrimination based on race, color, national origin, sex, age, or disability and enclose a copy of all decisions. Please describe all corrective actions taken. (Do not include employment complaints not covered by 40 C.F.R. Parts 5 and 7.)

UC Berkeley's Office for the Prevention of Harassment and Discrimination conducted 31 Investigations closed between 7/1/18 - 6/30/19. No lawsuits have been decided against UC Berkeley.

V. List all civil rights compliance reviews of the applicant/recipient conducted by any agency within the last two years and enclose a copy of the review and any decisions, orders, or agreements based on the review. Please describe any corrective action taken. (40 C.F.R. § 7.80(c)(3))

California State Audit: June 2018 – findings and recommendations in linked report: https://www.auditor.ca.gov/pdfs/reports/2013-124.pdf
U.S. Dept. of Education Office for Civil Rights, investigation of complaint nos. 90-14-2322, 09-15-2392 and 09-16-2399. Resolution agreement and resolution letter attached. NASA Title IX Compliance Review of UC Berkeley's Astronomy Department 2016-2018. Report issued and monitoring in progress.

VI. Is the applicant requesting EPA assistance for new construction? If no, proceed to VII; if yes, answer (a) and/or (b) below.

☐ Yes ☒ No

a. If the grant is for new construction, will all new facilities or alterations to existing facilities be designed and constructed to be readily accessible to and usable by persons with disabilities? If yes, proceed to VII; if no, proceed to VI(b).

☐ Yes ☐ No

b. If the grant is for new construction and the new facilities or alterations to existing facilities will not be readily accessible to and usable by persons with disabilities, explain how a regulatory exception (40 C.F.R. 7.70) applies.

VII. Does the applicant/recipient provide initial and continuing notice that it does not discriminate on the basis of race, color, national origin, sex, age, or disability in its program or activities? (40 C.F.R 5.140 and 7.95) ☒ Yes ☐ No

a. Do the methods of notice accommodate those with impaired vision or hearing? ☒ Yes ☐ No

b. Is the notice posted in a prominent place in the applicant's offices or facilities or, for education programs and activities, in appropriate periodicals and other written communications? ☒ Yes ☐ No

c. Does the notice identify a designated civil rights coordinator? ☒ Yes ☐ No

VIII. Does the applicant/recipient maintain demographic data on the race, color, national origin, sex, age, or handicap of the population it serves? (40 C.F.R. 7.85(a)) ☒ Yes ☐ No

IX. Does the applicant/recipient have a policy/procedure for providing access to services for persons with limited English proficiency? (40 C.F.R. Part 7, E.O. 13166) ☒ Yes ☐ No

X. If the applicant is an education program or activity, or has 15 or more employees, has it designated an employee to coordinate its compliance with 40 C.F.R. Parts 5 and 7? Provide the name, title, position, mailing address, e-mail address, fax number, and telephone number of the designated coordinator.

At UC Berkeley, the Office for the Prevention of Harassment and Discrimination handles all administrative complaints of discrimination (including harassment) on the basis of sex, gender, gender identity and expression, sexual orientation and pregnancy for all faculty, staff, students, applicants and visitors. The campus Title IX Officer is housed in this office:
Elizabeth Rome
Title IX Officer and Interim Associate Director
Office for the Prevention of Harassment and Discrimination (OPHD)
2111 Bancroft Way, Suite 300, MC 1130
University of California
Berkeley CA 94620
Tel: 510 642-7985
Email: ask_ophd.berkeley.edu

XI. If the applicant is an education program or activity, or has 15 or more employees, has it adopted grievance procedures that assure the prompt and fair resolution of complaints that allege a violation of 40 C.F.R. Parts 5 and 7? Provide a legal citation or Internet Address for, or a copy of, the procedures.

A number of different grievance procedures apply for staff, faculty and students at UC Berkeley: Staff: http://hr.berkeley.edu/policies/policies-procedures/university/discrimination
Students: http://sa.berkeley.edu/grievance
Faculty: http://ofew.berkeley.edu/equity/grievances

For the Applicant/Recipient

I certify that the statements I have made on this form and all attachments thereto are true, accurate and complete. I acknowledge that any knowingly false or misleading statement may be punishable by fine or imprisonment or both under applicable law. I assure that I will fully comply with all applicable civil rights statutes and EPA regulations.

A. Signature of Authorized Official	B. Title of Authorized Official	C. Date
Margaret Nguyen	Contracts and Grants Officer	01/13/2022

For the U.S. Environmental Protection Agency

I have reviewed the information provided by the applicant/recipient and hereby certify that the applicant/recipient has submitted all preaward compliance information required by 40 C.F.R. Parts 5 and 7; that based on the information submitted, this application satisfies the preaward provisions of 40 C.F.R. Parts 5 and 7; and that the applicant has given assurance that it will fully comply with all applicable civil rights statures and EPA regulations.

A. *Signature of Authorized EPA Official	B. Title of Authorized Official	C. Date

*** See Instructions**

Instructions for EPA FORM 4700-4 (Rev. 06/2014)

General. Recipients of Federal financial assistance from the U.S. Environmental Protection Agency must comply with the following statutes and regulations.
Title VI of the Civil Rights Acts of 1964 provides that no person in the United States shall, on the grounds of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving Federal financial assistance. The Act goes on to explain that the statute shall not be construed to authorize action with respect to any employment practice of any employer, employment agency, or labor organization (except where the primary objective of the Federal financial assistance is to provide employment). Section 13 of the 1972 Amendments to the Federal Water Pollution Control Act provides that no person in the United States shall on the ground of sex, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under the Federal Water Pollution Control Act, as amended. Employment discrimination on the basis of sex is prohibited in all such programs or activities. Section 504 of the Rehabilitation Act of 1973 provides that no otherwise qualified individual with a disability in the United States shall solely by reason of disability be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving Federal financial assistance. Employment discrimination on the basis of disability is prohibited in all such programs or activities. The Age Discrimination Act of 1975 provides that no person on the basis of age shall be excluded from participation under any program or activity receiving Federal financial assistance. Employment discrimination is not covered. Age discrimination in employment is prohibited by the Age Discrimination in Employment Act administered by the Equal Employment Opportunity Commission. Title IX of the Education Amendments of 1972 provides that no person in the United States on the basis of sex shall be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any education program or activity receiving Federal financial assistance. Employment discrimination on the basis of sex is prohibited in all such education programs or activities. Note: an education program or activity is not limited to only those conducted by a formal institution. 40 C.F.R. Part 5 implements Title IX of the Education Amendments of 1972. 40 C.F.R. Part 7 implements Title VI of the Civil Rights Act of 1964, Section 13 of the 1972 Amendments to the Federal Water Pollution Control Act, and Section 504 of The Rehabilitation Act of 1973. The Executive Order 13166 (E.O. 13166) entitled; "Improving Access to Services for Persons with Limited English Proficiency" requires Federal agencies work to ensure that recipients of Federal financial assistance provide meaningful access to their LEP applicants and beneficiaries.

Items “Applicant” means any entity that files an application or unsolicited proposal or otherwise requests EPA assistance. 40 C.F.R. §§ 5.105, 7.25. “Recipient” means any entity, other than applicant, which will actually receive EPA assistance. 40 C.F.R. §§ 5.105, 7.25. “Civil rights lawsuits and administrative complaints” means any lawsuit or administrative complaint alleging discrimination on the basis of race, color, national origin, sex, age, or disability pending or decided against the applicant and/or entity which actually benefits from the grant, but excluding employment complaints not covered by 40 C.F.R. Parts 5 and 7. For example, if a city is the named applicant but the grant will actually benefit the Department of Sewage, civil rights lawsuits involving both the city and the Department of Sewage should be listed. “Civil rights compliance review” means any review assessing the applicant’s and/or recipient’s compliance with laws prohibiting discrimination on the basis of race, color, national origin, sex, age, or disability. Submit this form with the original and required copies of applications, requests for extensions, requests for increase of funds, etc. Updates of information are all that are required after the initial application submission. If any item is not relevant to the project for which assistance is requested, write “NA” for “Not Applicable.” In the event applicant is uncertain about how to answer any questions, EPA program officials should be contacted for clarification. * Note: Signature appears in the Approval Section of the EPA Comprehensive Administrative Review For Grants/Cooperative Agreements & Continuation/Supplemental Awards form.

A knowledge-to-implementation framework for Enhanced Aquifer Recharge

Table of Contents

Abstract

Funding Opportunity: Life-cycle analysis to support cost effective enhanced aquifer recharge (EPA-G2022-STAR-C1)

Project Title: A knowledge-to-implementation framework for Enhanced Aquifer Recharge

Investigators: PI: Michael Kiparsky (UC Berkeley); co-PIs: Ellen Bruno (UC Berkeley); Helen Dahlke, Thomas Harter (UC Davis); Andrew T. Fisher (UC Santa Cruz); Dave Owen (UC Hastings School of Law). Additional information on team leadership is available at: clee.berkeley.edu; are.berkeley.edu; https://websites.pmc.ucsc.edu/~afisher/; https://watershed.ucdavis.edu; https://www.uchastings.edu/people/dave-owen/

Institutions:

University of California, Berkeley, Berkeley, California (applying institution)
University of California, Davis, Davis, California
University of California, Santa Cruz, Santa Cruz, California
UC Hastings Law, San Francisco, California

Project period and location: July 1, 2022 – June 30, 2025, at the four campuses above plus field locations nationwide.

Project cost: $2,000,000 (including all direct and indirect costs)

Project summary:

Objective: We aim to contribute to the nation's water-related human, environmental, and economic well-being by removing barriers, developing tools, and providing knowledge in service of implementation of Enhanced Aquifer Recharge (EAR). We conceptualize a life cycle view of EAR to encompass **three pillars of decision making** for EAR: **geochemical and physical considerations; legal & institutional considerations; and cost-benefit analysis & life-cycle assessment.** Our **overarching hypothesis** is that through strategically combining applied research, decision-support innovations, and public engagement, we can lower barriers to widespread adoption of EAR and unlock its potential to provide multiple water security benefits.

Approach: To address these issues, we propose a knowledge-to-action program that combines information synthesis and targeted research, novel tool development, and strategic dissemination, informed throughout by focused engagement. Because of the strength of our team's background and ongoing activity on EAR, our general approach to advancing each topic will be to **build directly on extensive ongoing efforts**, leveraging EPA support to a) generalize and contextualize cutting edge research contributions, b) build and articulate conceptual bridges among currently siloed topics to produce a comprehensive picture of the life cycle of EAR implementation, and c) extend scholarly insights to create actionable recommendations for practitioners. The program will develop and formalize best practices for EAR, using methods and approaches consistent with EPA's stated vision for this topic

Expected results: Our capstone product will be an **EAR Lifecycle Map, an integrative report** that summarizes the results of and interconnections among all research components. The report will serve as a roadmap for decision-makers contemplating EAR projects, and a repository from which key resources and tools can be found and evaluated. The EAR Lifecycle Map will embody co-production and relevance through structured engagement, and will be supported by cutting-edge research products, syntheses, and decision tools.

Supplemental keywords: Managed Aquifer Recharge (MAR); Infiltration; Groundwater recharge; Interdisciplinary; Innovation; Incentives; Public policy; Pollution prevention; Law; Economics of groundwater recharge; Water resources; Environmental policy

Research Plan

1. Introduction and objectives

Groundwater depletion is causing severe impacts to human and environmental systems to accumulate across the United States, including unreliable water supply, land subsidence and damage to crucial infrastructure, impaired water quality, reduced surface water flows, harm to groundwater dependent ecosystems, and damage to the aquifer systems themselves [2]. Climate change is exacerbating these trends, as more extreme flood and drought regimes and intensifying demand push groundwater resources further away from sustainability.

In the face of these challenges, water and environmental managers are increasingly turning to Enhanced Aquifer Recharge (EAR). EAR involves the use of engineered or natural infrastructure to intentionally recharge aquifers. Techniques include managed aquifer recharge (MAR), artificial recharge, aquifer storage and recovery (ASR), and related practices [3-6]. Coupled with demand management and other conservation approaches, EAR holds significant promise as a crucial tool for alleviating stresses on groundwater systems [3, 5, 7]. A range of purposes and outcomes motivate EAR, including mitigating the impacts of drought exacerbated by climate change, combating saltwater intrusion in coastal aquifers, diluting contaminants in drinking water supplies, reducing land subsidence, and increasing water supply reliability [8]. However, fulfilling the promise of EAR to avoid the major and often irreversible social, economic, and environmental impacts of widespread groundwater mismanagement will require acceleration in the pace and effectiveness of EAR implementation.

Knowledge about EAR is growing, particularly on technical topics, but important issues remain unresolved. Analyses have focused on physical methods for recharge (see, e.g. [3, 5, 7]) and advancements in hydrogeological tools including, crucially, tools for selection of physically appropriate sites (see, e.g., [9, 10]). Understanding of water quality has increased, including knowledge about constituents of concern, contaminant transport and tracing, and the evolution of regulations related to EAR (see, e.g., [2, 11]).

These advancements are foundational for scaling EAR implementation, but two crucial elements remain essential for actualizing its promise. First, extensive and detailed EAR case study development by our research team has revealed that crucial economic, institutional, geochemical and physical elements of EAR implementation remain understudied and poorly understood. These gaps present hurdles to implementation. Even EAR is technically viable, it may not be clear to those without access to specialized knowledge and resources [8].

Second, a crucial and unaddressed bottleneck for scaling EAR is the need for digestion and dissemination of knowledge and experience so it can be readily accessed, understood, and acted upon by relevant decision makers and interested stakeholders. Effective tools, guidance, tailored information, and decision frameworks are sorely needed to enable broader adoption and diffusion of EAR. Furthermore, while bespoke analyses are available from cutting edge academic and consulting sources, a lack of broadly applicable and accessible tools and guidance hinders efforts to develop new EAR projects.

To address these issues, we propose to develop a knowledge-to-implementation program that combines a) information synthesis and targeted research, b) novel tool development, and c) strategic dissemination, informed throughout by focused engagement. This program will build on principles developed in efforts to bring scientific knowledge to bear on pressing real world problems [12], including addressing a key challenge in science communication: bridging abstract or conceptual scientific understanding with relevant real-world decision-making. Our efforts will prioritize co-production of knowledge with practitioners and decision-makers, both to focus our

efforts on the elements that matter most to them, and to ensure that the form and format of our outputs and activities will best serve the various communities with interests in EAR.

Our team has an **extensive track record**, with over a century of collective experience working on EAR and closely related issues, individually and through our history of successful collaboration. Our complementary expertise spans the key economic, technical, legal, and institutional elements that comprise the life cycle of EAR implementation, and does so with a deep history of producing applied research that contributes scholarly understanding and translational benefit to advance real-world applications.

We will leverage experience with EAR projects across the nation to a) develop a picture of the landscape through synthesis of existing information; b) expand this synthesis with new research results; c) develop tools and decision frameworks to fill key gaps; d) produce a unified EAR Lifecycle Map, a synthesis document that encapsulates the state of the practice for EAR into a roadmap for practitioners; and e) distill key messages about EAR into a suite of fit-for-purpose communication products that increase the reach of our outputs, supporting broader use of EAR approaches and thus increasing human and environmental well-being across the nation.

We conceptualize a life cycle view of EAR to encompass three interrelated and mutually supportive **pillars of decision making** for EAR: **geochemical and physical considerations; legal & institutional considerations; and cost-benefit analysis & life-cycle assessment.** Our **overarching hypothesis** is that through strategically combining applied research, decision-support innovations, and public engagement, we can lower barriers to widespread adoption of EAR and unlock EAR's potential to provide multiple water security benefits. For each pillar, we detail specific hypotheses and objectives in the sections below.

Because of the strength of our team's background and ongoing activity on EAR, our general approach to advancing each topic will be to **build directly on extensive ongoing efforts**, leveraging EPA support to a) generalize cutting edge research contributions, b) build and articulate conceptual bridges among currently siloed topics to produce a comprehensive picture of the life cycle of EAR implementation, and c) extend scholarly insights to create actionable recommendations for practitioners. The proposed program will develop and formalize best practices for EAR, using methods and approaches consistent with EPA's stated vision for research and engagement on this topic [13, 14]

2. Approach and Activities

2.1. Overview of methods and approach

Our overarching approach, illustrated in Figure 1**,** will rely on a knowledge-to-action framework [12, 15, 16] to combine research with knowledge translation, oriented specifically towards the implementation of EAR. Generically, a knowledge-to-action framework combines an iterative cycle of knowledge creation and action phases, each informed by the other [15]. A crucial component is the involvement of stakeholders, so that knowledge can be effectively tailored to the needs of those who will ultimately use or be affected by it. This engagement, ideally beginning at the research design phase, enables co-production of knowledge [17-21]. The ultimate goal is the successful development of tools that are useful, useable, and used, minimizing risk of 'reality disconnect' while still fostering academically interesting advances.

Our proposed program relies heavily on synthesis and communication of existing data, information, and knowledge with a target audience of decision makers contemplating EAR implementation. The program has a secondary component of primary research, oriented towards filling key gaps in available knowledge, and developing tools built on existing scholarly work.

The outcome of this process will be a national population of decision-makers with better understanding of, and better access to, their options for EAR and how to actualize them locally.

Our team's activities will be tailored for each pillar described below from the following general structure: 1) Literature review, informed by project team experience and expert elicitation, to identify key questions and information gaps; 2) case study research involving synthesis of published examples, unpublished detailed information from our previous work, document analysis, interviews with practitioners and stakeholders, and development of new case studies where key gaps are indicated; 3) engagement with our professional network and relevant organized public EAR networks (e.g., California Flood-MAR network; IAH-MAR network; NAWI Water-TAP); 4) qualitative methods including focus groups, interviews, document analysis, and expert elicitation to fill specific gaps and develop new information.

Our overarching goal to develop a combination of flexibly applicable tools and decision frameworks, the data to parameterize these tools in a general way (e.g., ranges of data for a particular field in the CBA tool), fact sheets and other materials for qualitative context, and guidance on refining options for specific situations faced by decision makers. Naturally, the blend of quantitative and qualitative methods, original research and synthesis, and tool development will be tailored for each pillar. Engagement with EAR practioners, decision makers, and stakeholders be heavily emphasized throughout the project, as described in the community engagement section and outputs sections.

The three pillars as we define them are highly interrelated. We frame these pillars not as academic subjects, but as topics designed for investigation based on their relevance as direct inputs to decision making. As such, the pillars are organized to reflect a sequence of foundational questions decision-makers must answer: "Is it physically possible to use EAR in my local area?" preceeds, "Is it legally permissible for me to implement EAR given local circumstances?", and the affirmative details of each of these questions flow into the economic viability of EAR, leading to answers to questions such as "What path will results in the most cost-effective path to EAR implementation, who will benefit, and in what ways?"

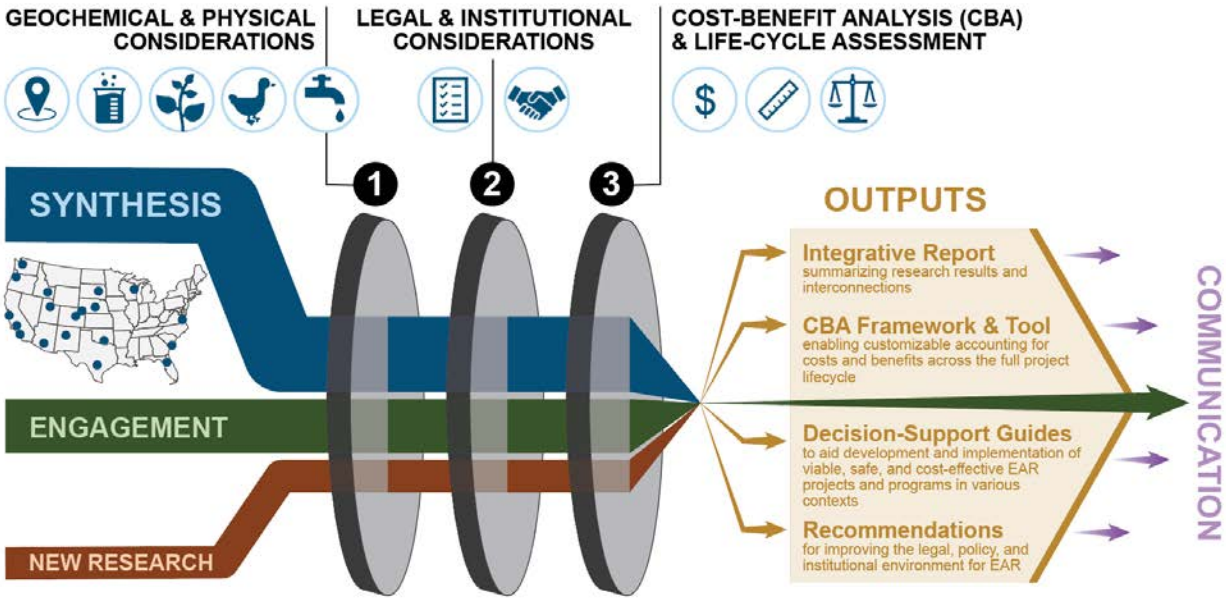

Figure 1: Conceptual illustration of our approach to this project. The ultimate outcome will be decision-makers with clearer understanding and better tools at their disposal for their local implementation of EAR.

2.2. Pillar 1: Geochemical and physical considerations

The first pillar for EAR decision making involves understanding and accounting for biogeochemical and physical factors that influence the selection, installation, and operation of suitable and effective sites and methods for EAR. EAR projects typically must consider, both as a matter of establishing project viability and in response to legal requirements (Pillar 2) and economic reality (Pillar 3), hydrogeology and water quality of aquifer system, site location, soil and vadose zone characteristics, water availability for EAR, source water quality, source water conveyance, and infrastructure and treatment needs.

We **hypothesize** that clarifying and communicating geochemical and physical guidance on three crucial topics will accelerate EAR implementation: (a) screening and evaluating potential sites, (b) conditions and processes needed to maintain operations, and (c) water quality. Motivated by this hypothesis, the project team will advance the following objectives and activities, orienting our work around *key questions for decision-makers and stakeholders*:

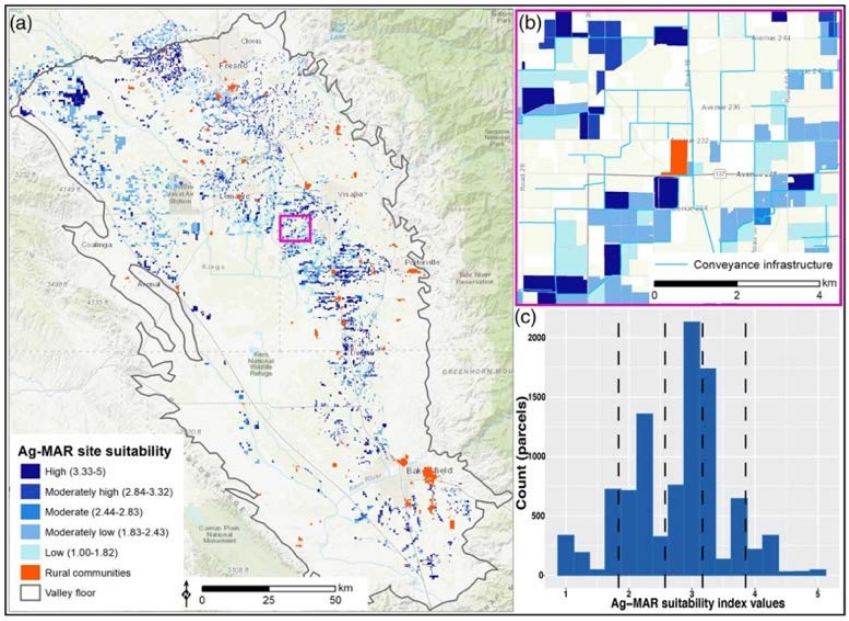

Figure 2: Example suitability map for EAR on agricultural land using flood flows ("Ag-MAR") based on physical, chemical, and social factors [1]. This kind of map is most useful within a GIS that allows display of multiple scales and/or areas, and ability to add/remove factors as desired. Inset map (b) shows area in pink rectangle from main map (a), including infrastructure available to route water.

First, we will address foundational questions for EAR projects around **project siting**: *Where should an EAR project be located and what EAR method should be used?* Our team will build on its pioneering contributions to methods for evaluating and prioritizing potential EAR project sites [1, 22, 23]. Our team has pioneered decision support methods that combine geospatial biophysical datasets with socio-economic, legal and institutional data and auxiliary information such as stakeholder preferences, drinking water vulnerability, and community/ecosystem resilience [1, 22-24]. Naturally, evaluating available source waters of various provenance is both a technical and legal matter (see Pillar 2 and [25]). We propose to 1) synthesize and summarize the range of decision support approaches to EAR site selection, highlighting their strengths, weaknesses, and the ideal contexts for application of each method, and 2) produce guidance for how EAR suitability mapping can help screen potential sites and focus subsequent field investigations.

Proposed research will address the lack of "standard" datasets, methods, and scales for EAR suitability analyses: projects and data availability vary greatly, so guidance on data sources and their likely relevance will be a useful step towards generalizing these methods. Recognizing intra-regional variability, we will focus on methods that include flexibility in choosing and weighting relevant factors and scales. The goal of this effort is to guide decision makers through

the choices and constraints that present bottlenecks to implementation of conceptually simple, but operationally challenging, "big-data" approaches to EAR site and method selection.

Second, we will address questions related to the installation, operation and management of EAR systems, including: *How much water is available for EAR from what sources, and how do we maintain project performance over its lifetime?* Informed operation and management of EAR systems is crucial to maintain overall system performance. EAR efficacy varies greatly based on regional and site-specific conditions, EAR method, and the nature of the water sources. For infiltration basins, soil clogging is a pernicious physical, chemical, and biological problem [e.g., 26]. For injection wells, carbonate clogging must be managed when the injectate is not sufficiently acidic [27]. These and other processes can result in reduced infiltration capacity or aquifer conductivity over time [28]. Mitigation can include physical maintenance of basin surfaces, and pre-treatment approaches like sediment detention, the choice of which depends on whether the source of the problem is, for example, sediment transported in source water or *in situ* erosion of basin walls. **We propose** to link **synthesis of this topic** with the decision support approach, focusing on assessment of factors most important to each major kind of EAR system. As many useful findings are in agency and contractor reports, considerable work will be required to identify and synthesize information beyond peer-reviewed sources.

Third, we will address water quality issues, driven by legal and regulatory requirements, and the need to preserve and support long-term aquifer health for a range of beneficial uses. Decision-maker questions will include: *What is the best option for EAR given the nature of the target aquifer and the available source waters?* EAR systems can have either positive or negative influences on water quality, with implications for human and environmental health. In general, high-quality source water is preferable, either diverted surface water or highly treated water from other sources. When recharged water quality is better than ambient groundwater, absent reactions release undesirable compounds, EAR may improve groundwater quality improvement through dilution [4, 29]. However, it is not always easy to find sufficient high-quality water for EAR. In practice, many potential surface water sources, soils, and or aquifers have the potential to result in groundwater contamination. Even when source water quality is high, soil and/or aquifer reactions can release geogenic (naturally occurring) compounds such as arsenic [30, 31] and other trace metals [32]. In some cases, EAR operators adjust source water chemistry to minimize the contaminant mobilization [33]. Recharging agricultural landscapes can mobilize salts, nitrate and pesticides residing in the vadose zone [34-37], or release other non-point source contaminants [38]. Microbial pathogens [39-41] and contaminants of emerging concern like PFAS also pose risks to human health, and have been linked to EAR [42, 43]. In addition, when non-traditional water sources are applied, with variable and/or unpredictable water quality, EAR systems have the potential to achieve quantitative water quality improvement during infiltration, including reducing concentrations of nitrate, organic compounds, and some pharmaceuticals [44-47]. We **propose** to **assimilate and synthesize a large literature** on these and related topics, and link risks and solutions to specific EAR methods, water sources, and field operations.

2.3. Pillar 2: Legal & institutional considerations

The second pillar of EAR decision making involves legal and institutional considerations, which we define broadly to include regulation, organizational structure and design, financing, and various processes that enable collaboration, outreach, and stakeholder involvement in service of EAR implementation. The legal and institutional context for decision making can motivate, enable, or impede EAR implementation and affect the technical and economic viability of

different approaches [48-50]. For example, each element of EAR—such as acquiring a source of water, conveying it to a recharge location, gaining land access, building and maintaining recharge facilities, infiltrating or injecting source water, monitoring and accounting for impacts and benefits, recovering stored water, and funding EAR activities—may be subject to legal controls [25]. However, these legal controls typically were not developed with EAR in mind, are often administered in siloed and fragmented ways, and can vary significantly from state to state [25]. Additionally, garnering sufficient political and financial support for an EAR project and successfully shepherding it through applicable permitting processes requires communication and collaboration among stakeholders with different priorities (e.g., water supply reliability, flood protection, habitat restoration, species protection), values, and resources (e.g., funding, land ownership, technical expertise, local knowledge) [51, 52]. Our extensive research on the legal landscape for EAR [25, 53-58] suggests the need for greater legal and regulatory clarity in many areas, and for guidance in effectively working within legal constraints. Case studies of particular EAR projects and programs by our research team [8] and others [59] indicate that navigating a complex patchwork of legal and institutional responsibility and stakeholder interests can be challenging for even sophisticated EAR proponents, but that viable pathways often exist for doing so.

We **hypothesize** that the legal and organizational context for EAR can strongly influence its costs and benefits, and that accessible, practical frameworks that help water managers, local stakeholders, and policymakers navigate—and improve—this context are needed to facilitate broader implementation of viable, safe, and cost-effective EAR.

The project team will collaborate with community partners and others to accomplish the following **objectives and activities**:

(1) *Synthesize legal and organizational themes from EAR case studies* — Members of the project team have produced a pathbreaking collection of case studies focused on the institutional context and motivation for EAR projects around the country [8]. We propose to build on this work by synthesizing key legal and organizational takeaways from these and other case studies [e.g., 59], such as which governmental and private entities should be involved in developing and implementing EAR projects in different contexts, and in what ways. We will develop supplementary case studies to address key gaps identified through community engagement and the synthesis process, then fold the results into the EAR Lifecycle Map.

(2) *Review key legal and policy context for EAR* — To complement thematic case study synthesis, we propose to build on our ongoing program of legal and policy research [25, 53-58] to examine laws and policies that motivate, enable, or impede EAR in a spectrum of U.S. jurisdictions. We will emphasize requirements or incentives for sustainable groundwater management and conjunctive use, rights to use or store water (including municipal wastewater and captured flood- or stormwater), permitting and regulatory compliance issues (e.g., related to water rights, water quality, species protections, and environmental review), constraints on or supports for EAR funding, and key areas of ambiguity or uncertainty that could affect EAR.

(3) *Develop frameworks for effectively navigating the complex legal and organizational context for EAR projects and programs* — The thematic case study synthesis and legal review will inform development of decision-support frameworks that address a spectrum of motivating factors and objectives for EAR as well as key differences between legal jurisdictions, geographic settings (e.g., urban, agricultural, wildlands), EAR approaches, stakeholder engagement models, and other important variables. In addition to a decision-support

framework for those looking to implement individual EAR projects, we will produce a framework to help water agencies and other interested entities develop a programmatic approach to EAR. The latter will build on our ongoing work with Santa Clara Valley Water District as a case study to illustrate viability, and our prior work on institutional design for groundwater sustainability agencies in California [60, 61]. Crucially, we will focus on highlighting and clarifying incentive structures that motivate (or fail to motivate) EAR in the face of common pool resource challenges inherent to groundwater management [62, 63]. Our review will leverage our innovative work with Pajaro Valley Water Management Agency on Recharge Net Metering (ReNeM) as an incentive for distributed stormwater recharge [49], our studies of groundwater banking [64, 65], our work on the legal and policy context for local groundwater markets [58], and our series on addressing groundwater-surface water interactions [55, 57] in California. Finally, and relatedly, we will explore the meaning and operationalization of the concept of "multi-benefit" EAR itself, which is often used as justification, but has not been clearly and precisely articulated although it increasingly underpins policy and funding actions. While we will explore this topic here from a jurisdictional and stakeholder perspective, the topic, as with many others, has clear linkages to Pillars 2 and 3 as well.

(4) *Generate recommendations for legal, policy, or institutional changes* policymakers could pursue to facilitate more extensive, effective, and affordable implementation of EAR.

Our methods will include a combination of literature review (drawing heavily on existing case studies by the project team and others), legal research, and additional or more in-depth case studies. Initial research will target a sample of jurisdictions with a spectrum of relevant characteristics and inform our selection of key legal, policy, and institutional questions. Interviews and virtual workshops with a broad range of EAR stakeholders will provide insights into legal and organizational barriers, opportunities, and ways of navigating them successfully, as well as potential changes policymakers could make to improve the legal and organizational context for EAR. Throughout, we will engage with community and non-academic partners and participants to refine research design and implementation, striving to co-produce all aspects of our research and outputs to ensure they are useful for and accessible to their audiences.

2.4. Pillar 3: Cost-benefit analysis & life-cycle assessment

The third pillar of decision making involves economic considerations. Cost-benefit analysis (CBA) is a foundational tool that allows project proponents like water agencies to evaluate potential investments for cost effectiveness, as often required by state and federal rule-making and funding processes. For example, regulatory changes to drinking water contaminant thresholds under the Safe Drinking Water Act §1412(b)(6) are subject to careful analyses of benefits and costs to ensure that changes are transparent, justified, and welfare-improving. As a result, CBA is, or should be, an essential component of informed decision-making.

In practice, decision makers often lack key data, and lack a guiding framework for integrating and analyzing these data. Costs and benefits of EAR projects are challenging to quantify: they vary across space, change over time, and are often site-specific. Quantifying capital, operations and maintenance (O&M), and other indirect costs and ancillary benefits across a project's lifecycle is rarely done systematically. Despite calls for a generalized and comprehensive CBA framework, little research exists on the costs and benefits of EAR and the few past attempts to quantify elusive CBA components have not been aggregated, limiting their practical application and generalizability.

We **hypothesize** that 1) an effective CBA framework, parameterized with readily available data to account for local circumstances, would facilitate economically optimal decisions about EAR projects; 2) traditional CBA can be structured to evaluate the first-order economics of a potential EAR project from the perspective of project proponents and stakeholders; and 3) CBA can be extended to account for the full project lifecycle, including internalizing environmental effects and other externalities.

Our **research objectives** are to develop a generalized framework for CBA of EAR projects with customizable parameter ranges applicable for specific circumstances of proposed projects. This will both require input and perspective from Pillars 1 and 2, and in turn clarify economic dimensions of EAR proposals and inform decisions about project selection, siting, and operation (see Pillar 1) and legal and organizational viability (Pillar 2).

Our **approach** will involve the following: 1) evaluate specific user needs through structured engagement; 2) develop a generalizable CBA framework; 3) parameterize the framework with a data library; and 4) develop and disseminate accessible, generalizable tools for screening-level CBA of EAR projects.

First, we will co-produce the **design specifications** for a useful and useable CBA tool [66] by working directly with key decision makers in interviews and focus groups. We will leverage previous research by our team [67-71] and others on urban water and stormwater management, augmented by a survey of other existing costing and life-cycle analysis tools developed in related applications. We will identify and resolve critical data gaps or parameters with significant uncertainty, to the extent data sources exist or can be developed.

Second, we will **develop frameworks** for quantifying direct and ancillary economic costs and benefits of EAR projects. These frameworks will expand and generalize research our team is currently conducting in the Pajaro Valley, CA [72] (Figure 3). This Pajaro Valley project uses CBA to evaluate a set of novel incentives for EAR called Recharge Net Metering [49, 73-75]. We will leverage the detailed and unusually thorough data sets we have developed through this project, combining costs for capital investments and ongoing O&M for planning, permitting, construction, operation, and monitoring and management with a method to estimate direct and indirect benefits through interferences from user fees.

Preliminary conclusions reflect the utility of our approach for decision-making: Results are sensitive to project lifespan assumptions, a key question for natural infrastructure often deployed in EAR. Crucially, this cost-benefit analysis method in multi-party efforts can have vastly different results for the same project, depending on which entity's point of view is being modeled, with profound implications for program design and incentive structures (see also Pillar 2). Clarity borne of CBA could also enable multi-party agreements that aggregate funding sources or jointly finance multi-benefit EAR projects [51].

To incorporate environmental impacts associated with EAR to the CBA, we will inform this work with insights from life-cycle environmental assessment [76]. LCA can augment CBA with externalities ignored by traditional CBA, yet increasingly relevant to decision makers cognizant of the need for projects to serve multiple interests and deliver multiple benefits simultaneously (see also Pillar 2). For example, crucial, often-non-monetized costs and benefits can include environmental damage or long-term ecosystem health, the resilience benefits of decentralization and diversification of water supplies; energy and climate benefits from changes in groundwater levels, etc. We will quantify such environmental and social costs and benefits

using estimates from the environmental economics literature or estimate them using methods adapted from other water management studies [e.g., 77].

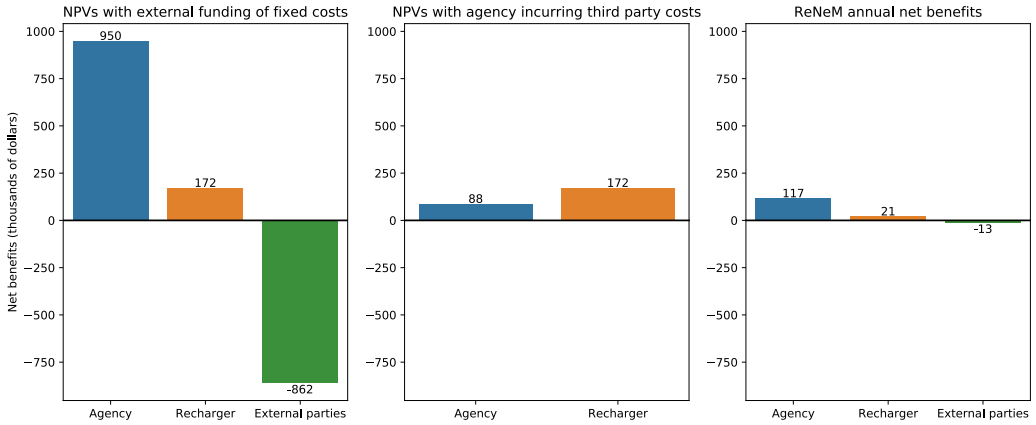

Figure 3: Preliminary CBA results for EAR in the Recharge Net Metering program, Pajaro Valley, CA [72]. Our analysis can reveal not only project costs, but also differences in perceived costs and benefits across different parties with interests in a single EAR project. This method thus has direct relevance for institutional incentives for EAR (see Pillar 2).

Third, we will **parameterize the CBA framework** with estimates and likely ranges for parameters across diverse EAR conditions. Drawing from the approach of our work in stormwater infrastructure [78], we will consolidate the best available data across a range of project types in a public database [79, 80]. A literature review will synthesize published empirical estimates from individual EAR projects [e.g., 52, 81], incorporate non-market valuation of water supplies [82], and quantify economy-level changes such as agricultural profits associated with recharge [83]. We will leverage unpublished data from detailed case studies developed by our research team [8], augmented by other technical literature. We will develop further data sources through analysis of technical literature, consulting reports, and unpublished data gained through interviews with local experts and managers. We will select case studies for diversity across factors including geography, source water, end use, and EAR method. Infrastructure and treatment costs will be adapted from existing open-source tools for related applications, including those Dr. Stokes-Draut has developed [69]. Results will be captured in the public database linked to the generalized CBA framework.

The final step will be to build an accessible, customizable, adaptable **open-source tool** that accounts for costs and benefits across the full EAR project lifecycle. The tools will contain a library of unit costs for infrastructure adaptable to different locations and scales using methods consistent with other EPA-funded costing tools (e.g., i-DST) [84]. The tool will calculate the levelized cost of water using customizable cost calculations that account for the project's location, construction date, expected operational life, size and capacity, site suitability, water quality requirements, and treatment train design, where applicable. Cost calculations will be consistent with federal cost analysis guidance [85]. Results will be reported as ranges for possible project costs that account for regional variability in costs and performance and uncertainty in future operating conditions due to climate change and will be validated against case study data. The tool will also provide first-order approximations of the life-cycle environmental impacts of with infrastructure construction, O&M, and end-of-life of recharge systems using methods developed by the team.

The tool will be developed in Excel and/or as an online tool, co-produced with stakeholder input and testing and directly informed by legal and institutional requirements surfaced through collaboration with Pillar 2 researchers. A set of recharge scenarios will be defined, described, quantified, and evaluated for sensitivity to key parameters to better understand the cost drivers under a range of conditions. These scenarios will be tested and illustrated through design charettes discussed below in Section 3.4, including, for example, the Arbuckle-Simpson aquifer in Oklahoma as one of the case studies. The scenarios will be provided as exemplars for others seeking to do CBA for groundwater recharge programs.

Ultimately, information from the tools and methods developed in Pillar 3 feeds back to Pillar 1, particularly through the potential to refine site selection based primarily on geochemical and physical factors.

In summary, this work will facilitate development of CBAs for future EAR by embedding economic costs and environmental impact quantification across the lifecycle into a broader CBA framework. The frameworks, tools, and examples will be available to users for screening potential EAR implementations.

3. Expected results, benefits, outputs, and outcomes

Our results and outputs will all be primarily oriented towards audiences of decision-makers and stakeholders (e.g., water agency staff, regulators, relevant stakeholders, landowners, EAR project proponents, and consultants), in support of our ultimate goal of accelerated national adoption and diffusion of EAR, with water resource, economic, environmental, and social benefits as discussed elsewhere in this proposal.

Our outputs will be oriented around communication of results to these audiences, with a secondary emphasis on dissemination to academic audiences who can build on our findings.

Our primary capstone product will be an EAR Lifecycle Map, summarizing the results of and interconnections among all research components. Our goal is for this report to serve as a roadmap for decision-makers contemplating EAR projects, and a repository from which key resources and tools can be found and evaluated. This resource will be designed as accessible summary guidance that incorporates and highlights key guidance and lessons learned into a digestible by substantive report of reasonable length (60-100 pages), organized around the three pillars of our program. This synthesis report will be augmented by references to individual, deeper explorations that we surface through our literature review and produce for this project – as such, a key output from each of the three pillars will be crucial context on which the other research pillars can directly draw.

The EAR Lifecycle Map synthesis report and the specific outputs described below will be *accessible rather than encyclopedic*; our goal is to provide *useful resources for practitioners* in the field, while providing reference to and evaluation of more exhaustive sources. The synthesis report will also contain *recommendations for policymakers* with legal, policy, and institutional changes that could facilitate more extensive, effective, and affordable implementation of EAR at scale, which will be highlighted in the communications products described below.

3.1. Pillar 1 Outputs: Geochemical and physical considerations

Our key **geochemical and biophysical outputs** will include: Chapters in the *Lifecycle Map*; A *knowledge database* of geologic, water quality and physico-chemical criteria and their interaction and dependencies to be considered for different EAR types and human and environmental health concerns; a *guide to decision support* approaches for EAR site selection and suitability mapping; aggregation and evaluation of *geospatial biophysical datasets* for use in decision support tools;

and a suite of practical documents detailing EAR-related *water quality* criteria, potential contaminants and their sources, transport pathways and mobility.

3.2. Pillar 2 Outputs: Legal & institutional considerations

Our **key legal, policy, and institutional outputs** will include: Chapters in the *Lifecycle Map*; *Decision-support guides,* in the form of a suite of practical documents that provide a framework to help water managers, consultants, and other stakeholders navigate the legal and organizational context for implementing EAR projects and programs, and *best practices for stakeholder engagement* and partnership to facilitate successful projects. In addition to these general guidance, we will produce several more targeted guides aimed at subsets of EAR decision making identified through our research and engagement activities (for example, assessments of specific legal issues, or decision trees focused on certain settings, such as urban, agricultural, or publicly managed non-agricultural lands).

3.3. Pillar 3 Outputs: Cost-benefit analysis & life-cycle assessment

Our **key economics outputs** will include: Chapters in the *Lifecycle Map*; a generalizable, flexible, and comprehensive *CBA framework* to be used for EAR siting and implementation; parameterization of the CBA framework with a *database of values for cost and benefit components* including for environmental and community effects, and guidance for likely ranges across diverse EAR conditions and options; a *decision-making tool*, co-designed with stakeholders to maximize adoption potential, to support informed decisions and ultimately, lead to expanded adoption of optimal EAR projects.

Each of the three pillars will also publish research results in open access peer-reviewed journals to demonstrate validity and legitimacy among academic and consulting audiences.

We aim to provide water managers, consultants, policymakers, and local stakeholders with the accessible, practical information they need to navigate—and potentially improve—the information resources available on geochemical and biophysical considerations for EAR, contributing to broader implementation of viable, safe, and cost-effective EAR in coming years.

3.4. Integration & communication

The capstone of our knowledge-to-implementation will lie in our efforts on overarching synthesis, integration, and communication. The primary effort for the bulk of Year 3 of this project will be focused on the following integration and outreach efforts, reflected also in the community engagement plan.

One engagement nexus for distilling and producing synthesis and communication outputs will be a major Symposium held in the final quarter of Year 2. Reprising and extending our successful Incentivizing Groundwater Recharge Symposium that we hosted in Berkeley, CA in September 2019 [86], the symposium will highlight research progress and enable learning from key practitioners. The symposium will focus on diversifying voices in the conversation around EAR through a scholarship program supported by intensive outreach. An explicit focus of the symposium proceedings will be workshopping and development of a “virtual road show.” This product will combine presentations distilling our research and outreach efforts, with real-world stories from thought leaders and successful implementers of EAR projects around the country who can personify the possibilities and pathways to EAR. This virtual road show will be developed and launched in Year 3.

Our EAR Lifecycle Map will be the central written integration that ties together insights generated and harvested during our research effort into a concise volume that provides a

roadmap for EAR implementation, targeted to decision makers and stakeholders. This synthesis, and the more detailed guidance, information, and tools it references for specific topics, will be developed with ongoing engagement.

We will organize one or more special conference sessions (e.g., BSMAR or NGRA) focusing on disseminating our work and those of key collaborators and leaders in the field.

Prior to the virtual road show, we will conduct one additional test of our package of tools and information. We will conduct approximately six virtual EAR selection and design charettes to test the methods we put together before their final release in Year 3. The potential EAR project proponents we solicit as volunteer participants will benefit from insights contributed by our team, and our outputs will gain the opportunity for field-testing and a final gap analysis.

Finally, in addition to more standard media outputs such as op-eds, blog posts, infographics, and fact sheets, we will develop video distillations of key outputs. Our experience with such video products [e.g., 87] suggests their effectiveness and importance for engaging with non-specialist audiences, and for drawing interested practitioners to more detailed resources.

Roadmaps and decision tools targeted at direct on-the-ground use will be published as publicly available reports and technical whitepapers, accompanied by freely available software products. All products, including video products and webcasts, will be freely online on a project website housed at UC Berkeley's Center for Law, Energy & the Environment and mirrored at co-PI institutions. Our efforts will be supported by exposure and outreach through social media, professional networks, and professional meetings.

Our team has a long and successful track record of tailoring outputs to the subject matter, audience, and goal outcomes. We will apply this experience to the full suite of outputs, but will also augment our efforts with design and communications professionals for full effect.

4. Innovation

Water is an inherently interdisciplinary topic; thus, advancing EAR and its multi-benefit potential nationally will require not just the development of new approaches to technology and management practices, but also strategic communication and cross-cutting synthesis [8, 88].

The scholars comprising our team are leading innovators within their respective fields, as evidenced by publications in top, peer-reviewed and legal journals, regular consultation by implementing agencies, and frequent media interviews and citations. More importantly, team members have outstanding collaborative track records of multi- and interdisciplinary applied research that has directly influenced policy and management decisions [e.g., 56, 57, 60, 73, 75, 89-93]. Thus, the project's overarching innovation is its boundary-spanning nature and its outputs, which will dissolve silos to better-reflect the interconnections between EAR and other elements of water, environmental, social, and economic systems.

Our knowledge to implementation framework will ensure that innovative research is grounded in innovative practice. Research and tool development across the three research pillars will formalize and generalize emerging methods such as GIS-based site selection decision support tools, address knotty water quality concerns, apply emerging remote EAR site instrumentation methodology, develop novel incentive structures, and incorporate environmental impacts and benefits into Cost Benefit Analysis via life cycle assessment. Engagement and co-production will ground the syntheses and tools in decision-makers' needs. Further, by structuring the project around a unified Lifecycle Map of EAR and its supporting products, we will *enable broader applied innovation by others* through its real-world use.

Though each of the project's efforts—law, science, and economics—will be individually innovative, the project's central innovation will be its integration of science, law, and economics

research through planning, implementation, and management that builds connections across disciplinary boundaries. Impediments to broad incorporation and legitimization of EAR projects are often multidisciplinary barriers; thus, the convergence of multidisciplinary innovations will fill knowledge gaps, address multiple stakeholder needs, and provide generalizable guidance for EAR participants throughout the U.S.

5. Sustainability

The proposed work is predicated on the belief that an interdisciplinary research approach can produce a suite of solutions that promotes further deployment of EAR while concurrently addressing and ensuring three pillars of sustainability: social sustainability, economic sustainability, and environmental sustainability.

Environmentally, EAR projects can bolster the long-term sustainability of groundwater resources. Such projects improve the integrity of the groundwater resource while, if implemented thoughtfully, improving groundwater quality. More sustainable groundwater reserves also ensure the provision of a suite of ecosystem services [94, 95] and hydrologic system services [96] including supporting groundwater-dependent ecosystems, promoting surface water-groundwater connections, nutrient cycling, and flood management. Furthermore, EAR projects can integrate existing systems to collaboratively support water security [51], often at low cost.

The proposed work's interdisciplinary approach to EAR will synthesize traditionally siloed information to produce EAR support tools that are both accessible and scalable. These solutions will support all three pillars of sustainability. For instance, the team will seek extensive feedback from stakeholders to co-produce solutions that address community needs. This engagement will incorporate the voices of disadvantaged communities and underserved water systems in an effort, not only address their unique needs, but also to develop solutions that enable these communities and water systems to deploy more effective and inclusive EAR projects. More broadly, the decision support tools the proposed work plans to develop will support community efforts to sustainably plan and manage their water resources. Additionally, the incorporation of life cycle assessment will help the team produce a more sophisticated accounting of an EAR project—an accounting that appropriately quantifies the environmental, legal, and regulatory costs and benefits linked to EAR projects—so that communities across the country can use these decision support tools to develop effective, efficient, and economical EAR projects based on their local needs.

6. Project management

Leadership: Our team is uniquely placed to deliver on EPA's aims for advancing EAR. PI Michael Kiparsky has spent 20 years leading research and engagement efforts at the intersection of water institutions, science, economics, and law, including extensive work on enhanced aquifer recharge. He also has experience leading interdisciplinary, federally-funded research projects with multiple PIs involving human subject research. co-PI Andrew Fisher, co-PI Helen Dahlke, and co-PI Thomas Harter bring decades of nationally-recognized leadership in applied geochemical and physical considerations, and, crucially, deep expertise leading implementation of EAR projects. co-PI Ellen Bruno has deep expertise and experience in applied CBA, and will work with Jenn Stokes-Draut (technical advisor) to integrated LCA. Dave Owen (co-PI) is a leading scholar of water, land-use, and environmental law, with specific expertise in legal elements of groundwater recharge.

Expertise: Beyond its impressive leadership panel, this team includes researchers with strong backgrounds in life-cycle assessment (Jennifer Stokes-Draut [UCB and LBNL]), land-use

principles, climate adaptation, inclusive decision-making (Louise Bedsworth [UCB]), institutional innovation, regulatory analysis, and water governance (Nell Green Nylen [UCB] & Molly Bruce [UCB]). Members of this team also have extensive histories of fruitful collaboration, a joint productivity demonstrated through numerous successful projects together. Crucially, the team has previously collaborated on interdisciplinary projects that blend the physical, economic, and institutional understandings of EAR. As interdisciplinary scholars, team members understand, both based on academic insights and on long experience, that effective interdisciplinary outcomes are by necessity the result of far more than a list of disparate departments and specialties on a page. Rather, selection of a team that has interest, experience, and a thirst for truly boundary-spanning work can make the difference between a funded collection of individual outputs (i.e., interdisciplinarity by stapler) versus investment that results in a coherent whole.

Management: Though the project will enjoy the benefits of interdisciplinarity, researchers will spearhead different portions of the project's three research pillars based on their primary expertise (Figure 4); co-PI Fisher, co-PI Dahlke, and co-PI Harter will cooperatively lead examination of geochemical and physical considerations. co-PI Owen will lead examination of legal and institutional considerations. co-PI Bruno and PI Kiparsky will cooperatively lead examination of cost-benefit analysis and life-cycle assessment. PI Kiparsky will lead overall project management, ensuring that each pillar remains on track toward success and that necessary cross-pollination between these pillars is occurring, that the project remains on-budget, and that quality assurance is maintained. co-PI Fisher will assist in QA/QC. Project work will engage both named, key personnel and additional research personnel to be identified and hired.

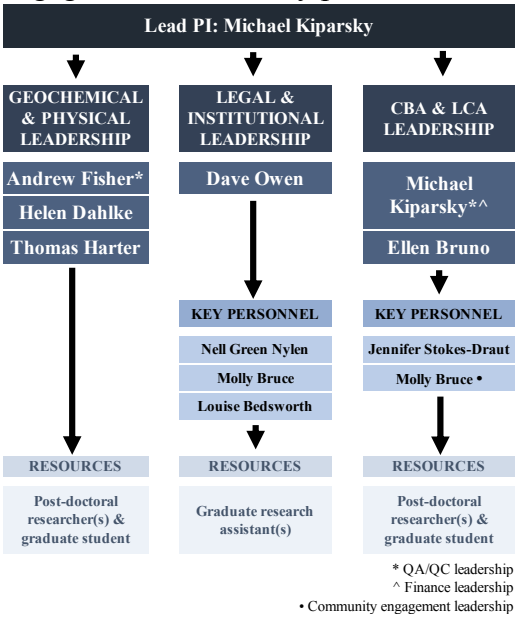

Figure 4: Project leadership structure.

Project schedule & structure: The proposed work will span a 3-year period (Figure 5). While most tasks will be concurrent, continuous communication with project personnel across tasks will ensure that decisions are made according to the project's goals and objectives, that QA/QC is maintained, and that cross-pollination occurs. Therein, topical progress meetings will be held biweekly by teleconference within each pillar, and project-wide meetings will be held bimonthly by teleconference. This structure is particularly important to ensure that forward momentum is maintained, and cross-pollination can occur across topics (Figure 1).

Facilities:

UCSC – Fisher's group at the University of California, Santa Cruz, has access to all facilities needed to complete proposed work, including office, computer (workstations, printers, plotters), field (vehicles, loggers, samplers), and laboratory equipment (instruments, glassware, etc.). UCSC is a Hispanic Serving Institution, is one of the youngest UC campuses, and has notable centers of excellence in (among other programs) genomics, Earth and planetary sciences, linguistics, and video game design.

UCD - The University of California, Davis has extensive facilities for field and laboratory research (Russell Ranch, UCD Student Farm, Interdisciplinary Center for Inductively-

Coupled Plasma Mass Spectrometry, Stable Isotope Facility, Analytical Laboratory), high-performance computing (Farm Cluster), the NIFA/NSF-funded Artificial Intelligence Institute for Next Generation Food Systems, and over 100 years of experience in Cooperative extension, stakeholder outreach, and information dissemination to communities. UCD researchers on this team also have extensive connections to state, local and federal water and regulatory agencies which we will leverage for the proposed work.

UCB - The Center for Law, Energy & the Environment at UCB School of Law has extensive facilities for convening events as well as a 15-year history of successfully organizing and facilitating workshops, conferences, focus groups, and other meetings. This experience, and the related intellectual infrastructure of the UC Berkeley Campus, are key resources on which we will draw heavily to complete the proposed work.

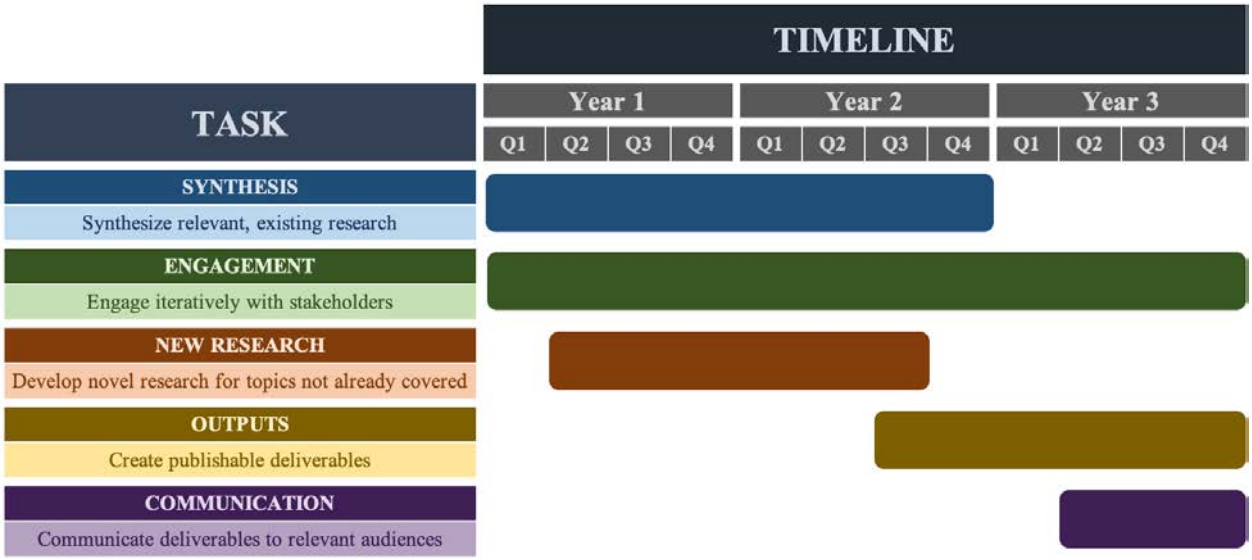

Figure 5: Project timeline and milestones.

7. Conclusion

We have proposed a knowledge-to-implementation framework for Enhanced Aquifer Recharge. We believe our proposal not only responds to EPA's clear call for intellectual and practical leadership and action on EAR, but that it does so in ways that expand this vision to be greater than the sum of its parts. This is fitting, as the additive set of outputs and outcomes in our proposal are consistent with the recognized need for knowledge generation that is grounded in engagement, and targeted towards practical, on the ground implementation outcomes.

Producing such products is, and has been, central goals for the research and engagement programs of all our team members – it is on this deep and ongoing foundation that we propose to build an integrated whole that will enable our work and the work of others in this field to drive true, lasting, and impactful change at a national scale.

The proposed work's interdisciplinary, knowledge-to-action framework will enable communities across the country to understand, advocate for, and actualize environmental, economic, and public health benefits of EAR projects while using and advancing socially inclusive frameworks for deployment and management of multi-benefit EAR projects.

Quality Assurance Statement

Quality Assurance Overview

The application team is familiar with EPA expectations and standards for Quality Assurance (https://www.epa.gov/quality/agency-wide-quality-program-documents and linked documents) and is prepared to meet all requirements. That said, the primary basis for the proposed work is assessment of existing information and studies, and development of a research framework and simple tools for life cycle analysis, assessment of institutional requirements and bottlenecks, and calculating the magnitude and nature of economic costs and incentives. Some of this information is available in the peer-reviewed literature, where analytical standards are documented and research practices aid in assurance of data quality. However, for older studies in particular, it can be difficult to demonstrate repeatability given historical limitations in the amount and kind of detailed information concerning sample collection, laboratory processing, survey data, and analytical standards. In addition, field samples from operating hydrologic systems can't be replicated, and journal papers rarely include levels of detail found in lab notebooks and listings of standard operating procedures that permit complete recapitulation of analyses. As a consequence, projects of this kind must work with a range of available information, including results from earlier studies completed with a range of methods and standards. In particular, much of the data generated by and available to water agencies, non-governmental organizations, and stakeholders was collected under conditions that limited opportunities for a research-grade QA/QC program. This does not mean that data from water agency studies, management plans, and contractor reports is not helpful or can’t be used, but it does require clear and nuanced assessment of data sources, methods for collection, and the basis for interpretation. We will do this.

We will also be prepared for the possibility that modest hydrologic data could be collected during the last phase of the proposed project period, when several existing contracts have ended, to aid in assessment of EAR system performance.

Additionally, we will gather information on legal and institutional considerations for EAR through interviews and stakeholder convenings. QA/QC and data management for these aspects of the project will be governed by Institutional Review Board requirements, to be determined as described in the Human Subjects Research Statement.

Quality Assurance Leadership and Procedures

PI Kiparsky will be the primary Quality Assurance Manager for the proposed project, overseeing QA/QC activities for the team, with support from Co-PIs having expertise in particular areas. For example, Co-PI Fisher will oversee QA/QC for synthesis and integration of assessments of EAR geochemical and physical factors and performance, including analysis of new hydrologic data, if any, associated with active EAR systems (e.g., mass balance calculations). There will be regular leadership meetings by teleconference among the PI and Co-PIs, and QA/QC will be a standing agenda item to be updated at least once per quarter while the project is operating.

In general, secondary data will be collected from existing peer-reviewed papers and book chapters, agency and contractor reports, online databases (national, state, and local), and other documents as may be revealed through archival activities. Metadata will be assembled for all data sources (as described in the Scientific Data Management Plan), and data plus metadata will be assembled as part of regular project activities for uploading to a public repository. For

technical data not subject to provisions in our Human Subjects Research Protocol, newly acquired data (for example, metadata resulting from discussion with agency staff and stakeholders) will be documented with information on date, time, venue, and key words. We expect that most archival data will be from the last 20-30 years, but there may be older sources used, and data can come from essentially any geographic region. It is likely that many more sources will be assessed than will be included in formal analysis, and we will document how decisions are made concerning inclusion of individual data sources.

Copies of key documents in PDF format will be stored on a central GoogleDrive or Box folder organized by topic and region, with additional identifiers and keywords recorded on a GoogleSheet at the top of the folder structure that will allow search of these materials. The complete archive folder will be password protected for use by project personnel.

Additional QA topics related to human subjects research will be detailed in our Human Subjects Research Protocol, which is subject to review and approval by the UC Berkeley Institutional Review Board.

Human Subjects Research Statement

The proposed research includes potential human subjects research associated primarily with Legal & Institutional Considerations to assess the legal and organizational context for EAR in a spectrum of jurisdictions across the nation and co-produce both frameworks for effectively navigating this context and recommendations for improving it. Prior to beginning any human subjects work, refined plans for the proposed research will be submitted for review to the Institutional Review Board (IRB), the Committee for Protection of Human Subjects, for the University of California, Berkeley (FWA00006252; IRB00000455 and IRB00005610).

1. **Risk to Human Subjects**

a. Human Subjects Involvement, Characteristics, and Design

To expand the implementation of viable, safe, and cost-effective EAR, we need a better understanding the legal and organizational context for EAR implementation, including the often-crucial role of communication and collaboration among local stakeholders with different priorities, values, and resources. Our qualitative research takes a mixed methods approach to assessing this context and co-producing decision-support tools and recommendations that includes the following potential human subjects research:

- Interviews with knowledgeable parties to aid the development of supplemental case studies of the legal and institutional dimensions of EAR.
- Stakeholder convenings (workshops) with a spectrum of EAR stakeholders from across the country.

Participants in interviews and workshops will provide critical insights—that could not be derived in other ways—into key legal and organizational barriers, opportunities, and ways of navigating them successfully and into potential policy changes at the federal, state, or local level that could improve the legal and organizational context for EAR going forward.

Interview and workshop participants will be selected for their involvement in decision making for EAR, their role as stakeholders who will be affected by EAR projects or programs, or their involvement in community advocacy with underrepresented communities that may be affected by EAR. They will include stakeholders and decision makers associated with water and wastewater utilities (e.g., utility managers and high-level staff), consultants, technical service providers, state and federal water quality regulators, community advocates from underserved communities, NGOs, landowners, and other entities that might pursue EAR or be affected by it.

Interviews will be focused on supplemental case studies targeted to address gaps in knowledge about the legal and organizational context for EAR, including key gaps in geographic or jurisdictional representation identified through literature review, legal research, and synthesis. Workshops will include participants from across the United States. Academic team members will identify potential interviewees and workshop participants in collaboration with community research partners and key informants, through publicly available information, and via snowball sampling. We will engage community / non-academic team members / partners throughout to ensure that the design, implementation, and analysis of the research meets the needs of potential users and beneficiaries.

All research participants will be adults (age 18 and older), some of whom will be from economically vulnerable populations. The participation of socioeconomically vulnerable groups will contribute critical perspectives that are too often excluded from water decision making. These perspectives will be crucial for helping us to understand the legal and organizational context for EAR—including the priorities, values, and resources of socioeconomically vulnerable stakeholders—and how to expand viable, safe, and cost-effective EAR implementation that helps meet their needs and concerns.

b. Sources of Materials

Interviews will be conducted by phone or Zoom depending on the participant's preference. Workshops will be conducted by Zoom. Collected material from interview and workshop participants will include researchers' notes and audio/video recordings that will be used to aid in data transcription and/or checking notes for accuracy. For Zoom interviews and workshops, we will use the UC Berkeley-licensed version of Zoom and adhere to the UC Berkeley best practices and guidance for Zoom security, including keeping the software up-to-date, using a password-protected meeting code, not allowing others to join before the host, and not allowing others to screen share. We will only do local recordings onto the computer (not Cloud recordings) from Zoom. Participants' personal information (name, organizational affiliation, contact information) will be omitted or anonymized in reporting of results. Data will be secured on a password protected computer and backed up to secure cloud-based service(s) as described in the Scientific Data Management Plan. Data will be shared through a secure platform as described in the Scientific Data Management Plan, and accessible to only relevant researchers on the project team approved to conduct Human Subjects Research. All data will be destroyed 5 years after resulting publications.

c. Potential Risks

There is minimal risk in this study in which interviewees and workshop participants will describe and reflect on their personal and/or professional experiences and views related to the legal and organization context for EAR, which is not considered a sensitive topic. It is possible that, due to the specific nature of this project, although individual identities will be kept anonymous, participants might be identifiable to knowledgeable persons in the field.

2. Adequacy of Protection Against Risks

To minimize potential risks to interview and workshop participants, an Information Letter will clearly state, and the interviewer will remind the interviewee at the start of the interview, that confidentiality cannot be guaranteed due to the unique nature of each institution's experience. Participants will be informed about the following elements, at a minimum: a) The identity/affiliation of the researchers; b) A clear description of the study procedures; c) A statement that participation in the research is voluntary; d) Contact information for questions about the research. Participants will also be informed that their name, contact information, and any other identifying information will be kept confidential and that research results will not include a list of interview participants and will not link any identifying information to quotes or any other data, unless they specifically grant permission for it. Audio/video recording will be conducted only if interviewees / workshop participants agree to be audio/video recorded at the beginning of the interview or workshop. Participants will be given the opportunity to review

their own quotes and contributions to final publications and will be asked how they should be identified in any publications. They will also be given the opportunity to withdraw their information any time prior to publication of results.

There is a possibility that data privacy could be breached if, e.g., the researcher's computers are hacked, revealing participants answers to interview questions or contributions to workshop discussions. We expect the magnitude of potential harm associated with such a breach would be minimal, since interviews and workshops will not be designed to elicit sensitive information and would not put participants at risk of any civil or criminal liability.

3. Potential Benefits of the Proposed Research to Human Subjects and Others

Interview and workshop participants could benefit by developing a better understanding of the legal and organizational context for EAR and how to navigate that context more effectively. Underserved communities in particular could benefit from guidance on improving coordination among and within organizations with different interests to support EAR that helps meet multiple community needs. Workshop participation will provide opportunities for members of underrepresented groups and decision makers at regulatory agencies, water utilities, and other stakeholder organizations to form networking relationships with each other. These relationships may serve as a point of entry for people from marginalized groups to be meaningfully included in future decision making for EAR, as well as for decision makers to have access to the valuable perspectives of community members from marginalized groups.

The potential benefits for research participants outweigh the potential risks associated with participation in this study. The risks to participants are reasonable because we expect the risks of a potential breach of confidentiality to be minimal while participants may gain knowledge that could help their communities, or help them in their work.

4. Importance of the Knowledge to be Gained

Navigating the complex patchwork of institutional responsibility, legal coverage, stakeholders, and potentially competing priorities can be challenging for even sophisticated EAR proponents. Because the legal and organizational context for EAR can strongly influence its costs and benefits, accessible, practical frameworks that help water managers, local stakeholders, and policymakers navigate—and improve—this context are needed to facilitate broader implementation of viable, safe, and cost-effective EAR.

Interviews and workshops will give academic researchers and collaborating partners insights into the legal and institutional context for EAR and how to navigate it effectively. Resulting publications and other outputs will convey these insights widely, providing critical, accessible information to decision makers and stakeholders that can accelerate widespread implementation of effective and affordable EAR that improves water security and sustainability across the nation.

The risks to research participants are reasonable because we expect the risks of a potential breach of confidentiality to be minimal while we expect to gain knowledge of great interest and utility to academics, potential implementers of EAR, and the many stakeholders potentially affected by decisions about whether, where, and how to implement it.

Scientific Data Management Plan

SDMP Goal and Platform

The overall data management goal for the proposed project is to ensure that all distribution products (e.g., journal articles, presentations, white papers), data, and metadata generated in association with this work are archived in a stable repository so that they remain secure and publicly accessible for the long term. We propose to accomplish this using the Dryad Digital Repository (https://datadryad.org/stash), co-developed with the California Digital Library. Dryad infrastructure is robust, redundant, standards compliant, flexible, persistent (with DOI and ORCID identifiers) and features a searchable and discoverable structure that assures community access for decades into the future. Other platforms, as listed below, will also be employed at various stages of the project.

Data Collection

The team will collect: (1) Metadata throughout all data categories and types, described below; (2) Maps and diagrams indicating locations where samples and data were collected; (3) Hydrogeologic data: workflow for analysis, overall EAR system performance, water levels, flow rates, precipitation, mass balance; (4) Geochemical data: workflow for analysis, sample metadata, sample analytical results; (5) Microbiological data: workflow for analysis, sample metadata, tabulated results from DNA/RNA analyses.

Data will be collected in the following formats: (1) Text and tables, generated from word processor and spreadsheet; (2) Maps and diagrams indicating locations where samples and data were collected, generated with ArcGIS, Illustrator, Acrobat and other programs, saved as separate PDFs; (3) Hydrogeologic data: text (ASCII) format; (4) Geochemical data: text (ASCII) format; (5) Microbiological data: text (ASCII) format, if possible - depending on file sizes, some of the genomics data may be saved in binary (standard) formats used for processing.

Documentation and Metadata

Metadata and documentation will include the following: 1) Details of experimental or modeling protocols and methods; 2) Analytical and statistical methods employed; 3) Definitions of variables, vocabularies, units of measurement, any assumptions made, and the format and file type of the data; 4) Who created or contributed to the data, its title, date of creation and under what conditions it can be accessed; 5) Additional details will be included as appropriate - all efforts will be made to include sufficient metadata such that a third party researcher can recreate analyses from raw data. Metadata will be recorded in or appended to original data files were possible, and where not possible will be included in separate documents clearly indicated in the original data files or protocols.

Copyright and Intellectual Property Rights (IP/IPR) issues

Data collected will be considered to be in the public domain once initial publication of results has taken place. Thus, we anticipate no copyright, licensing, or restrictions on third party reuse of data. The only exception we foresee to this related to technical data is where privacy considerations require anonymizing details, masking specific geographic location (e.g., obscuring location to prohibit tracing data to a specific parcel of land), or other IRB-related considerations.

Storage and Backup Plan

Short term (as project is developed and run): GoogleDrive, Box.com, and File Stream, to make data and other work accessible to the project team. Data will be password protected and restricted to project team members and key collaborators, until evaluation of any privacy

considerations has been conducted and data are suitable to release publicly, per the above sections. Backups and data security will be conducted to the standards of the above mentioned service providers, which have been approved by University of California IT services. *Long term* (beginning in first project year, continuing to and beyond project completion): California Digital Library using Dryad (datadryad.org).

Data sharing, access, security

Short term (as project is developed and run): project team will work mainly from a shared GoogleDrive or Box.com folder (with subfolders by topic, purpose, and time). These services automatically back up data to the cloud, and synchronize files and access. This space will be password protected and accessible only to selected project team members. *Long term*: a subset of data will become accessible to the public when uploaded to CDL/Dryad, which will be done in association with preparation and publication of technical reports, theses, and papers. Much of this will occur near the end and after the proposed work period – we anticipate that all data generated by the project that is to be made public being accessible within 12 months of project completion. Any data deemed private and sensitive will be scrubbed and deleted securely by the time the project sunsets, which we anticipate would be within 12 months of project end date. All relevant data will be deposited to Dash, the Data Publication platform, and preserved in the backend Merritt Repository for both public access and long-term storage upon completion of the project study. All relevant data will be made publicly available upon deposit and will be findable through a DataCite DOI granted by Dash. https://dash.ucop.edu

The only anticipated restrictions on long-term data sharing will flow from Institutional Review Board requirements, to be determined as described in the Human Subjects Research Statement.

Responsibilities and Resources

Data Management for this project is to be the primary responsibility of PI Kiparsky, with assistance from Co-PIs Fisher, Dahlke, and Harter. Kiparsky will work with the Co-PIs to prepare and upload data, and will make sure they are able to complete this work if Kiparsky is not able to do so. Data status and archiving will be a standing agenda topic of standard meetings between the PIs and the full project team. The project team takes this Data Management seriously and considers associated steps to be primary, critical expectations and milestones for the project. Novel data generation will be a modest part of the project relative to synthesis of existing data and engagement, dissemination, and communication efforts, and staff time budgeted for proposed activities will be sufficient to cover data management.

Project team members, and particularly co-PI Fisher, have significant experience with data management methods proposed in this Data Management Plan. Additional expertise is available as needed for technical support through IT departments the respective collaborating institutions. Use of the California Digital Library, Dryad, Dash, and Merritt Repository is covered by Indirect Costs. No additional hardware or software beyond that budgeted in the project or pre-existing in respective research groups will be required to support the Data Management Plan.

Community Engagement Plan

Our entire research and engagement proposal is based around a knowledge to action framework, steeped in co-production of knowledge through engagement with decision makers and stakeholders. Our proposed project includes qualitative research that draws upon the expertise and perspective of interested parties as subjects. Thus, this community engagement plan reflects, and is reflected by, the proposal as a whole. Further, there are tight linkages between this Community Engagement Plan and our Human Subjects Research Statement.

What we plan to do and why it will help: The proposed knowledge-to-action framework will engage with communities and stakeholders in several crucial ways: (1) in the process of synthesizing existing research, the team may find gaps that needs to be filled with novel research, the bulk of which will involve direct outreach to communities and regulators whose work is tangential to EAR; (2) the team's decision-support tools and recommendations will be co-produced through extensive outreach and by seeking feedback from potential users of such decision-support tools and targets of such recommendations; (3) the team will conduct outreach-style community engagement centered around communication of deliverables; and (4) the outputs and associated products from this work are primarily targeted towards practitioners and community members, and thus are themselves both based on, and a form of, community engagement.

These categories of community engagement will take the form of targeted ***semi-structured interviews*** with a broad range of EAR experts and interested parties in order to aid synthesis and development of supplemental case studies; larger ***workshop-style stakeholder convening events*** with regulators, those they regulate, and community members; a ***symposium*** meant to highlight the team's research progress while also providing an additional opportunity for stakeholder input and feedback; media outreach and networking; and a range of ***synthesis and communication products*** including a ***video distillation*** of the decision-making toolkit and recommendations developed by the team. The intent of these interviews and workshops is to procure information on EAR's existing legal and organizational contexts and to solicit ideas for how to improve these legal and organizational contexts while the broad intent of the symposium and video distillation is to communicate lessons learned.

Interviewees and workshop participants will include decision makers associated with water and wastewater utilities (e.g., utility managers and high-level staff), consultants, technical service providers, state and federal water quality regulators, community advocates from underserved communities, community advocates from communities that may be impacted by EAR (e.g., Leadership Counsel for Justice and Accountability, the Community Water Center, and Self-Help Enterprises), NGOs, landowners, organized public EAR networks (e.g., California Flood-MAR network; IAH-MAR network; NAWI Water-TAP), and other entities that might pursue EAR or be affected by its proliferation.

We will make particular effort to include recognized experts, but also to broaden participation to include voices that may not always have an opportunity to influence emerging conversations like this one. We will seek input from disadvantaged community representatives and members of underrepresented ethnic and racial groups with relevant interests in our qualitative sampling. Further, we will actively recruit them to join in conversations such as our Symposium as participants and speakers, and will offer our scholarship program to cover their costs. Recruitment will happen through our networks, including our connections with relevant NGOs and organizations at our universities.

Engagement with broader communities of EAR stakeholders is essential to the project's success because, through their formal and informal participation, they will provide insights not available by other means which will in turn have a direct impact on the quality and utility of the deliverables the team provides. Furthermore, participation of socioeconomically vulnerable groups is essential to the project's success because it will contribute critical perspectives that are too often excluded from water decision making. These perspectives will be crucial for helping us to understand the legal and organizational context for EAR—including the priorities, values, and resources of socioeconomically vulnerable stakeholders—and how to expand viable, safe, and cost-effective EAR implementation that helps meet their needs and concerns

It is also our hope that interviewees and workshop participants will personally benefit from participation in this project by developing a better understanding of the various contexts that influence the proliferation of EAR projects and how to navigate the complexities inherent in those various contexts. It is also our intent that underserved communities in particular will benefit from guidance on improving coordination among and within organizations with different interests to support EAR that helps meet multiple community needs. Workshop participation will provide opportunities for members of underrepresented groups and decision makers at regulatory agencies, water utilities, and other stakeholder organizations to form networking relationships with each other. These relationships may serve as a point of entry for people from marginalized groups to be meaningfully included in future decision making for EAR, as well as for decision makers to have access to the valuable perspectives of community members from marginalized groups.

This interview- and workshop-style approach is also helpful because it will ensure that the form and format of the proposed outputs will best serve the various communities with interests in EAR. By engaging with communities and stakeholders as early as the research design phase of the project, our team will have the opportunity to co-produce knowledge in an effort to develop a more successful suite of tools and recommendations.

Equally essential is that we translate the project's research outcomes into assessible, practitioner-oriented materials that are then actively disseminated. This process of active dissemination will include production of video-based communication tools so that research outcomes are digestible, even to non-expert and non-practitioner audiences. Our experience with such video products suggests the effectiveness and importance for engaging with non-specialist audiences, and for drawing interested practitioners to our more detailed resources.

How we will coordinate outreach: To ensure that community engagement remains a central tenet of the proposed work, PI Kiparsky will ensure that it is a component of each bi-monthly full-team meeting so that team members have the support and accountability to proactively address potential concerns and develop more robust engagement methods. Likewise, PIs Fisher, Harter, Owens, Bruno, and Dahlke will ensure that community engagement discussions are also a component of each bi-weekly pillar-specific meeting. More broadly, frequent communication will be crucial to ensure effective multi-way feedback mechanisms and accountability across objectives and between project researchers.

Why we can do it successfully: This team is well-poised to undertake these community engagement and outreach efforts successfully. We know this from deep and consistent experience.

Team members also have ongoing and enduring engagement with various EAR practitioners in the Central Valley, along California's Central Coast, and in Northern California as well as active projects in these regions. This engagement is evidenced by the proposed work's

letters of support which serve as a small sample of entities with which we have close connections. Further, two of our three campuses (UCD & UCSC) are Minority Serving Institutions or Hispanic Serving Institutions with strong traditions of involving Latinx, Asian American, Native American, and Pacific Islander students.

The convening power of our team and our institutions has proven to be very strong over the years – people tend to respond to our invitations to engage, not only because of the prestige associated with our universitates, but because we put tremendous effort into thoughtful topic selection and framing of our conversations, projects, and events.

This convening power is a crucial point. We are clearly a California-centric team, approaching a nationally-relevant topic. This is intentional. Our team made a conscious choice to prioritize our proven interdisciplinary chemistry and the depth of our collective expertise, neither of which we believe can be easily assembled for any given proposal without the benefit of deep collective experience. Critically, we do not believe this is a disadvantage for the purposes of engagement or broad relevance. We collectively have vast and deep networks in the field of EAR and water and environmental resources generally. And, speaking frankly, people listen and respond to our invitations for participation in research projects we design and conduct. Our engagement will be national in scope, and effectively so.

We previously held a fruitful symposium with broad national representation titled Incentivizing Groundwater Recharge Symposium in Berkeley, California in September, 2019. This high profile event resulted in a multi-state exchange, and the production of our case study collection on which we will build insights for the proposed work. This symposium illustrates a large capacity for engagement, on which we will draw directly, and which is described in the following text.

Our team members have a long and successful history of convenings-based research. At the Center for Law, Energy & the Environment alone, our water program has conducted dozens of joint research and engagement projects over the past 10 years, many of which have involved other members of this research team as co-conveners or participants. We have honed methods for carefully building workshops through balanced invitation lists, including careful attention to various axes of diversity in our attendees. We have extensive facilitation and moderation skills and experience across a range of group sizes, methods, goals, approaches, and outcomes for convening-based projects.

In general, our convening-based projects have two main outputs: the first is the conversation itself, which is designed to raise the conceptual bar for all involved by encouraging open and sometimes provocative exchanges and generation of ideas. The second output is typically a synthesis report. These reports, typically targeted towards decision makers, capture key ideas from the facilitated discussion, and augment them with our own research to produce products that are relevant and digestible, while also being credible, robust and academically legitimate. These products of engagement not only advance thinking within the communities from which our participants bring their views, but also typically both include and are targeted towards decision makers such as agency staff and elected officials.

The impact of these projects is also reflected in a consistent history of placing project-related Op-Eds in papers of record, and drawing public interest reflected in interviews and quotations in a range of media outlets. Outcomes from these efforts have included direct influence on state agency actions [56], clarification of legal and regulatory ambiguity [56], new legislation [97] and legislative implementation [98], state budget decisions [89], and governance and management actions [60], to point to just a few selected examples of impacts.

Ultimately, we are extremely well poised to engage, and have built our project and knowledge-to-action framework around meaningful engagement and the co-production of knowledge in support of EAR implementation. Community engagement in this project will be a strength and contribution in and of itself, but will also contributes to the overarching goals for the project. These goals, in the end, are ultimately to the benefit of communities nationwide, as the result of enabling EAR implementation.

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BUDGET JUSTIFICATION

PERSONNEL

Name	Position/Title	Annual Salary	% Time	Year 1	Year 2	Year 3	Total
Michael Kiparsky	PI	$138,000	25%	$34,500	$34,500	$34,500	$103,500
Louise Bedsworth	Program Director	$163,600	10%	$16,360	$16,360	$16,360	$49,079
Nell Green Nylen	Research Fellow	$91,600	35%	$32,060	$32,060	$32,060	$96,180
Molly Bruce	Research Fellow	$65,200	50%	$32,598	$32,598	$53,240*	$118,436
Postdoc 1 TBD	Postdoc	$65,292	100%	$65,292	$65,292		$130,584
Postdoc 2 TBD	Postdoc	$65,292	100%		$65,292		$65,292
Kevin Quach	Program Administrator	$59,508	5%	$2,975	$2,975	$2,975	$8,926
PhD Student TBD	Graduate Student	$88,826	49%*		$54,850	$56,496	$111,346
Total				**$183,785**	**$303,927**	**$195,631**	**$683,343**

*See descriptions for explanation of differences in salary and time by year.

Michael Kiparsky (PI)
Michael Kiparsky, Director of the CLEE Wheeler Water Institute, will serve as project director, and project lead for the efforts led by CLEE. He will work on intercampus exchange between other researchers and engagement with external stakeholders, supervise the efforts of CLEE's project team, participate in research efforts, and oversee synthesis and communications efforts.

Louise Bedsworth
Louise Bedsworth, Land Use Program Director at CLEE, will lead efforts involving integrating land use and project siting into EAR. She will conduct legal, regulatory, institutional and technical analysis, and supervise work by Research Fellows.

Nell Green Nylen
Nell Green Nylen, Senior Research Fellow at the Wheeler Water Institute at CLEE, will focus on qualitative research on the project. She will conduct legal, regulatory, institutional and technical analysis, and participate in writing and engagement with subject matter experts.

Molly Bruce
Molly Bruce, Research Fellow at the Wheeler Water Institute at CLEE, will focus on qualitative research on the project. She will conduct legal, regulatory, institutional and technical analysis,

and participate in writing and engagement with subject matter experts. Ms. Bruce will contribute 50% effort in Years 1&2, and 82% in Year 3 of this project.

Postdoctoral Scholar 1 (TBD)
We will hire an interdisciplinary post-doctoral scholar or research fellow to focus on a range of semi-quantitative and qualitative research tasks, including data gathering and analysis on the geophysical synthesis and contributions to other topic areas (e.g., infrastructure cost estimates or cost-benefit modeling). In addition to conducting technical analysis, the scholar will participate in writing and engagement with subject matter experts. This postdoc will be jointly supervised by members of the leadership team as appropriate for the specific topics of focus.

Postdoctoral Scholar 2 (TBD)
This postdoc will work on life-cycle cost and environmental accounting and tool development. This postdoc will be supervised by Dr. Stokes-Draut and will only be working in year 2.

Kevin "Kiki" Quach
Kevin Quach, Program Administrator at CLEE, will assist with research tasks and meeting organization.

PhD Student (TBD)
We will hire a graduate student to focus on a range of quantitative research tasks, including data gathering and analysis of costs and benefits. In addition to conducting technical analysis, the scholar will participate in writing and engagement with stakeholders. The student will contribute 49% effort during the academic year (4.41 months), and 100% during the 3 summer months in Year 2 and 3. We are assuming a 3% inflation rate for this position due to past annual union increases for graduate students. This student will primarily be advised by Dr. Bruno with additional collaborative input from Dr. Stokes and other members of the research team as appropriate.

FRINGE BENEFITS

Position/Title	Fringe Rate %	Year 1	Year 2	Year 3	Total
PI	35.9%	$12,386	$12,386	$12,386	$37,157
Program Director	35.9%	$5,873	$5,873	$5,873	$17,619
Research Fellow	35.9%	$11,509	$11,509	$11,509	$34,529
Research Fellow	35.9%	$11,703	$11,703	$19,113	$42,519
Postdoc 1	14.4%	$9,402	$9,402		$18,804
Postdoc 2	14.4%		$9,402		$9,402
Program Administrator	43.8%	$1,303	$1,303	$1,303	$3,910
Graduate Student	2.6%		$1,426	$1,469	$2,895
Total		**$52,176**	**$63,004**	**$51,654**	**$166,834**

Travel

Expenses are mainly for airfare, mileage, and other transportation to/from field sites, public and technical meetings, and visits with collaborating agencies/groups (water supply, resource conservation, NGO, regulatory, etc.). Trip dates and destinations will be determined in conjunction with stakeholders, and are subject to COVID-19 considerations.

Travel for each year will include 1) attendance for selected team members at EPA STAR Progress Reviews and the EPA STAR Final Workshop; 2) presentation of results at a national water management meeting with target audience of decision-makers, regulators, consultants, and scholars (e.g., BSMAR, NGWA); 3) travel for periodic collaboration meetings among team members and for engagement with local and regional regulators and agency decision makers.

A travel budget of $19,806 ($6,602 each year) is requested for these purposes.

Purpose	Location	Item	Computation	Cost
EPA STAR Progress Review	Washington, DC	Lodging	4 people x $150/night x 2 nights	$1,200
		Airfare	4 people x $500 round trip	$2,000
		Per diem	4 people x $62/day	$248
		Local transport	3 people x $125	$375
National water management conference	TBD	Lodging	1 person x $150/night x 2 nights	$300
		Airfare	1 person x $500 round trip	$500
		Per diem	1 person x $62/day	$62
		Local transport	1 person x 125	$125
		Registration fees	$500	$500
Regional site visits and collaboration	Within California	Mileage	12 trips x 184 miles x $0.585/mile	$1,292
Total annual travel				**$6,602**

A separate trip in year two will include $2,000 for one domestic water industry conference (e.g., the AWWA ACE event) where this research will be disseminated.

Purpose of Travel	Location	Item	Computation	Cost
Water industry-focused conference to present project outcomes for dissemination	TBD	Registration	1 person x $650	$ 650
		Lodging	1 person x $190/night x 3 nights	$ 570
		Airfare	1 person x $500 roundtrip airfare	$ 500
		Meals	1 person x $70/day x 4 days	$ 280
		Total		$ 2,000

Supplies

Computer

A laptop computer will be purchased for the Postdoctoral Scholar ($2,500).

Other

Design and Publication

These costs include graphic design and printing of project whitepapers and other communication materials. Journal publication includes author charges for open access publication. Graphic design budget includes fees for graphic design services, potentially including report layout, infographics, or other communications materials. The budget in year three includes funds for a barrage of fact sheets, infographics, explainers, and other outputs targeted towards building understanding and support for EAR among practitioners, decision-makers, and lay stakeholders.

Year 1: One open-access journal article at $2,000 [geophysical and technical data synthesis]
Year 2: One open-access journal article @ $2,000 and two whitepapers @$1,000/each.
Year 3: Two open-access journal articles @$2,000/each; one whitepaper @1,000. Design and communications services as described above @$20,000.

Publication costs of $5,000 are requested. $4,800 will cover open access fees in Y3 (see for example, the *Journal of Public Economics* article publishing charge for open access). $200 will cover submission fees in Y2. Total costs of design and publication is **$36,000.**

Symposium

The symposium will be held in Berkeley, CA. Previous experience suggests that most attendees, including speakers, have travel funds available through their agencies to attend in their professional capacities. However, we will offer scholarships and travel assistance, and actively solicit applications from to potential attendees who can diversify the composition of the discussion geographically or by representing disadvantaged and underrepresented voices.

Symposium costs	**Conference costs**		
	Total event attendance	150	
	Item	**Est'd cost per person**	**subtotal**
	contiental breakfast	$8	$1,200
	box lunch	$12	$1,800
	coffee service	$5	$750
	reception	$20	$3,000
	materials (folders, printing etc)	$4	$600
	University venue (free)	$0	$0
	Subtotal Conference costs		**$7,350**
Scholarships and travel	Number of scholarships	20	

	Item	cost per person	subtotal
	Lodging	$150	$3,000
	Airfare	$500	$10,000
	Per diem	$62	$1,240
	Scholarship subtotal		**$14,240**
	Total conference costs		**$21,590**

Video Production

The video production budget will support the production of one or more video products designed to articulate key conceptual elements of EAR. The video effort will be informed by stakeholder engagement, and co-produced with key EAR practitioners. Our team has used similar approaches to help generate understanding and support for complex incentives for recharge in other projects, and we will build on this experience to target

Based on our prior experience with groundwater recharge video production, we will plan to produce between 3 and 5 videos, at a total cost of $30,000, in Year 3 of the project.

Graduate Student Fee Remission

The University of California provides full remission of tuition, fees, and graduate student health insurance to all graduate students who are employed on-campus 45% time or greater during the academic year. The rate for in-state remission is $10,630 per semester in year 2 and $11,161 per semester in year 3 assuming a 5% inflation rate.

Subawards

Organization	Year 1	Year 2	Year 3	Total
UC Davis	$24,563	$28,304	$29,392	$82,259
UC Santa Cruz	$83,677	$82,985	$88,250	$254,912
UC Hastings	$19,998	$19,998	$19,998	$59,994
Total	**$128,238**	**$131,287**	**$137,640**	**$397,165**

UC Davis

Professors Helen Dahlke and Thomas Harter will lead, jointly with Professor Andrew Fisher (UCSC), research and synthesis on geophysical elements and technical methods for EAR.

UC Santa Cruz

Professor Andrew Fisher will lead, jointly with Professors Helen Dahlke and Thomas Harter, research and synthesis on geophysical elements and technical methods for EAR. Professor Fisher will also lead work on methods and considerations for managing water quality, in collaboration with others on the team.

UC Hastings

Professor Dave Owen will lead research on legal, policy and institutional topics, in collaboration with Dr. Kiparsky, Dr. Green Nylen, Ms. Bruce, and others on the team.

INDIRECT COSTS

Indirect Cost Rate %	Year 1	Year 2	Year 3	Total
60.5%	$161,572	$247,036	$188,570	$597,178

Indirect costs are based on University negotiated rates with the cognizant federal authority and are applied at a rate of 60.5%. Indirect costs are applied using the Modified Total Direct Cost (MTDC) formula, per rate agreement dated June 25, 2020. Modified total direct costs exclude equipment, capital expenditures, charges for patient care, student tuition remission, rental costs of off-site facilities, scholarships, and fellowships, participant support costs and the portion of each subgrant and subcontract in excess of $25,000. For more information, please see: http://www.spo.berkeley.edu/policy/fa.html. The rates after July 1, 2022 are provisional and subject to change based upon our updated federally negotiated indirect cost rate agreement.

Louise Wells Bedsworth
Center for Law, Energy, and the Environment, University of California, Berkeley
Berkeley, California 94704

Education

Doctor of Philosophy, Energy and Resources, University of California, Berkeley
Master of Science, Civil and Environmental Engineering, University of California, Berkeley
Bachelor of Science, 1996, Earth, Atmospheric, and Planetary Sciences, Massachusetts Institute of Technology

Professional Experience

June 2021 – present	Program Director, Land Use, Center for Law, Energy, and the Environment, Berkeley Law *Conducting policy-oriented research to support develop replicable tools to support sustainable land use; governance models that advance integrated land use; and implementation of community-engaged practices in research.*
July 2018 – April 2021	Executive Director, California Strategic Growth Council *Led core staff and associated partnerships in the development and execution of programs to support equitable, sustainable, resilient, and healthy community development in California.*
August 2013 – July 2018	Deputy Director, Governor's Office of Planning and Research *Led multidisciplinary staff to inform long-term planning and environmental policy in California.*
October 2011 – August 2013	Senior Researcher, Governor's Office of Planning and Research *Drafted comprehensive, long-term environmental goals and policy report and indicator set for State of California.*
August 2014 – August 2018	Adjunct Researcher, University of California, Davis *Principal Investigator for US EPA grant to integrate extreme events impacts into management decisions for air and water quality in California.*
July 2006 – August 2011	Research Fellow, Public Policy Institute of California *Conducted research on environmental policy issues relevant to California, including climate adaptation, local climate action, and transportation and land use.*
February 2003 – June 2011	Senior Vehicles Analyst, Union of Concerned Scientists *Led technical work to inform greenhouse gas emission standard development for passenger vehicles.*
July 2002 – February 2003	Visiting Fellow, Public Policy Institute of California *Analyzed air quality in the San Joaquin Valley.*

August 1996 – June 2002	Graduate Student Researcher, University of California, Berkeley *Examined roles of science and uncertainty in regulatory decision making*.
January – May 2002	Research Analyst, Redefining Progress *Supported development of ecological footprint calculator*

Peer-Reviewed Publications

Baker, Z., J Ekstrom, K. Meagher, BL Preston, and **L. Bedsworth**. 2020. The Social Structure of Climate Research and Practitioner Engagement: Evidence from California. *Global Environmental Change* 63: https://doi.org/10.1016/j.gloenvcha.2020.102074.

Ekstrom, JA and **L Bedsworth**. 2018. Adapting air quality management for a changing climate: Survey of local districts in California. *Journal of the Air & Waste Management Association* 68(9): 931-944.

Baker, Z; J Ekstrom, and **L Bedsworth**. 2018. Climate information? Embedding climate futures within temporalities of California water management, *Environmental Sociology* 4:4, 419-433.

Ekstrom, JA; **L Bedsworth**; and A Fencl. 2017. Gauging climate preparedness to inform adaptation needs: local level adaptation in drinking water quality in CA, USA. *Climatic Change* 140: 467-481.

Franco, Guido, **Louise Bedsworth**, and Amber Pairis. 2014. California's Comprehensive Climate Change Program: The Pivotal Role of Research. *EM*

Bedsworth, Louise and Ellen Hanak. 2012. Climate Policy at the Local Level: Insights from California. *Global Environmental Change* 23(3): 664-677.

Bedsworth, Louise. 2012. California's local health agencies and the state's climate adaptation strategy. *Climatic Change* 111(1): 119-133.

Bedsworth, Louise. Air Quality Planning in California's Changing Climate. *Climatic Change* 111(1): 101-118.

Bedsworth, Louise and Ellen Hanak. 2012. Guest Editorial: Preparing California for a Changing Climate. *Climatic Change* 111(1): 1-4.

Bedsworth, Louise and Ellen Hanak. 2010. Adaptation to Climate Change – A Review of Challenges and Tradeoffs in Six Sectors. *Journal of the American Planning Association* 76(4): 477-495.

Bedsworth, Louise. 2009. Climate Change and California's Local Health Officers – A Role for Scientists. *Bulletin of the American Meteorological Society*: doi: 10.1175/2008BAMS2745.1. [Online 18 December 2008]

Bedsworth, Louise. 2009. Preparing for Climate Change: A Perspective from Local Public Health Officers in California. *Environmental Health Perspectives* 117(4): 617-623.

Bedsworth, Louise Wells, Micah D. Lowenthal, and William E. Kastenberg. 2004. Uncertainty and Regulation: The Rhetoric of Risk in the California Low-Level Radioactive Waste Debate. *Science, Technology, and Human Values* 29: 406 - 427.

Bedsworth, Louise Wells and William E. Kastenberg. 2002. Science and Uncertainty in Environmental Regulation: Insights from the Evaluation of California's Smog Check Program. *Science and Public Policy* 29(1): 13-24.

BIOGRAPHICAL SKETCH – MOLLY BRUCE

University of California, Berkeley, School of Law | 393 Simon Hall, Berkeley, CA 94720
(704) 658-5306 | molly.bruce@berkeley.edu

EXPERIENCE

University of California, Berkeley School of Law : Center for Law, Energy & the Environment, Berkeley, CA
Wheeler Water Institute Water Policy Fellow, September 2021 – Present
Support the proliferation of innovative groundwater recharge efforts.

National Aeronautics and Space Administration : Jet Propulsion Laboratory (NASA JPL), Pasadena, CA
Project Associate, January 2021 – April 2021
Used satellite data to examine issues concerning climate adaptation—issues such as estuary loss—in order to develop predictive models.

North Carolina Conservation Network, Raleigh, NC
Legal Extern, August 2020 – May 2021
Supported the development of equitable & enduring clean energy policy in North Carolina.

Duke University, Durham, NC
Graduate Teaching Assistant, August 2020 – May 2021
Assisted graduate-level courses taught by (1) Prof. Steve Roady, Ocean & Coastal Law & Policy, (2) Dr. Pat Halpin & Prof. Jesse Clearly, Marine Geospatial Analysis, and (3) Prof. Jonathan Wiener and Prof. Kate Konschnik, Climate Change & the Law

Marine Robotics & Remote Sensing Lab (MaRRS Lab), Beaufort, NC
Researcher, February 2020 – May 2021
Used innovative technologies including UASs, rovers, AUVs, and various software packages to address questions related to climate change.

Nicholas Institute for Environmental Policy Solutions, Durham, NC
Researcher, August 2019 – May 2021
Surveyed science & policy lit. concerning impacts to coastal ecosystems in specific states. Developed a report for Pew Research Center.

Duke University Center on Risk in Science and Society & Administrative Conference of the United States, Durham NC
Research Assistant for Dr. Lori Bennear & Prof. Jonathan Wiener, March 2019 – May 2021
Examined how laws, regulations, and guidance documents influence adaptive approaches to administration of agency mandates. Conducted legal & policy research on *cy pres* resolutions & collective remedies to class actions—particularly within the environmental context.

Surfrider Foundation, San Clemente, CA
Legal Department and Environmental Department Split Intern, May 2019 – August 2019
Advocated for stewardship of marine resources before administrative lawmaking bodies. Submitted public comments and gave public testimony.

UNFCCC – International Institute for Sustainable Development, Katowice, Poland
COP24 Assistant, November 2018 – December 2018

Augmented IISD's presence at COP24. Attended negotiations on IISD's behalf. Facilitated remote engagement with the climate negotiations.

North Carolina Department of Justice – Environmental Division, Raleigh, NC
Coastal, Commissions, and Administrative Legal Intern, May 2018 – August 2018
Drafted legal memoranda for litigation. Sought civil penalties for environmental contamination. Worked with state environmental agencies.

Habitat for Humanity, Durham, NC
AmeriCorps Team Leader, August 2016 – July 2017
Worked with the construction team. Led volunteer groups. Partnered with low-income families to fortify their homeownership success.

EDUCATION

Duke University School of Law, Durham, NC
Juris Doctor, May 2021
Honors: Dean's Scholarship, Paul Hardin III Scholarship, & Burdman Fellowship
NC Wildlife Federation Scholarship, Piedmont Silver Eagles Scholarship
Public Interest Public Service Certificate
Writing: *Use of Drones for Conservation: Implications under the ESA & MMPA for the UAS research & hobbyist communities*
Activities: Duke University Board of Trustees, *Climate Change & Sustainability Task Force Advisor*
Environmental Law Society, *President*
Environmental Defense Fund, *Pro-Bono Research Project Leader*
Oceana, *Pro-Bono Research Project Leader*

Duke University Nicholas School of the Environment, Durham, NC
Master of Environmental Management in Coastal Environmental Management, May 2021
Honors: Tim & Karen Hixon Wildlife Conservation Fellowship
Geospatial Analysis Certificate
Activities: Ocean Policy Working Group, *Action Team Coordinator*

University of North Carolina at Chapel Hill, Chapel Hill, NC
Bachelor of Arts in Geography/GIS and Global Studies, *Magna Cumlaude*, May 2016
Thesis: *The Airway Less Traveled: The Gendered Experiences of Eight Female Pilots*
Honors: Phi Beta Kappa & Honors Laureate with Distinction
Buckley Public Service Scholar
J. Douglas Eyre Award for Outstanding Leadership

ELLEN M. BRUNO

ebruno@berkeley.edu ◇ ellen-bruno.com

EDUCATION

University of California, Davis
Ph.D. in Agricultural and Resource Economics *2018*
M.S. in Agricultural and Resource Economics *2016*

University of California, San Diego *2013*
B.S. in Management Science, *summa cum laude*
Minors in Math, Environmental Science

APPOINTMENTS

07/2018 - present Assistant Specialist in Cooperative Extension
Department of Agricultural and Resource Economics
University of California, Berkeley

SELECTED RESEARCH PUBLICATIONS

Ellen M. Bruno and Katrina Jessoe. (2021) "Using Price Elasticities of Water Demand to Inform Policy." *Annual Review of Resource Economics* 13.9: 1-15.

Ellen M. Bruno and Katrina Jessoe. (2021) "Missing Markets: Evidence on Agricultural Water Demand from Volumetric Pricing." *Journal of Public Economics* 196: 104374.

Bruno, Ellen M. and Richard J. Sexton. (2020) "The Gains from Agricultural Groundwater Trade and the Potential for Market Power: Theory and Application." *American Journal of Agricultural Economics* 102.3: 884-910.

DeVincentis, Alyssa J., Sam Sandoval Solis, Ellen M. Bruno, Amber Leavitt, Anna Gomes, Sloane Rice, and Daniele Zaccaria. (2020) "Using Cost-Benefit Analysis to Understand Adoption of Winter Cover Cropping in California's Specialty Crop Systems." *Journal of Environmental Management* 261: 110025.

Saitone, Tina L. and Ellen M. Bruno. (2020) "Cost Effectiveness of Livestock Guardian Dogs for Predator Control." *Wildlife Society Bulletin* 44.1: 101-109.

SELECTED EXTENSION PUBLICATIONS

Bruno, Ellen M. (2021) "Identifying Policies to Mitigate the Costs of Drought." *ARE Update* 25.1: 13 - 15.

Ayres, Andrew, Ellen Hanak, Brian Gray, Gokce Sencan, Ellen Bruno, Alvar Escriva-Bou, and Greg Gartrell. (2021). "Improving California's Water Market: How Water Trading and Banking Can Support Groundwater Management." *Public Policy Institute of California.* Technical Report.

Bruno, Ellen M. and Heidi Schweizer. (2021) "Why Wall Street Investors' Trading California Water Futures is Nothing to Fear– and Unlikely to Work Anyway." *The Conversation.*

Wardle, Arthur R., Paige Griggs, and Ellen M. Bruno. (2021) "A Progress Report on California's Sustainable Groundwater Management Act." *ARE Update* 24.3: 1-4.

Bruno, Ellen M., Alyssa DeVincentis, Sam Sandoval Solis, and Daniele Zaccaria. (2020) "Assessing the Costs and Benefits of Winter Cover Cropping in California." *ARE Update* 23.6: 9-11.

Bruno, Ellen M., Andrew Ayres, and Emmanuel Asinas. (2019) "Managing Flood Water for Aquifer Recharge: Economic Considerations for Policy." *Global Water Forum.*

Bruno, Ellen M. and Tina Saitone. (2019) "Livestock Guardian Dogs: Do the Benefits Outweigh the Costs for Sheep Producers?" *ARE Update* 22.6: 9-11.

Bruno, Ellen M. and Katrina Jessoe. (2018) "Climate Change and California's Water Supply: How Can We Adapt?" *ARE Update* 22.1: 1-3.

Bruno, Ellen M. (2018) "The Economic Impacts of Agricultural Groundwater Markets." *ARE Update* 21.6: 9-11.

AWARDS

2020	Award for Most Downloaded Article in the 2019-2020 Issue of *ARE Update*
2019	Award for Most Downloaded Article in the 2018-2019 Issue of *ARE Update*
2019	Outstanding Doctoral Dissertation Award, *Agricultural & Applied Economics Association*
2019	Gordon A. King Award for Best Dissertation, ARE Dept, UC Davis
2017	Award for Most Downloaded Article in the 2016-2017 Issue of *ARE Update*
2017	Outstanding Graduate Paper Award, *Western Agricultural Economics Association*
2013	Joel Dean Award for Excellence in Management Science, UC San Diego

RECENT PRESENTATIONS

2021: The National Academy of Sciences, Water Science and Technology Board Meeting; Property and Environment Research Center (PERC) Workshop on Water Markets; Pennsylvania State University; SWELL (Seminar in Water Economics onLLine); University of Arizona; Groundwater Resources Association Future of Water Conference

2020: AGU Conference; UC Davis; Cal Poly College of Agriculture, Food, and Environmental Sciences; AAEA Pre-conference Workshop on Specialty Crop Challenges; UC ANR Pistachio Workgroup Meeting; Groundwater Resources Association 3rd Annual GSA Summit; UC ANR Silver Solutions Seminar; NGO Groundwater Collaborative Workshop; UC ANR Water Program Team Meeting, Davis, CA; Giannini Foundation Big Ag Data Conference, Davis, CA; AERE @ ASSA, San Diego, CA.

PROFESSIONAL ACTIVITIES

2021	Member, Ad Hoc Advisory Panel for SWEEP, CA Department of Food & Agriculture
2020 - present	Member, Public Policy Institute of California Water Policy Center Research Network
2020 - present	Co-chair, UC ANR Water Program Team
2020 - present	Member, Union of Concerned Scientists Groundwater Technical Assistance Network
2019 - 2021	UC Berkeley Representative, UC ANR Academic Assembly Council
2019 - 2021	Abstract Reviewer, AERE Summer Conference
2019 - present	Panel Member, UC ANR Strategic Initiative: Water Quality, Quantity, and Security
2019 - 2020	Selected Paper Topic Leader, AAEA Annual Meeting
2018 - present	Co-editor, *ARE Update*
2018 - 2019	Member, Economic Advisory Subcommittee for Flood-MAR Program, California Department of Water Resources

Biographical Sketch

Helen E. Dahlke

University of California, Davis
Land, Air and Water Resources
One Shields Avenue
Davis, CA 95616

Phone: +1 (530) 302-5358
Email: hdahlke@ucdavis.edu
Web: http://dahlke.ucdavis.edu
https://orcid.org/0000-0001-8757-6982

Education and Training

College/University	*Major*	*Degree, Year*
Friedrich-Schiller University of Jena, Germany	Physical Geography	MSc 2004
Cornell University, Biological and Environmental Engineering	Environmental Engineering	PhD 2011

Research and Professional Experience

Associate Professor in Integrated Hydrologic Sciences — 04/ 2017 – present
Land, Air and Water Resources, University of California, Davis

Assistant Professor in Integrated Hydrologic Sciences — 04/ 2013 – 03/207
Land, Air and Water Resources, University of California, Davis

Postdoctoral Research Associate, Stockholm University, Sweden — 10/2010 – 04/2013

Synergistic Activities

Grants

PI United States Department of Agriculture award (2020-2024) *Synergistic Managed Aquifer Recharge Strategies to Sustain Irrigated Agriculture* ($800,000);
Co-PI United States Department of Agriculture award (2021-2023) *Quantifying the environmental effects of implementing managed agricultural aquifer recharge in agricultural production systems*. Scott Bradford (PI) ($600,000);
PI Gordon and Betty Moore Foundation (2018-2022) *Developing science-based approaches to managed agricultural groundwater re-charge in California's Central Valley*. ($1,650,000);
PI National Science Foundation Award (2017-2021) CNH-L: *The dynamics of rural poverty, land use, and water in California's changing Central Valley* ($1,599,743) focusing on estimating climate change impacts on the surface and groundwater supply of the Tulare Lake Basin and recommendations for climate adaptation for disadvantage communities;
PI California Department of Pesticide Regulation Award (2018-2021) *A Field Study to Evaluate the Impacts of On-farm Recharge on the Leaching Behavior of Agricultural Pesticides*. ($299,559);
PI USDA Economic Research Service Award (2018-2021) *Regional Aquifer Management: Hydrology of Managed Aquifer Recharge in the Central Valley Aquifer and Mississippi Embayment*. ($299,947);
Co-PI Binational Agricultural Research and Development Award (2018-2021) *Increasing water availability through agricultural groundwater recharge*. ($310,000).

Scientific and Public Outreach

- Congressional science briefing titled 'Water security in the West: A science briefing on water for people and nature' in Washington D.C to inform members of congress, DOI, USDA, Office of Management and Budget, Congressional Research Service, U.S. Global

Change Research Program on water, climate change and agricultural groundwater banking in California (25-26 Oct. 2016)
- I have given over 100 presentations on agricultural managed aquifer recharge in the past 5 years

Honors and Awards

USDA ThinkWater Fellow 2017
LEAD21 Program Fellow of 2020-2021

Products most closely related to the proposed project

- Murphy, N.P., H. Waterhouse, and **H.E. Dahlke**. Influence of Agricultural Managed Aquifer Recharge on nitrate transport – the role of soil type and flooding frequency. Vadose Zone Journal, https://doi.org/10.1002/vzj2.20150.
- Ganot, Y. and **H.E. Dahlke**. A model for estimating Ag-MAR flooding duration based on crop tolerance, root depth, and soil texture data. Agricultural Water Management, https://doi.org/10.1016/j.agwat.2021.107031.
- Ganot, Y. and **Dahlke, H.E.**, 2021. Natural and forced soil aeration during agricultural managed aquifer recharge. Vadose Zone Journal, p.e20128, https://doi.org/10.1002/vzj2.20128.
- Waterhouse, H., Arora, B., Spycher, N.F., Nico, P.S., Ulrich, C., **Dahlke, H.E.** and Horwath, W.R., 2021. Influence of Agricultural Managed Aquifer Recharge (AgMAR) and Stratigraphic Heterogeneities on Nitrate Reduction in the Deep Subsurface. Water Resources Research, p.e2020WR029148, https://doi.org/10.1029/2020WR029148.
- Marwaha, N., Kourakos, G., Levintal, E., and **Dahlke, H.E.** 2021. Identifying agricultural managed aquifer recharge locations to benefit drinking water supply in rural communities. Water Resources Research, https://doi.org/10.1029/2020WR028811.
- Waterhouse, H., Bachand, S., Bachand, P.A.M., Mountjoy, D., Choperena, J., **Dahlke, H.E.**, Horwath, W.R. 2020. Agricultural managed aquifer recharge — water quality factors to consider. California Agriculture 74(3):144-154. https://doi.org/10.3733/ca.2020a0020.
- Pauloo, R., Escriva-Bou, A., **Dahlke, H.**, Fencl, A., Guillon, H. and Fogg, G., 2020. Domestic well vulnerability to drought duration and unsustainable groundwater management in California's Central Valley. Environmental Research Letters. https://doi.org/10.1088/1748-9326/ab6f10.
- Kourakos, G., **Dahlke, H.E.**, Harter, T. 2019. Increasing Groundwater Availability and Baseflow through Agricultural Managed Aquifer Recharge in an Irrigated Basin. Water Resources Research, https://doi.org/10.1029/2018WR024019.
- Ghasemizade, M., Asante, K., Peterson, C., Kocis, T.N., **Dahlke, H.E.**, Harter, T. 2019. An integrated approach toward groundwater banking in the southern Central Valley, California. Water Resources Research, https://doi.org/10.1029/2018WR024069.
- **Dahlke, H.E.**, LaHue, G.T., Mautner, M.R.L., Murphy, N.P., Patterson, N.K., Waterhouse, H., Yang, F. and Foglia, L. 2018. Managed Aquifer Recharge as a tool to enhance sustainable groundwater management in California: examples from field and modeling studies. In Friesen, J., Sinobas, L.R. (eds.), *Advances in Chemical Pollution, Environmental Management and Protection: Advanced Tools for Integrated Water Resources Management Volume 3*‘, Elsevier Publishing, 66 pp. https://doi.org/10.1016/bs.apmp.2018.07.003.
- Kocis, T.N. and **H.E. Dahlke**. 2017. Availability of high-magnitude streamflow for groundwater banking in the Central Valley, California. Environmental Research Letters, 12: 084009.

OMB No. 0925-0001 and 0925-0002 (Rev. 12/2020 Approved Through 02/28/2023)

BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors.
Follow this format for each person. DO NOT EXCEED FIVE PAGES.

NAME: Fisher, Andrew

eRA COMMONS USER NAME (credential, e.g., agency login):

POSITION TITLE: Distinguished Professor

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE (if applicable)	END DATE MM/YYYY	FIELD OF STUDY
Stanford University, Stanford, CA	BS	06/1984	Geology
University of Miami, RSMAS, Miami, FL	PHD	05/1989	Marine Geology and Geophysics

A. Personal Statement

Fisher is the UCSC Director for UC Water, co-PI for the Center for Dark Energy Biosphere Investigations, and founder of The Recharge Initiative (www.rechargeinitiative.org), a focused effort to protect, enhance, and improve the availability and reliability of groundwater resources. Fisher has authored or co-authored >200 articles, book chapters, reports, and other documents, and supervised 24 graduate students and >50 undergraduate student researchers. Fisher teaches classes in geology, hydrology, groundwater, and groundwater modeling, and conducts research on: managed recharge, geothermics, marine hydrothermal circulation, surface water – groundwater interactions, coupled flows (fluid-heat-solutes), water quality, and development of new hydrologic tools and techniques. He has served on numerous technical advisory committees for agencies, municipalities, and NGOs. Here are some recent publications relevant to this proposal:

1. Pensky J, Fisher AT, Gorski G, Schrad N, Beganskas S, Saltikov C. Enhanced cycling of nitrogen and metals during rapid infiltration: implications for managed recharge. Science of the Total Environment. Forthcoming; in review.
2. Gorski G, Dailey H, Fisher AT, Schrad N, Saltikov C. Denitrification during infiltration for managed aquifer recharge: Infiltration rate controls and microbial response. Sci Total Environ. 2020 Jul 20;727:138642. PubMed PMID: 32334223.
3. Beganskas S, Young KS, Fisher AT, Harmon R, Lozano S. Runoff Modeling of a Coastal Basin to Assess Variations in Response to Shifting Climate and Land Use: Implications for Managed Recharge. Water Resource Management. 2019 February 08; 33:1683-1698. Available from: https://link.springer.com/article/10.1007%2Fs11269-019-2197-4 DOI: 10.1007/s11269-019-2197-4
4. Kiparsky M, Milman A, Owen D, Fisher AT. The Importance of Institutional Design for Distributed Local-Level Governance of Groundwater: The Case of California's Sustainable Groundwater Management Act. Water. 2017 September 30; 9(10):755-. Available from: http://www.mdpi.com/2073-4441/9/10/755 DOI: 10.3390/w9100755

B. Positions, Scientific Appointments and Honors

Positions and Scientific Appointments

2019 - Distinguished Professor, University of California, Santa Cruz, Earth and Planetary Sciences Department, affiliated with: Ocean Sciences, Environmental Studies, Microbiology and Environmental Toxicology, Santa Cruz, CA

2003 - 2019 Professor, University of California, Santa Cruz, Earth and Planetary Sciences Department, Santa Cruz, CA

1999 - 2003	Associate Professor, University of California, Santa Cruz, Department of Earth Sciences, Santa Cruz, CA
1995 - 1999	Assistant Professor, University of California, Santa Cruz, Department of Earth Sciences, Santa Cruz, CA
1993 - 1995	Associate Scientist and Graduate Faculty, Indiana University, Department of Geological Sciences and Indiana Geological Survey, Bloomington, IN
1993 - 1993	Visiting Assistant Professor, Texas A & M University, Department of Geophysics, College Station, TX
1989 - 1993	Adjunct Assistant Professor, Texas A & M University, Department of Geophysics, College Station, TX
1989 - 1993	Staff Scientist, Texas A & M University, Ocean Drilling Program, College Station, TX
1988 - 1988	Exploration Geologist, Shell Western Exploration & Production, Inc., Houston, TX

Honors

2020 - 2022	Distinguished Lecturer, Sigma Xi
2016 - 2017	Distinguished Lecturer, International Ocean Discovery Program
2003 - 2004	Distinguished Lecturer, National Science Foundation - RIDGE2000
1996 - 1997	Distinguished Lecturer, JOI/United States Science Support Program
2019	Fellow, American Association for the Advancement of Science
2018	Fellow, American Geophysical Union
2017	Excellence in Teaching Award, University of California, Santa Cruz
2016	O. E. Meinzer Award in Hydrogeology, Geological Society of America
2016	Watershed Hero Award, Blue Circle, Santa Cruz County
2012	Excellence in Teaching Award, University of California, Santa Cruz
2011	Bennett Distinguished Lecturer, University of Leicester, UK
2008	Distinguished Service Award, College 8, University of California, Santa Cruz
2006	Fellow, Geological Society of America

C. Contribution to Science

1. Additional, selected publications related to proposed work:

   a. Miller K, Fisher AT, Kiparsky M. Incentivizing Groundwater Recharge in the Pajaro Valley Through Recharge Net Metering (ReNeM). Case Studies in the Environment. 2021 April 21; 5(1). Available from: https://online.ucpress.edu/cse/article/5/1/1222393/116573/Incentivizing-Groundwater-Recharge-in-the-Pajaro?searchresult=1

   b. Gorski G, Fisher AT, Beganskas S, Weir WB, Redford K, Schmidt C, Saltikov C. Field and Laboratory Studies Linking Hydrologic, Geochemical, and Microbiological Processes and Enhanced Denitrification during Infiltration for Managed Recharge. Environ Sci Technol. 2019 Aug 20;53(16):9491-9501. PubMed PMID: 31352778.

   c. Beganskas S, Gorski G, Weathers T, Fisher A, Schmidt C, Saltikov C, Redford K, Stoneburner B, Harmon R, Weir W. A horizontal permeable reactive barrier stimulates nitrate removal and shifts microbial ecology during rapid infiltration for managed recharge. Water Research. 2018 November; 144:274-284. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0043135418305827 DOI: 10.1016/j.watres.2018.07.039

   d. Beganskas S, Fisher AT. Coupling distributed stormwater collection and managed aquifer recharge: Field application and implications. J Environ Manage. 2017 Sep 15;200:366-379. PubMed PMID: 28599220.

Biographical Sketch — Nell Green Nylen

University of California, Berkeley, School of Law • 393 Simon Hall, Berkeley, CA 94720
ngreennylen@berkeley.edu

Education

Stanford University	Geological and Environmental Sciences	B.S.	1996
Stanford University	Geological and Environmental Sciences	Ph.D.	2005
University of California, Berkeley	Law	J.D.	2012

Work Experience

2016-present	Senior Research Fellow, Wheeler Water Institute, Center for Law, Energy & the Environment, University of California, Berkeley, School of Law, Berkeley, CA
2013–2016	Research Fellow, Wheeler Water Institute, Center for Law, Energy & the Environment, University of California, Berkeley, School of Law, Berkeley, CA
2012–2013	Law Clerk to Justice Gregory J. Hobbs, Jr., Colorado Supreme Court, Denver, CO
2011	Teaching Assistant (Part-time), University of California, Berkeley, School of Law, Berkeley, CA
2011	Legal Intern, California Attorney General's Office, Oakland, CA
2010	Legal Intern, Center for Biological Diversity, San Francisco, CA
2009	Research and Curatorial Assistant, California Academy of Sciences, San Francisco, CA
2006–2008	Museum Assistant and GIS Specialist (Part-time), Yale Peabody Museum of Natural History, New Haven, CT
2006–2008	Assistant to Professor Michael Donoghue (Part-time), Yale University, New Haven, CT
1998–2002	Teaching Assistant (Part-time), Stanford University, Stanford, CA
1997–1998	GIS, CAD, and Graphics Specialist, Stanford University, Stanford, CA
1997	GIS and Graphics Intern, Stanford University, Stanford, CA
1996–1997	Geologist, United States Geological Survey, Menlo Park, CA
1995–1996	Teaching Assistant, Stanford University, Stanford, CA

Selected Publications

Lidia Cano Pecharroman, Christopher Williams, Nell Green Nylen, and Michael Kiparsky. (2021) "How Can We Govern Large-Scale Green Infrastructure for Multiple Water Security Benefits?" *Blue Green Systems* 3(1): 62–80.

Nell Green Nylen. (2021) "Surface Water Quality Regulation as a Driver for Groundwater Recharge: The Case of Virginia's Sustainable Water Initiative for Tomorrow." *Case Studies in the Environment* 5(1): 1124592.

Kate Fritz and Nell Green Nylen. (2020) "When Does a Groundwater Recharge Project NOT Need a Water Right?" *Legal Planet*, Aug. 3, 2020.

Kate Fritz and Nell Green Nylen. (2020) "Water Right Permitting Options for Groundwater Recharge: Avoiding Unintended Consequences." *Legal Planet*, July 27, 2020.

Dave Owen, Alida Cantor, Nell Green Nylen, Thomas Harter, and Michael Kiparsky. (2019) "California Groundwater Management, Science-Policy Interfaces, and the Legacies of Artificial Legal Distinctions." *Environmental Research Letters* 14(4): 045016.

Kathleen Miller, Nell Green Nylen, Holly Doremus, Dave Owen, and Andrew Fisher. (2018) Issue Brief: When Is Groundwater Recharge a Beneficial Use of Surface Water in California?. Center for Law, Energy & the Environment, University of California. 8 pp.

Nell Green Nylen, Michael Kiparsky, Dave Owen, Holly Doremus, and Michael Hanemann. (2018) Addressing Institutional Vulnerabilities in California's Drought Water Allocation, Part 1: Water Rights Administration and Oversight During Major Statewide Droughts, 1976–2016, California's Fourth Climate Change Assessment, California Natural Resources Agency, Publication number: CCCA4-CNRA-2018-009. 172 pp.

Alida Cantor, Dave Owen, Thomas Harter, Nell Green Nylen, and Michael Kiparsky. (2018) Navigating Groundwater-Surface Water Interactions Under the Sustainable Groundwater Management Act. Center for Law, Energy & the Environment, University of California, Berkeley. 50 pp.

Nell Green Nylen, Michael Kiparsky, Kelly Archer, and Kurt Schnier. (2017) Trading Sustainably: Critical Considerations for Local Groundwater Markets Under the Sustainable Groundwater Management Act. Center for Law, Energy & the Environment, University of California, Berkeley. 90 pp.

Nell Green Nylen and Michael Kiparsky. (2015) Accelerating Cost-Effective Green Stormwater Infrastructure: Learning from Local Implementation. Center for Law, Energy & the Environment, University of California, Berkeley. 47 pp.

Synergistic Activities and Associations

- Member, Executive Committee of Environmental Law Section of the California Lawyers Association, 2020–present
- Board Member, California Water Law Symposium Board of Directors, 2019–present (Secretary, 2021–present)
- Member, County Drought Advisory Group, convened by California Department of Water Resources to aid AB 1668 implementation, 2018–2020
- More than 20 invited presentations from 2014–2021
- Worked with 16 undergraduate or graduate student research assistants from 2014–2021

Bar Admission

California (inactive)

Thomas Harter, Ph.D., Nora S. Gustavsson Endowed Professor in Water Resources

Department of Land, Air, and Water Resources, University of California, Davis, CA 95616
ph/530-400-1784; thharter@ucdavis.edu; http://groundwater.ucdavis.edu;

HISTORY OF EMPLOYMENT

2015-present	Professor and Professor of Cooperative Extension
2005-2015	Professor of Cooperative Extension
1999-2005	Associate Professor of Cooperative Extension (equivalent to Assoc. Professor)
1995-1999	Assistant Professor of Cooperative Extension (equivalent to Asst. Professor)
1994-1995	Postdoctoral Fellow, Dept. Hydroloy and Water Resour., Univ. of Arizona
1987-1994	Graduate Research Assistant, Universität Freiburg, Germany and Univ. of Arizona

DEGREES

University of Arizona	Hydrology	Ph.D., 1994
Universität Freiburg, Germany	Hydrology	Diplom (M.S.), 1989
Universität Freiburg, Germany	Physical Geography/Hydrology	Vordiplom (B.S.), 1985

RESEARCH EXPERIENCE

Summary: Pioneering research into understanding of subsurface flow and transport processes, process dynamics, and quantifying external stressors at the highly heterogeneous, multi-scale, multi-dimensional, and multi-disciplinary interface between agriculture and groundwater. My work has not only provided significant and broad new scientific insights, but also important technical tools and information used by scientists, consultants, a broad diversity of stakeholders, and by policy and decision makers in efforts for more efficient and sustainable management of groundwater resources in agricultural regions.

Agricultural Pollution Source Characterization and Pollutant Fate/Transport in the Deep Vadose Zone;

- Quantification and assessment of pollutant sources and alternative management practices across large agricultural landscapes (nitrate, pathogens, pharmaceutical);
- Development of new methods to assess and understand long-term dynamics of agricultural pollutant fate and transport in heterogeneous, deep alluvial vadose zones; including field characterization, laboratory measurements, and development of advanced stochastic computer modeling approaches.

Legacy and Emerging Agricultural Nonpoint Source Contamination of Shared Groundwater Resources: Pollutant Sources, Fate, and Transport, Remedial Actions, and Management Tools;

- Development of stochastic approaches for the assessment of groundwater contamination;
- Mathematical/computational methods development for fate and transport modeling, upscaling across bench-, plot-, field-, farm-, to regional scale.
- Development and application of highly efficient, high resolution basin-scale nonpoint source transport modeling software;
- Development of monitoring network designs and best management practices;
- Environmental fate and transport of salts, nitrate, pathogens (Cryptosporidium, E. Coli H7 O157, Salmonella, Campylobacter), antibiotics and other pharmaceuticals, steroid hormones;
- Groundwater forensics related to identifying a diversity of agricultural and non-agricultural nonpoint (diffuse) pollution sources;

Groundwater Resources Modeling, Assessment, and Management in Irrigated Agriculture-dominated Basins: Development of integrated, field research-based approaches to basin groundwater and surface water models, e.g., for the development of conjunctive use management strategies in semi-arid irrigated agricultural regions and for sustainable groundwater management that is aimed at not only preventing overdraft, land subsidence, and seawater intrusion, but also protects groundwater-dependent ecosystems including baseflow in streams with sensitive habitats

HONORS & MEMBERSHIPS

2021-current	Nora S. Gustavsson Endowed Professor, Water Resources, UC Davis
2007-2020	Robert M. Hagan Endowed Chair, Water Management and Policy, UC Davis
2008	Western Extension Directors' Award of Excellence
2007	Kevin J. Neese Award, Groundwater Resources Association
1991	Harshbarger Fellow, University of Arizona
1985	Fulbright Fellow, University of Arizona

Member- Soil Science Society of America, Groundwater Resources Association, International Association of Hydrology, and American Geophysical Union

SERVICE TO THE COMMUNITY - SELECTED ACTIVITIES

Scientific advisor in numerous national, state, and regional capacities (legislative committees, technical advisory committees, scientific advisor, expert reviewer, convener/organizer of multiple conferences) focused on the development and implementation of policies and regulations at the groundwater-agriculture nexus, including California's 2014 Sustainable Groundwater Management Act and its regulatory framework and guidance, on the implementation and assessment of over 150 Groundwater Sustainability Plans, and the nonpoint source (nitrate and salinity) regulatory development of California's Water Quality Control Act (Dairy Order, Irrigated Lands Regulatory Program, Salinity and Nutrient Management Plans) and similar planning and assessment efforts nationally and internationally. Annually providing nearly 100 presentations, workshops, invited lectures, technical consultations to decision-makers, in addition to extensive state and national committee service guiding stakeholders, NGOs, and state and federal policy makers.

1998-current	Member & Chair (1998-2000), Vadose Zone Technical Committee
2017-present	Associate Director, UC Davis Center for Watershed Sciences
2016-present	Chair, Hydrologic Sciences Graduate Group, UC Davis
2014-present	Board of Directors, Water Education Foundation
2008-2019	Board of Directors, Groundwater Resources Association

2016 and 2010 Lead organizer and chair of the International Conference "Toward Sustainable Groundwater in Agriculture: Linking Science and Policy", San Francisco, California. Brought together scientists, water managers, and agricultural leaders from around the world to present and discuss research and challenges at the groundwater-agriculture nexus.

2012 - Lead author and senior project director, Nitrate in Drinking Water Study for 2012 Report to the California Legislature. Major scientific-technical study and policy analysis for the California legislature, including eight peer-reviewed technical reports (1,300+ pages), a main report, 12 peer-reviewed scientific articles, invited presentations and briefings to state, national, and international audiences, stakeholder groups, and state leadership.

1995-current Teacher of undergraduate and graduate courses at UC Davis on groundwater hydrology, groundwater modeling, and the global groundwater-agriculture nexus. Delivers two to four short courses annually through GRA, WEF, University of Freiburg, and others, with 20-250 participants in each.

2004-2010	Associate Editor, Water Resources Research
2014-present	Associate Editor, Journal of Environmental Quality
2004-2018	Associate Editor, Vadose Zone Journal
2011	Guest Editor, WRR special issue "Toward Sustain. Groundwater in Agriculture"
2020-2021	Guest Editor, Vadose Zone Journal, special issue on transboundary soil hydrology

MICHAEL KIPARSKY

EDUCATION

2005-2010 **Ph.D.**, *Energy and Resources Group*, **University of California, Berkeley**
2002-2004 **MS**, *Energy and Resources Group*, **University of California, Berkeley**
1990-1995 **AB**, *Department of Ecology & Evolutionary Biology*, **Brown University**

SELECTED HONORS AND AWARDS

2018 **Invited contributor**, "Tenth Bienniel Rosenberg International Forum on Water Policy - Sustainable Groundwater Management: The Path Forward," San Jose, CA, October 2018.
2017 **Winner** (with Richard Roos-Collins), Imagine H_2O California Water Policy Challenge. April 2017
2016 **Invited participant**, "California's Water Future: An Advanced Communication Workshop." COMPASS, Santa Barbara, May 2016
2016 **Highlighted** as one of "Nine Experts to Watch on California Water Policy" by *Water Deeply*, July 7, 2016. https://www.newsdeeply.com/water/articles/2016/07/07/nine-experts-to-watch-on-california-water-policy
2011 **NSF** CHANS Fellow, International Network of Research on Coupled Human and Natural Systems, 2011 AAAS Annual Meeting ($1000)
2010 **NSF** American Meteorological Society Policy Colloquium Scholarship (~$8,000 for tuition and travel)
2009 **Udall** Environmental Public Policy & Conflict Resolution Ph.D. Fellowship ($24,000; one of two awarded nationally)
2008 **NSF** Doctoral Dissertation Improvement Grant (with Michael Hanemann). Funded jointly by Geography and Regional Science Program and Decision, Risk and Management Science Program (BCS-0826103; $11,975)
2008 **CALFED** Science Fellowship ($98,750)
2008 **Association of California Water Agencies** Steven K. Hall ACWA Water Law & Policy Scholarship ($7,000; one awarded)
2003 **NSF** Graduate Research Fellowship ($122,500)

ACADEMIC APPOINTMENTS

2015-present **Director, Wheeler Water Institute**
2012-15 **Associate Director, Wheeler Water Institute**
Center for Law, Energy and the Environment, UC Berkeley School of Law, Berkeley, CA
2015-19 **Co-Director, UC Water Security and Sustainability Research Initiative (UC Water)**
www.ucwater.org
2012-13 **Research Scientist**
Berkeley Water Center, UC Berkeley, Berkeley, CA
2010-2011 **Research Assistant Professor**
Department of Geography, University of Idaho, Moscow, ID

RELEVANT PROFESSIONAL EXPERIENCE

2007-2011 **Senior Resources Planner** *Tully & Young, Inc.*, Sacramento, CA
2003-2005 **Science Policy Analyst** *CALFED Science Program*, Berkeley and Sacramento, CA
2002-2004 **Research Assistant and Research Affiliate** *Pacific Institute,* Oakland, CA

OTHER RELEVANT ACTIVITIES

- Extensive experience with stakeholder engagement, including convening, moderating, and facilitating over a dozen major forums resulting in published synthesis (outputs) and impacts on decision making (outcomes).
- Regular invited testimony and outreach to state agencies.
- Consistent mentions, quotes and interviews in state, national, and international media outlets.

SELECTED RELEVANT FUNDED PROJECTS

2021 **Santa Clara Valley Water District**, "Water Resource Innovation Partnership (WRIP)," ($249,863)

2021 **Gordon and Betty Moore Foundation**, "Recharge Net Metering (ReNeM) to secure water resources, enhance aquatic systems, sustain landscapes, and empower local institutions," ($980,196)

2019 †**The Water Foundation**, "Making Recharge Net Metering work: Implementation, validation, and engagement to enable broader adoption of an innovative incentive system for recharge," (with UCSC and Resource Conservation District of Santa Cruz, $100,000)

2018 †**Nestle Waters North America**, "Incentives for Groundwater Recharge," ($186,000)

2017 †**USDA Agriculture and Food Research Initiative (AFRI)**, "Recharge Net Metering: Application and Evaluation of a Novel Approach to Achieving Sustainable Groundwater Supply and Quality," ($463,338)

2016 †**The Nature Conservancy**, "Governance and Financing for Multi-Benefit Natural Infrastructure." ($50,000)

2015 ††**UC Office of the President** Multicampus Research Programs and Initiatives, "UC Water Security and Sustainability Research Initiative" ($3,529,750)

2012 ††**NSF** IGERT "Adaptation to Change in Water Resources: Science to Inform Decision-making Across Disciplines, Cultures and Scales" (University of Idaho, DGE 1249400; $3,099,997)

SELECTED RELATED JOURNAL ARTICLES

- Lidia Cano Pecharroman, Christopher Williams, Nell Green Nylen, and **Michael Kiparsky**. 2021. How can we govern large-scale green infrastructure for multiple water security benefits? *Blue-Green Systems* 3(1):62.
- Kathleen Miller, Anita Milman, and **Michael Kiparsky**. 2021. Introduction to the Special Collection: Institutional Dimensions of Groundwater Recharge. *Case Studies in the Environment* 5(1):1245648.
- Dave Owen, Alida Cantor, Nell Green Nylen, Thomas Harter and **Michael Kiparsky**. 2019. "California groundwater management, science-policy interfaces, and the legacies of artificial legal distinctions." *Environmental Research Letters* 14(4): 045016
- **Michael Kiparsky**, Anita Milman, Dave Owen, and Andrew T. Fisher. 2017. "The Importance of Institutional Design for Distributed Local Level Governance of Groundwater." *Water*, 9(10):755.
- **Michael Kiparsky.** 2016. "Unanswered questions for implementation of the Sustainable Groundwater Management Act." *California Agriculture* 70(4): 165-168.

SELECTED RELATED POLICY WHITEPAPERS AND OP-EDS

- **Kiparsky, M**, AT Fisher. WM Hanemann, J Bowie, R Kantor, C Coburn, and B Lockwood. 2018. Recharge Net Metering to Enhance Groundwater Sustainability. Center for Law, Energy & the Environment, UC Berkeley School of Law, Berkeley, CA. 4 pp. doi.org/10.15779/J2792D
- Cantor, A, D Owen, T Harter, N Green Nylen, and **M Kiparsky**. 2018. Navigating Groundwater-Surface Water Interactions under the Sustainable Groundwater Management Act. Center for Law, Energy & the Environment, UC Berkeley School of Law, Berkeley, CA. 50 pp. doi.org/10.15779/J23P87
- Nell Green Nylen, **Michael Kiparsky**, Kelly Archer, and Kurt Schnier. 2017. Trading Sustainably: Critical Considerations for Local Groundwater Markets Under the Sustainable Groundwater Management Act. Center for Law, Energy & the Environment, University of California at Berkeley. Berkeley, CA. 90 pp.
- **Michael Kiparsky.** "In drought-stricken California, who owns water rights can still be a mystery." *Los Angeles Times.* July 15, 2021.
- Dave Owen, Alida Cantor, and **Michael Kiparsky.** "Opinion: State law recognizes rivers and groundwater are connected — now what?" *San Jose Mercury News*, May 9, 2018.
- Nell Green Nylen and **Michael Kiparsky.** "Are markets an easy solution for California's groundwater problems?" *Bakersfield Californian*, August 1, 2017.
- **Michael Kiparsky** and Holly Doremus**.** "California needs strong, fair and effective groundwater agencies." *Fresno Bee*, May 16, 2016.

DAVE OWEN
University of California, Hastings Law
200 McAllister Street, San Francisco, CA 94102
owendave@uchastings.edu – 415-703-8285

ACADEMIC EMPLOYMENT

Harry D. Sunderland Professor Law, University of California, Hastings Law.

Professor of Law and Associate Dean for Research, University of Maine School of Law (2013-15)

Associate Professor of Law, University of Maine School of Law (2007-13)

PUBLICATIONS: BOOK, ARTICLES, AND REPORTS

Practicing Environmental Law (Foundation Press, 2nd ed. 2021) (with Todd Aagaard & Justin Pidot).

Law, Land Use, and Groundwater Recharge, 73 STAN. L. REV. 1163 (2021)

The Realities of Takings Litigation, 47 BYU L. Rev. 577 (2021)

Coequal Federalism and Federal-State Agencies, 55 GA. L. REV. 287 (2020) (with Hannah Wiseman)

Consultants, the Environment, and the Law, 61 ARIZ. L. REV. 823 (2019)

Private Facilitators of Public Regulation: A Study of the Environmental Consulting Industry, REGULATION AND GOVERNANCE (2019).

California Groundwater Management, Science-Policy Interfaces, and the Legacies of Artificial Legal Distinctions, ENVIRONMENTAL RESEARCH LETTERS (2019) (with Alida Cantor et al.)

Cooperative Subfederalism, 9 UC IRVINE L. REV. 177 (2018)

Federal Laboratories of Democracy, 52 UC DAVIS L. REV 1119 (2018) (with Hannah Wiseman)

Addressing Institutional Vulnerabilities in California's Drought Water Allocation (2018) (with Nell Green Nylen et al.)

Navigating Groundwater-Surface Water Interactions under the Sustainable Groundwater Management Act (2018) (with Alida Cantor et al.)

Water and Taxes, 50 U.C. DAVIS L. REV. 1559 (2017).

Little Streams and Legal Transformations, 2017 UTAH L. REV. 1.

Designing Effective Groundwater Sustainability Agencies: Criteria for Evaluation of Local Governance Options (with Michael Kiparsky et al.).

Regional Federal Administration, 63 UCLA L. REV. 58 (2016). Selected for reprinting in 48 LAND USE & ENVTL. L. REV. (2017) as one of the top five environmental law articles of 2015-16.

The Importance of Institutional Design for Distributed Local-Level Governance of Groundwater: The Case of California's Sustainable Groundwater Management Act, MDPI WATER (2017) (with Michael Kiparsky et al.).

Predicting stream vulnerability to urbanization stress with Bayesian network models, LANDSCAPE AND URBAN PLANNING (2017) (with Kristen K. Weil et al.).

Trading Dams, 48 U.C. DAVIS L. REV. 1043 (2015) (co-authored with Colin Apse). Recipient of the Morrison Prize for Sustainability Scholarship.

Interdisciplinary Research and Environmental Law, 41 ECOLOGY L.Q. 887 (2015) (coauthored with Caroline Noblet).

Overallocation, Conflict, and Water Transfers, 9 ENVTL. RES. LETTERS (2014)

Taking Groundwater, 91 WASH. U. L. REV. 253 (2014).

Mapping, Modeling, and the Fragmentation of Environmental Law, 2013 UTAH L. REV. 219. Reprinted in 46 LAND USE & ENVTL. L. REV. (2015) as one of the top six environmental law articles of 2013-14. Reprinted in the *Environmental Law and Policy Annual Review*, 45 Envtl. L. Rep. 10796 (2015) for receiving honorable mention as one of the top environmental law and policy articles of 2013.

The Mono Lake Case, The Public Trust Doctrine, and the Administrative State, 45 U.C. DAVIS L. REV. 1099 (2012)

Critical Habitat and the Challenge of Regulating Small Harms, 64 FLORIDA L. REV. 141 (2012), Reprinted in the *Environmental Law and Policy Annual Review*, 43 ENVTL. L. REP. 10662 (2013), as one of the top environmental law and policy articles of 2012.

Urbanization, Water Quality, and the Regulated Landscape, 82 U. COLORADO L. REV. 431 (2011).

Collaboration, Clean Water Act Residual Designation Authority, and Collective Permitting: A Case Study of Long Creek, 1 WATERSHED SCI. BULLETIN 25 (2010) (with Curtis Bohlen et al.).

Probabilities, Planning Failures, and Environmental Law, 84 TULANE L. REV. 265 (2009), Reprinted in 42 LAND USE & ENVTL. L. REV. (2011) as one of the top five environmental law articles of 2009-10.

Legal constraints, environmental variability, and the limits of innovative environmental governance, 12 ENVTL. SCI. & POL'Y 684 (2009).

Explaining the Klamath, 22 CONSERVATION BIOLOGY 1664 (2008) (book review).

Climate Change and Environmental Assessment Law, 33 COLUM. J. ENVTL. L. 57 (2008).

Law, Environmental Dynamism, Reliability: The Rise and Fall of CALFED, 37 ENVTL. L. 1145 (2008).

Technocracy and Democracy: Conflicts Between Models and Participation in Environmental Law and Planning, 56 HASTINGS L.J. 901 (2005) (co-authored with James Fine).

The Disappointing History of the National Marine Sanctuaries Act, 11 N.Y.U. ENVTL. L.J. 711 (2003).

Prescriptive Laws, Uncertain Science, and Political Stories: Forest Planning in the Sierra Nevada, 29 ECOLOGY L.Q. 747 (2003).

EDUCATION

University of California, Berkeley School of Law (Boalt Hall), J.D. 2002
Honors: Order of the Coif
Amherst College, B.A., Geology 1996
Honors: Magna cum laude

PRIOR EMPLOYMENT

2003-2007 Associate Attorney, Rossmann and Moore, San Francisco, California.

2002-2003 Clerk to Judge Samuel Conti, United States District Court, Northern District of California.

1996-2000 Geologist/Environmental Auditor, Woodard & Curran, Inc., Dedham, Massachusetts.

United States
ENVIRONMENTAL PROTECTION AGENCY
Washington, DC 20460

OMB Control No. 2030-0020
Approval expires 06/30/2024

Current and Pending Support

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: Louise Bedsworth

Other agencies (including NSF) to which this proposal has been/will be submitted.
None

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Coyote Valley Credits Program

Source of Support: Peninsula Open Space Trust
Total Award Amount: 100,000.00 Total Award Period Covered: 01/01/2021 to 06/30/2022
Location of Project: Berkeley, CA
Person-Months Per Year Committed to the Project. Cal: 4.80 Acad: Sumr:

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: A Protocol for Reduction of Methane in the Agriculture Sector

Source of Support: Rockefeller Brothers Fund
Total Award Amount: 100,000.00 Total Award Period Covered: 06/04/2021 to 05/04/2022
Location of Project: Berkeley, CA
Person-Months Per Year Committed to the Project. Cal: 2.40 Acad: Sumr:

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: The Climate Leadership Training Program at CCCI

Source of Support: Patrick J. McGovern Foundation
Total Award Amount: 400,000.00 Total Award Period Covered: 02/19/2020 to 12/31/2022
Location of Project: Berkeley, CA
Person-Months Per Year Committed to the Project. Cal: 0.60 Acad: Sumr:

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: California-China Climate Policy Institute

Source of Support: William and Flora Hewlett Foundation
Total Award Amount: 2,000,000.00 Total Award Period Covered: 08/01/2019 to 04/30/2022
Location of Project: Berkeley, CA
Person-Months Per Year Committed to the Project. Cal: 2.00 Acad: Sumr:

Support: ☐ Current ☑ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: San Francisco Climate Action Funding Consultant

Source of Support: City of San Francisco
Total Award Amount: 100,000.00 Total Award Period Covered: 01/01/2022 to 10/01/2022
Location of Project: Berkeley, CA
Person-Months Per Year Committed to the Project. Cal: 2.00 Acad: Sumr:

*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

United States
ENVIRONMENTAL PROTECTION AGENCY
Washington, DC 20460

OMB Control No. 2030-0020
Approval expires 06/30/2024

Current and Pending Support

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: Ellen Bruno

Other agencies (including NSF) to which this proposal has been/will be submitted.

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal:

COVID-19: Collaborative Research: Compounding Human and Natural Disasters: Implication on Agriculture Sectors

Source of Support: National Science Foundation
Total Award Amount: 100,000 Total Award Period Covered: 06/2020 to 05/2022
Location of Project: UC Berkeley
Person-Months Per Year Committed to the Project. Cal: Acad: 0 Sumr: 0

Support: ☐ Current ☑ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal:

Decentralized management of integrated water resources: Understanding cross-scale decision feedbacks to support coordinated sustainability

Source of Support: National Science Foundation
Total Award Amount: 316,998 Total Award Period Covered: 09/2022 to 08/2026
Location of Project: UC Berkeley
Person-Months Per Year Committed to the Project. Cal: Acad: 0 Sumr: 1

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal:

Advancing Water Policy for Agricultural Sustainability

Source of Support: Foundation for Food & Agriculture Research
Total Award Amount: 391,954 Total Award Period Covered: 09/2021 to 08/2024
Location of Project: UC Berkeley
Person-Months Per Year Committed to the Project. Cal: Acad: 0 Sumr: 1

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal:

Securing a climate resilient water future for agriculture and ecosystems through innovation in measurement, management, and markets

Source of Support: United States Department of Agriculture
Total Award Amount: 924,646 Total Award Period Covered: 10/2021 to 09/2025
Location of Project: UC Berkeley
Person-Months Per Year Committed to the Project. Cal: Acad: 0 Sumr: 1

Support: ☐ Current ☑ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal:

Assessing the potential of regenerative agriculture to support soil health and C sequestration

Source of Support: California Department of Food and Agriculture
Total Award Amount: 11,291 Total Award Period Covered: 01/2022 to 12/2024
Location of Project: UC Berkeley
Person-Months Per Year Committed to the Project. Cal: Acad: 0 Sumr: 0

*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

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ENVIRONMENTAL PROTECTION AGENCY
Washington, DC 20460

OMB Control No. 2030-0020
Approval expires 06/30/2024

Current and Pending Support

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: Helen Dahlke

Other agencies (including NSF) to which this proposal has been/will be submitted.

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Securing a climate resilient water future for agriculture and ecosystems through innovation in measurement, management, and markets

Source of Support: USDA NIFA
Total Award Amount: 530,000.00 Total Award Period Covered: 09/01/2021 to 09/01/2025
Location of Project: Davis, CA
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr: 0.24

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Sustaining Groundwater And Irrigated Agriculture In The Southwestern United States Under A Changing Climate

Source of Support: USDA NIFA
Total Award Amount: 419,563.00 Total Award Period Covered: 01/01/2022 to 12/31/2025
Location of Project: Davis, CA
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr: 0.24

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Synergistic Managed Aquifer Recharge Strategies to Sustain Irrigated Agriculture

Source of Support: USDA NRCS
Total Award Amount: 800,000.00 Total Award Period Covered: 09/25/2020 to 09/24/2024
Location of Project: Davis, CA
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr: 0.17

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Techniques to minimize nitrate loss from the root zone during managed aquifer recharge

Source of Support: California Fertilizer Research and Education Program
Total Award Amount: 224,623.70 Total Award Period Covered: 01/01/2021 to 12/31/2023
Location of Project: Davis, CA
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr: 0.00

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Implementation of the Stream Aquifer Flow Exchange (SAFE) method in Integrated Water Flow Model (IWFM)

Source of Support: California Department of Water Resources
Total Award Amount: 294,314.00 Total Award Period Covered: 06/01/2020 to 06/30/2022
Location of Project: Davis, CA
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr: 0.24

*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

United States
ENVIRONMENTAL PROTECTION AGENCY
Washington, DC 20460

OMB Control No. 2030-0020
Approval expires 06/30/2024

Current and Pending Support

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: Helen Dahlke

Other agencies (including NSF) to which this proposal has been/will be submitted.

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Quantifying the environmental effects of implementing managed agricultural aquifer recharge in agricultural production systems

Source of Support: USDA NIFA
Total Award Amount: 499,339.00 Total Award Period Covered: 01/01/2021 to 12/31/2023
Location of Project: Davis, CA
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr: 0.24

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Developing science-based approaches to managed agricultural groundwater recharge in California's Central Valley

Source of Support: The Gordon and Betty Moore Foundation
Total Award Amount: 1,650,000.00 Total Award Period Covered: 10/26/2018 to 10/25/2022
Location of Project: Davis, CA
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr: 0.24

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: CNH-L: The dynamics of rural poverty, land use, and water in California's changing Central Valley

Source of Support: National Science Foundation
Total Award Amount: 1,559,754.00 Total Award Period Covered: 09/01/2017 to 02/28/2022
Location of Project: Davis, CA
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr: 0.36

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Regional Aquifer Management: Hydrology of Managed Aquifer Recharge in the Central Valley Aquifer and Mississippi Embayment

Source of Support: USDA Economic Research Service
Total Award Amount: 299,947.00 Total Award Period Covered: 10/01/2017 to 03/31/2022
Location of Project: Davis, CA
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr: 0.38

Support: ☐ Current ☑ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: ISES: Improving deliberative management of California's aquifer storage to promote social, economic and environmental co-benefits

Source of Support: National Science Foundation
Total Award Amount: 1,600,000.00 Total Award Period Covered: 09/01/2022 to 08/31/2025
Location of Project: Davis, CA
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr: 0.14

*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

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Washington, DC 20460

OMB Control No. 2030-0020
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Current and Pending Support

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: Andrew T. Fisher	Other agencies (including NSF) to which this proposal has been/will be submitted. None

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Recharge Net Metering (ReNeM) to secure water resources, enhance aquatic systems, sustain landscapes, and empower local institutions

Source of Support: Gordon and Betty Moore Foundation (Bay Area Conservation), Award #9964
Total Award Amount: 980,196.00 Total Award Period Covered: 11/01/2020 to 10/31/2023
Location of Project: University of California, Santa Cruz
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr: 0.75

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Collaborative research: A state-of-the-art marine heat flow probe to Advance Interdisciplinary Research by the U.S. Academic Community

Source of Support: U. S. National Science Foundation, Award OCE-1924384
Total Award Amount: 176,526.00 Total Award Period Covered: 09/01/2019 to 08/31/2021
Location of Project: University of California, Santa Cruz
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr: 0.33

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Exploring Ocean Worlds: Ocean System Science to Support the Search for Life

Source of Support: NASA (WHOI Subcontact), Award A101474
Total Award Amount: 471,196.00 Total Award Period Covered: 08/15/2019 to 08/14/2024
Location of Project: University of California, Santa Cruz
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr: 0.63

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Stormwater Management Partnership

Source of Support: USDA/NRCS (RCD Subcontract), Award # 1726
Total Award Amount: 79,968.00 Total Award Period Covered: 11/01/2018 to 10/31/2023
Location of Project: University of California, Santa Cruz
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr: 0.47

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Incentivizing and developing best practices to enhance groundwater supply and quality with managed recharge of non-traditional water sources

Source of Support: U.S. Department of Agriculture/NIFA award 2021-67019-33595
Total Award Amount: 349,744.00 Total Award Period Covered: 12/01/2020 to 11/30/2022
Location of Project: University of California, Santa Cruz
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr: 0.50

*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

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OMB Control No. 2030-0020
Approval expires 06/30/2024

Current and Pending Support

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: Andrew T. Fisher	Other agencies (including NSF) to which this proposal has been/will be submitted. None

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Center for Dark Energy Biosphere Investigations (C-DEBI), Phase 2

Source of Support: U. S. National Science Foundation (USC Subcontract), Award OIA-0939564
Total Award Amount: 873,789.00 Total Award Period Covered: 10/01/2015 to 09/30/2022
Location of Project: University of California, Santa Cruz
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr: 0.50

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Crustal Ocean Biosphere Research Exchange (COBRA)

Source of Support: U. S. National Science Foundation
Total Award Amount: 100,000.00 Total Award Period Covered: 10/01/2021 to 09/30/2026
Location of Project: University of California, Santa Cruz
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr: 0.43

Support: ☐ Current ☑ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: A knowledge-to-implementation framework for enhanced aquifer recharge (this proposal)

Source of Support: U. S. Environmental Protection Agency
Total Award Amount: 263,496.00 Total Award Period Covered: 07/01/2022 to 06/30/2025
Location of Project: University of California, Santa Cruz
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr: 0.50

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal:

Source of Support:
Total Award Amount: Total Award Period Covered: to
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal:

Source of Support:
Total Award Amount: Total Award Period Covered: to
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

United States
ENVIRONMENTAL PROTECTION AGENCY
Washington, DC 20460

OMB Control No. 2030-0020
Approval expires 06/30/2024

Current and Pending Support

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: Thomas Harter

Other agencies (including NSF) to which this proposal has been/will be submitted.

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Irrigation and Nitrogen Management and Monitoring to Improve Nut Production While Minimizing Groundwater Nitrate Leaching

Source of Support: CDFA Specialty Crop Block Grant
Total Award Amount: 450,000.00 Total Award Period Covered: 10/01/2019 to 03/31/2022
Location of Project: California
Person-Months Per Year Committed to the Project. Cal: 0.25 Acad: Sumr:

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Central Valley Groundwater Modeling Tool for CEAP

Source of Support: US Department of Agriculture
Total Award Amount: 275,000.00 Total Award Period Covered: 09/30/2018 to 09/30/2022
Location of Project: California
Person-Months Per Year Committed to the Project. Cal: 0.25 Acad: Sumr:

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Scott River Groundwater Study Scenario Implementation

Source of Support: North Coast Regional Water Board
Total Award Amount: 188,000.00 Total Award Period Covered: 07/01/2019 to 06/30/2022
Location of Project: California
Person-Months Per Year Committed to the Project. Cal: 0.25 Acad: Sumr:

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Antidegradation Policy Tool for Predicting Nitrate in Domestic and Production Wells by Machine Learning Techniques

Source of Support: California State Water Resources Control Board
Total Award Amount: 800,000.00 Total Award Period Covered: 07/01/2019 to 06/30/2024
Location of Project: California
Person-Months Per Year Committed to the Project. Cal: 0.60 Acad: Sumr:

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Central Valley Field CEAP

Source of Support: US Department of Agriculture
Total Award Amount: 560,450.00 Total Award Period Covered: 09/30/2019 to 09/30/2022
Location of Project: California
Person-Months Per Year Committed to the Project. Cal: 0.25 Acad: Sumr:

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ENVIRONMENTAL PROTECTION AGENCY
Washington, DC 20460

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Approval expires 06/30/2024

Current and Pending Support

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: Thomas Harter

Other agencies (including NSF) to which this proposal has been/will be submitted.

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Synergistic Managed Aquifer Recharge Strategies to Sustain Irrigated Agriculture

Source of Support: US Department of Agriculture
Total Award Amount: 800,000.00 Total Award Period Covered: 09/01/2021 to 08/31/2025
Location of Project:
Person-Months Per Year Committed to the Project. Cal: 0.25 Acad: Sumr:

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Techniques to Minimize Nitrate Loss from the Root Zone During Managed Aquifer Recharge

Source of Support: CDFA FREP
Total Award Amount: 225,000.00 Total Award Period Covered: 01/01/2021 to 12/31/2023
Location of Project:
Person-Months Per Year Committed to the Project. Cal: 0.25 Acad: Sumr:

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Developing Science-Based Approaches to Managed Agricultural Groundwater Recharge in California's Central Valley

Source of Support: Gordon and Betty More Foundation
Total Award Amount: 1,650,000.00 Total Award Period Covered: 10/26/2018 to 10/25/2022
Location of Project:
Person-Months Per Year Committed to the Project. Cal: 0.25 Acad: Sumr:

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Sustaining Groundwater and Irrigated Agriculture in the Southwestern United States Under a Changing Climate

Source of Support: US Department of Agriculture
Total Award Amount: 9,999,813.00 Total Award Period Covered: 10/01/2021 to 09/30/2026
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: 0.60 Sumr:

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Stakeholder-Supported Decision Making for Sustainable Conjunctive Management of Soil and Groundwater

Source of Support: National Science Foundation / Belmont Forum
Total Award Amount: 199,000.00 Total Award Period Covered: 01/01/2022 to 03/01/2024
Location of Project:
Person-Months Per Year Committed to the Project. Cal: 0.25 Acad: Sumr:

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Current and Pending Support

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Investigator: Thomas Harter

Other agencies (including NSF) to which this proposal has been/will be submitted.

Support: ☐ Current ☑ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Evaluating HFLC Nitrogen Management Strategies for Minimizing Reactive Nitrogen Mobilization from California Almond Orchards
Source of Support: Almond Board of California
Total Award Amount: 264,000.00 Total Award Period Covered: 09/01/2021 to 08/31/2024
Location of Project:
Person-Months Per Year Committed to the Project. Cal: 0.25 Acad: Sumr:

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Colusa County Multi-Benefit, On-Farm Managed Aquifer Recharge Project
Source of Support: The Nature Conservancy
Total Award Amount: 183,423.00 Total Award Period Covered: 09/15/2019 to 09/30/2022
Location of Project:
Person-Months Per Year Committed to the Project. Cal: 0.25 Acad: Sumr:

Support: ☐ Current ☑ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Developing Tools and Resources to Enable Economic, Institutional, and Technical Clarity in Support of Enhanced Aquifer Recharge Implementation (this proposal)
Source of Support: EPA Environmental Protection Agency
Total Award Amount: 2,000,000.00 Total Award Period Covered: 07/01/2022 to 06/30/2025
Location of Project: California
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr: 0.50

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal:
Source of Support:
Total Award Amount: Total Award Period Covered: to
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal:
Source of Support:
Total Award Amount: Total Award Period Covered: to
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

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Washington, DC 20460

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Approval expires 06/30/2024

Current and Pending Support

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: Michael Kiparsky	Other agencies (including NSF) to which this proposal has been/will be submitted. None

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Improving Water Rights Administration and Oversight for Future Droughts

Source of Support: State Water Resources Control Board
Total Award Amount: 296,188.00 Total Award Period Covered: 06/25/2020 to 01/31/2023
Location of Project: Berkeley, CA
Person-Months Per Year Committed to the Project. Cal: 1.68 Acad: Sumr:

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Water Resource Innovation Project with Valley Water

Source of Support: Santa Clara Valley Water District
Total Award Amount: 79,994.00 Total Award Period Covered: 01/01/2021 to 12/31/2022
Location of Project: Berkeley, CA
Person-Months Per Year Committed to the Project. Cal: 2.00 Acad: Sumr:

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Recharge Net Metering to secure water resources, enhance aquatic systems, sustain landscapes, and empower local institutions

Source of Support: Gordon and Betty Moore Foundation
Total Award Amount: 157,968.00 Total Award Period Covered: 11/02/2020 to 11/01/2023
Location of Project: Berkeley, CA
Person-Months Per Year Committed to the Project. Cal: 1.80 Acad: Sumr:

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: California-China Climate Policy Institute

Source of Support: William and Flora Hewlett Foundation
Total Award Amount: 2,000,000.00 Total Award Period Covered: 08/01/2019 to 04/30/2022
Location of Project: Berkeley, CA
Person-Months Per Year Committed to the Project. Cal: 2.00 Acad: Sumr:

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Securing a climate resilient water future for agriculture and ecosystems through innovation in measurement, management, and markets

Source of Support: USDA National Institute for Food and Agriculture
Total Award Amount: 230,163.00 Total Award Period Covered: 09/01/2021 to 08/31/2026
Location of Project: Berkeley, CA
Person-Months Per Year Committed to the Project. Cal: 1.80 Acad: Sumr:

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ENVIRONMENTAL PROTECTION AGENCY
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Current and Pending Support

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: Michael Kiparsky	Other agencies (including NSF) to which this proposal has been/will be submitted. None

Support: ☐ Current ☑ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: National Priorities: Water Innovation, Science, and Engagement to Advance Water Reuse

Source of Support: EPA Environmental Protection Agency
Total Award Amount: 559,942.00 Total Award Period Covered: 05/01/2022 to 04/30/2026
Location of Project: Berkeley, CA
Person-Months Per Year Committed to the Project. Cal: 1.80 Acad: Sumr:

Support: ☐ Current ☑ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Reinventing the Nation's Urban Water Reuse Systems (ReNUWeRs)

Source of Support: EPA Environmental Protection Agency
Total Award Amount: 3,245,670.00 Total Award Period Covered: 08/01/2022 to 07/31/2026
Location of Project: Berkeley, CA
Person-Months Per Year Committed to the Project. Cal: 4.50 Acad: Sumr:

Support: ☐ Current ☑ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Developing tools and resources to enable economic, institutional, and technical clarity in support of Enhanced Aquifer Recharge implementation

Source of Support: EPA Environmental Protection Agency
Total Award Amount: 2,000,000.00 Total Award Period Covered: 07/01/2022 to 06/30/2025
Location of Project: Berkeley, CA
Person-Months Per Year Committed to the Project. Cal: 3.00 Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: California-China Climate Policy Institute

Source of Support:
Total Award Amount: Total Award Period Covered: to
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal:

Source of Support:
Total Award Amount: Total Award Period Covered: to
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

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Approval expires 06/30/2024

Current and Pending Support

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: Dave Owen

Other agencies (including NSF) to which this proposal has been/will be submitted.

Support: ☐ Current ☑ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Developing tools and resources to enable economic, institutional, and technical clarity in support of enhanced aquifer recharge implementation

Source of Support: US Environmental Protection Agency
Total Award Amount: 2,000,000.00 Total Award Period Covered: 07/01/2022 to 06/30/2025
Location of Project: Berkeley and San Francisco, CA
Person-Months Per Year Committed to the Project. Cal: 1.00 Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal:

Source of Support:
Total Award Amount: Total Award Period Covered: to
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal:

Source of Support:
Total Award Amount: Total Award Period Covered: to
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal:

Source of Support:
Total Award Amount: Total Award Period Covered: to
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal:

Source of Support:
Total Award Amount: Total Award Period Covered: to
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

BRUCE BABBITT
5169 Watson St. NW
Washington, DC 20016

December 21, 2021

Michael Kiparsky
Director, Wheeler Water Institute
Center for Law, Energy & the Environment
UC Berkeley School of Law

via email, kiparsky@berkeley.edu

Dear Dr. Kiparsky:

I am pleased to support the research proposal entitled, "A knowledge-to-implementation framework for Enhanced Aquifer Recharge" (RFA EPA-G2022-STAR-C1). I recognize the need to understand the interplay between economics, institutional, technical, and other aspects of Enhanced Aquifer Recharge, and to develop methods and tools that enable water managers and stakeholders to more effectively implement recharge in a range of contexts. I would be delighted to see the University of California research team achieve its goals, and would be willing to engage with them by helping to refine research questions, provide information through documents and interviews, and review drafts of written products, as appropriate. I look forward to participating with you in this project.

Sincerely,

Bruce Babbitt

FELICIA MARCUS
WILLIAM C. LANDRETH VISITING FELLOW, STANFORD UNIVERSITY

Michael Kiparsky
Director, Wheeler Water Institute
Center for Law, Energy & the Environment
UC Berkeley School of Law

via email, kiparsky@berkeley.edu

Dear Dr. Kiparsky:

I strongly support your research proposal entitled, "A knowledge-to-implementation framework for Enhanced Aquifer Recharge" (RFA EPA-G2022-STAR-C1). As you know, this is an issue that I have followed closely through my former role as Chair of the State Water Resources Control Board developing and implementing the Sustainable Groundwater Management Act (SGMA) and now as the William C. Landreth Visiting Fellow at Stanford University. I have been greatly impressed by the work of your team on a variety of critical issues essential to moving forward and accelerating the pace of MAR to meet the enormous challenges facing California and other parts of the world. I'm eager to see the University of California research team build on its previous successes and depth of experience in supporting EAR implementation. Extending your track record of many excellent and practical reports and publications would be of great value nationally. I would also very much like to see this team reprise and extend the Incentivizing Groundwater Recharge Symposium. The 2019 event was a very thoughtful and important contribution. I would be happy to participate in another version of this gathering and a 'virtual roadshow' to extend the insights to a broader audience. I would be pleased to engage with your team by helping to refine research questions, provide information through documents and interviews, and review drafts of written products, as appropriate. I look forward to participating with you in this project.

With much respect and gratitude for your work,

Felicia Marcus

William C. Landreth Visiting Fellow

Stanford University, Water in the West Program

feliciaamarcus@gmail.com

CALIFORNIA Water Boards

GAVIN NEWSOM
GOVERNOR

JARED BLUMENFELD
SECRETARY FOR
ENVIRONMENTAL PROTECTION

State Water Resources Control Board

January 11, 2022

Michael Kiparsky
Director, Wheeler Water Institute
Center for Law, Energy & the Environment
UC Berkeley School of Law

via email, kiparsky@berkeley.edu

Dear Dr. Kiparsky:

The State Water Resources Control Board, Division of Water Rights is pleased to support the research proposal entitled, “A knowledge-to-implementation framework for Enhanced Aquifer Recharge” (RFA EPA-G2022-STAR-C1). We recognize the need to understand the interplay between economics, institutional, technical, and other aspects of Enhanced Aquifer Recharge, and to develop methods and tools that enable water managers and stakeholders to more effectively implement recharge in a range of contexts. We are pleased to collaborate with the University of California research team by helping to refine research questions, provide information through documents and interviews, and review drafts of written products, as appropriate. We look forward to participating with you in this project.

Respectfully,

Erik Ekdahl
Deputy Director, Division of Water Rights
State Water Resources Control Board
Erik.Ekdahl@Waterboards.ca.gov

STATE OF CALIFORNIA – CALIFORNIA NATURAL RESOURCES AGENCY
GAVIN NEWSOM, *Governor*

DEPARTMENT OF WATER RESOURCES
1416 NINTH STREET, P.O. BOX 942836
SACRAMENTO, CA 94236-0001
(916) 653-5791

January 12, 2022

Dr. Michael Kiparsky, Ph.D.
Director, Wheeler Water Institute
University of California, Berkeley
Center for Law, Energy & the Environment
Law Building
Berkeley, CA 94720-7200

RE: Letter of Support for Enhanced Aquifer Recharge Research Proposal

Dear Dr. Kiparsky:

The Department of Water Resources (DWR) is pleased to provide this letter of support regarding the research proposal entitled, "A knowledge-to-implementation framework for Enhanced Aquifer Recharge" for the United States Environmental Protection Agency Science to Achieve Results Program. Within the last decade, California has experienced extreme changes in climate, with record drought years followed by atmospheric river storm events that produce intense flashes of precipitation and snowpack. Based on recent legislation to sustainably manage California's groundwater, DWR provides planning resources to a network of interested parties and water managers developing local groundwater sustainability plans and programs, such as relevant datasets, groundwater modelling, and watershed analyses. A key area of emphasis for DWR is to provide technical, facilitation, and financial assistance to local water agencies to plan groundwater recharge and flood managed aquifer recharge efforts. Projects that promote this conjunctive water management approach can capture flood flows for groundwater recharge, replenish aquifers, and support diverse water users across our state, including communities, agriculture, and businesses. For these projects to be successful statewide, there is a great need to develop cost-benefit tools and frameworks to further analyze economic, technical, and institutional aspects of Enhanced Aquifer Recharge (EAR). By advancing research in this area, the life cycle costs of EAR can be more widely known across California's varying watershed and groundwater conditions to advance viable, safe, and cost-effective EAR strategies at the local and regional scale with State government support and investment. DWR is pleased to support the collaborative proposal your research team developed, and looks forward to participating in your efforts.

Sincerely,

Kamyar Guivetchi

Kamyar Guivetchi, Manager
Division of Planning

California State Senate
BILL DODD
SENATOR, THIRD DISTRICT

STATE CAPITOL, ROOM 5064
SACRAMENTO, CA 95814
TEL (916) 651-4003
FAX (916) 651-4903

COMMITTEES
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TRANSPORTATION AND HOUSING
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CALIFORNIA'S WINE INDUSTRY
CO-CHAIR

CHAIR: SENATE GOVERNMENTAL ORGANIZATION COMMITTEE

Michael Kiparsky
Director, Wheeler Water Institute
Center for Law, Energy & the Environment
UC Berkeley School of Law

via email, kiparsky@berkeley.edu

Dear Dr. Kiparsky:

I write in strong support your research proposal entitled, "A knowledge-to-implementation framework for Enhanced Aquifer Recharge" (RFA EPA-G2022-STAR-C1). I would like to see the University of California research team build on its previous successes and depth of experience in supporting EAR implementation. Extending your track record of impactful reports and publications on this topic would be of great value to California and to the national conversation on enhanced aquifer recharge. I would very much like to see the team conduct its planned symposium on EAR implementation. Your 2018 event on water decision making, at which I spoke, was thoughtfully conceived, based in rigorous research and facilitated engagement, and played a significant part in enabling the effective implementation of legislation I authored. As such, I would be very supportive of further efforts of this sort, given the importance of groundwater recharge to the state of California and the nation. To the extent the topics align with my legislative interests, I would be eager to participate in another symposium that you host on this topic, and support your team's work through my office.

Respectfully,

Bill Dodd

BILL DODD
Senator, 3rd Senate District

DOUGLAS A. DUCEY
Governor

THOMAS BUSCHATZKE
Director

ARIZONA DEPARTMENT of WATER RESOURCES
1110 West Washington Street, Suite 310
Phoenix, Arizona 85007
602.771.8500
azwater.gov

January 3, 2022

Dr. Michael Kiparsky
Director, Wheeler Water Institute
Center for Law, Energy & the Environment
UC Berkeley School of Law

Via email: kiparsky@berkeley.edu

RE: Research Proposal "A knowledge-to-implementation framework for Enhanced Aquifer Recharge" (RFA EPA-G2022-STAR-C1)

Dear Dr. Kiparsky,

The Arizona Department of Water Resources (Department) recognizes that understanding the interplay between economics, institutional, technical, and other aspects of Enhanced Aquifer Recharge, as well as the development methods and tools that enable water managers and stakeholders to more effectively implement recharge in a range of contexts, will be important to long-term water management efforts. The Department supports the University of California's proposal to develop a deeper understanding, framework, methods, and tools to help advance recharge and water management resiliency, including efforts to obtain funding to achieve these goals. I was pleased to share insights into the Arizona Water Banking Authority for the case studies your team recently published. The Department will be happy to provide available information and respond to inquiries as appropriate, and as staff are able.

Sincerely,

Thomas Buschatzke
Director

ORANGE COUNTY WATER DISTRICT
ORANGE COUNTY'S GROUNDWATER AUTHORITY

January 5, 2022

Michael Kiparsky
Director, Wheeler Water Institute
Center for Law, Energy & the Environment
UC Berkeley School of Law

via email, kiparsky@berkeley.edu

Subject: Letter of Support for Proposal to USEPA (RFA EPA-G2022-STAR-C1)

Dear Dr. Kiparsky:

Orange County Water District is pleased to support the research proposal entitled, "A knowledge-to-implementation framework for Enhanced Aquifer Recharge" (RFA EPA-G2022-STAR-C1). We recognize the need to understand the interplay between economics, institutional, technical, and other aspects of Enhanced Aquifer Recharge, and to develop methods and tools that enable water managers and stakeholders to more effectively implement recharge in a range of contexts. We are pleased to collaborate with the University of California research team by helping to refine research questions, provide information through documents and interviews, and review drafts of written products, as appropriate. We look forward to participating with you in this project. OCWD is a groundwater wholesaler serving 19 major retail water agencies and City water departments in North and Central Orange County in Southern California. As a critical part of our mission to provide a reliable, high quality water supply in a cost-effective and environmentally responsible manner, we conduct aquifer recharge to replenish groundwater, as well as maintain a seawater intrusion barrier. This local groundwater resource typically provides more than 75% of the annual water supply to more than 2.5 million residents. An important groundwater recharge source is our Groundwater Replenishment System (GWRS) in Fountain Valley, CA. At its current capacity of 100 million gallons per day (MGD), the GWRS AWPF is the world's largest water purification system for potable reuse.

Please feel free to contact me with any questions at (714) 378-3270 or mplumlee@ocwd.com.

Sincerely,

Megan H Plumlee

Megan H. Plumlee, Ph.D., P.E.
Director of Research
Orange County Water District
18700 Ward Street, Fountain Valley, CA 92706

IDAHO WATER RESOURCE BOARD

December 21, 2021

Michael Kiparsky
Director, Wheeler Water Institute
Center for Law, Energy & the Environment
UC Berkeley School of Law

via email, kiparsky@berkeley.edu

Dear Dr. Kiparsky:

On behalf of The Idaho Water Resource Board (IWRB), I want to express support of the research proposal entitled, "A knowledge-to-implementation framework for Enhanced Aquifer Recharge" (RFA EPA-G2022-STAR-C1). The IWRB recognizes the need to understand the interplay between economics, institutional, technical, and other aspects of Enhanced Aquifer Recharge, and to develop methods and tools that enable water managers and stakeholders to more effectively implement recharge in a range of contexts. The IWRB is supportive of collaboration with the University of California research team by helping to refine research questions, provide information through documents and interviews, and review drafts of written products, as appropriate. We look forward to participating with you in this project.

Respectfully,

Wesley Hipke

Wesley Hipke, P.G.
Water Projects Section Supervisor
Idaho Department of Water Resources

Albuquerque Bernalillo County
Water Utility Authority

PO Box 568
Albuquerque, NM 87103
www.abcwua.org

January 5, 2022

Michael Kiparsky
Director, Wheeler Water Institute
Center for Law, Energy & the Environment
UC Berkeley School of Law

via email, kiparsky@berkeley.edu

Dear Dr. Kiparsky:

The Albuquerque Bernalillo County Water Utility Authority (Water Authority) is pleased to support the research proposal entitled, "A knowledge-to-implementation framework for Enhanced Aquifer Recharge" (RFA EPA-G2022-STAR-C1). The Water Authority recognizes the need to understand the interplay between economics, institutional, technical, and other aspects of Enhanced Aquifer Recharge, and to develop methods and tools that enable water managers and stakeholders to more effectively implement recharge in a range of contexts. The Water Authority is pleased to collaborate with the University of California research team by helping to refine research questions, provide information through documents and interviews, and review drafts of written products, as appropriate. We look forward to participating with you in this project.

Respectfully,

Mark Kelly

Mark Kelly, P.E.
Water Resources Division Manager
Albuquerque Bernalillo County Water Utility Authority

San Antonio Water System

December 29, 2021

Dr. Michael Kiparsky
Director, Wheeler Water Institute
Center for Law, Energy & the Environment
UC Berkeley School of Law

via email: kiparsky@berkeley.edu

Re: Letter of Support

Dear Dr. Kiparsky:

SAWS is pleased to support the research proposal entitled, "A knowledge-to-implementation framework for Enhanced Aquifer Recharge" (RFA EPA-G2022-STAR-C1). We recognize the need to understand the interplay between economics, institutional, technical, and other aspects of Enhanced Aquifer Recharge, and to develop methods and tools that enable water managers and stakeholders to more effectively implement recharge in a range of contexts. We are pleased to collaborate with the University of California research team by helping to refine research questions, provide information through documents and interviews, and review drafts of written products, as appropriate. We look forward to participating with you in this project.

Sincerely,

Robert R. Puente
President/CEO

Omochumne Hartnell Water District

O
H
W
D

Kurt A Kautz
CHAIRMAN

Mark Stetars
VICE CHAIRMAN

Mark Wilson
TREASURE

Ken Mitchell
DIRECTOR

Paul Hensleigh
DIRECTOR

Michael Wackman
GENERAL MANAGER

Shasta Burns
BOARD SECRETARY

January 6, 2021

Michael Kiparsky
Director, Wheeler Water Institute
Center for Law, Energy & the Environment
UC Berkeley School of Law

via email, kiparsky@berkeley.edu

Dear Dr. Kiparsky:

I am pleased to support the research proposal entitled, "A knowledge-to-implementation framework for Enhanced Aquifer Recharge" (RFA EPA-G2022-STAR-C1). I recognize the need to understand the interplay between economics, institutional, technical, and other aspects of Enhanced Aquifer Recharge, and to develop methods and tools that enable water managers and stakeholders to more effectively implement recharge in a range of contexts. I support the University of California research team and would be willing to engage with them by helping to refine research questions, provide information through documents and interviews, and review drafts of written products, as appropriate. I look forward to participating with you in this project.

Thank you,

Mike Wackman

General Manager

Phone: 916-682-5958
Street Address: 7513 Sloughhouse Road, Elk Grove, CA
Mailing Address: P.O. Box 211, Wilton, CA 95693-0211
Email:info@ohwd.org

Valley Water

Clean Water • Healthy Environment • Flood Protection

January 5, 2022

Dr. Michael Kiparsky
Director, Wheeler Water Institute
Center for Law, Energy & the Environment
UC Berkeley School of Law

via email, kiparsky@berkeley.edu

Dear Dr. Kiparsky:

Valley Water is pleased to support the research proposal titled, “A knowledge-to-implementation Framework for Enhanced Aquifer Recharge,” being submitted by you and colleagues to the U.S. Environmental Protection Agency (RFA EPA-G2022-STAR-C1). As a groundwater management agency, Valley Water recognizes the need to understand the interplay among economic, institutional, technical, and other aspects of enhanced aquifer recharge (EAR), and to develop methods and tools that enable water managers and stakeholders to implement recharge more effectively over a range of contexts. New tools for implementing EAR projects are critical for maintaining water security and sustainably managing groundwater basins. Valley Water currently operates EAR facilities to maintain water supply reliability and groundwater sustainability, actively participates in an out-of-county groundwater bank, and is working to develop new groundwater banking opportunities in California. Therefore, we can directly benefit from this project as it will provide implementation information and tools to better manage these systems. We are pleased to collaborate with the University of California research team by helping to refine research questions, providing information through documents and interviews, and reviewing drafts of written products, as appropriate based on topics and timing. We look forward to participating with you in this project.

Sincerely,

Gregory Williams
Deputy Operating Officer
Raw Water Division

PAJARO VALLEY WATER MANAGEMENT AGENCY

36 BRENNAN STREET • WATSONVILLE, CA 95076
TEL: (831) 722-9292 FAX: (831) 722-3139
info@pvwater.org • pvwater.org

January 10, 2022

Michael Kiparsky
Director, Wheeler Water Institute
Center for Law, Energy & the Environment
UC Berkeley School of Law

via email, kiparsky@berkeley.edu

Dear Dr. Kiparsky:

Pajaro Valley Water Management Agency (PV Water) is pleased to support the research proposal titled, "A knowledge-to-implementation Framework for Enhanced Aquifer Recharge," being submitted by you and other colleagues to the U.S. Environmental Protection Agency (RFA EPA-G2022-STAR-C1). PV Water recognizes the need to understand the interplay between economics, institutional, technical, and other aspects of enhanced aquifer recharge, and to develop methods and tools that enable water managers like myself and interested parties to more effectively implement recharge in a range of contexts. PV Water has benefited greatly from years of productive collaboration with Dr. Fisher and his students, including through the now formalized Recharge Net Metering Program. Dr. Fisher, in collaboration with the Resource Conservation District of Santa Cruz County and individual property owners, has developed three projects, and PV Water looks forward to continuing its relationship with him and other research institutions in the interest of benefiting all Pajaro Valley water users. We are pleased to collaborate with the University of California research team by helping to refine research questions, provide information through documents and interviews, and review drafts of written products, as appropriate based on topics and timing. We look forward to participating with you in this project.

Kind regards,

Brian Lockwood, PG, CHG
General Manager

RESOURCE
CONSERVATION DISTRICT
OF SANTA CRUZ COUNTY

820 Bay Avenue, Suite 136
Capitola, California 95010
tel 831.464.2950
www.rcdsantacruz.org

Michael Kiparsky
Director, Wheeler Water Institute
Center for Law, Energy & the Environment
UC Berkeley School of Law

7 January 2022

via email, kiparsky@berkeley.edu

Dear Dr. Kiparsky:

The Resource Conservation District of Santa Cruz County (RCD) is pleased to support the research proposal titled, "A knowledge-to-implementation Framework for Enhanced Aquifer Recharge," being submitted by you and colleagues to the U.S. Environmental Protection Agency (RFA EPA-G2022-STAR-C1). My colleagues and I recognize the need to understand the interplay between economics, institutional, technical, and other aspects of enhanced aquifer recharge, and to develop methods and tools that enable water managers and stakeholders to more effectively implement recharge in a range of contexts. The work proposed is directly relevant to and will help inform the groundwater recharge work that RCD is actively engaged in, including collaborations with private landowners, agriculture, NRCS, the Pajaro Valley Water Management Agency, and other stakeholders that are working to achieve a healthy and sustainable groundwater supply in our region. If approved for funding, RCD will be pleased to collaborate with and support the work of the University of California research team. We will draw on our experience and lessons learned to help refine research questions, inform the development of documents and interviews, review drafts of written products, and facilitate communication with landowners, agriculture industry representatives or other stakeholders as appropriate.

Best wishes with the proposal,

Lisa Lurie
Executive Director

Scott Valley Irrigation District

P.O. Box 126
Fort Jones, CA 96032

January 4, 2022

Michael Kiparsky
Director, Wheeler Water Institute
Center for Law, Energy & the Environment
UC Berkeley School of Law

via email, kiparsky@berkeley.edu

Dear Dr. Kiparsky:
Scott Valley Irrigation District is pleased to support the research proposal entitled, "A knowledge-to-implementation framework for Enhanced Aquifer Recharge" (RFA EPA-G2022-STAR-C1). We recognize the need to understand the interplay between economics, institutional, technical, and other aspects of Enhanced Aquifer Recharge, and to develop methods and tools that enable water managers and stakeholders to more effectively implement recharge in a range of contexts. We are pleased to collaborate with the University of California research team by helping to refine research questions, provide information through documents and interviews, and review drafts of written products, as appropriate. We look forward to participating with you in this project.

Respectfully,

Jim Morris
S.V.I.D.

The Nature Conservancy

830 S. Street
Sacramento, California 95811

tel [916] 449-2850
fax [916] 442-2377

nature.org

4 January 2022

Michael Kiparsky
Director, Wheeler Water Institute
Center for Law, Energy & the Environment
UC Berkeley School of Law

via email, kiparsky@berkeley.edu

Dear Dr. Kiparsky:

The Nature Conservancy is pleased to support the research proposal entitled, "A knowledge-to-implementation framework for Enhanced Aquifer Recharge" (RFA EPA-G2022-STAR-C1). We recognize the need to understand the interplay between economics, institutional, technical, and other aspects of Enhanced Aquifer Recharge, and to develop methods and tools that enable water managers and stakeholders to more effectively implement recharge in a range of contexts. We are pleased to collaborate with the University of California research team by helping to refine research questions, provide information through documents and interviews, and review drafts of written products, as appropriate. We look forward to participating with you in this project.

Best Regards,

Sandi Matsumoto
Director, California Water Program
The Nature Conservancy

KERN WATER BANK AUTHORITY

January 5, 2022

Michael Kiparsky
Director, Wheeler Water Institute
Center for Law, Energy & the Environment
UC Berkeley School of Law

via email, kiparsky@berkeley.edu

Dear Dr. Kiparsky:

I am pleased to support the research proposal entitled, "A knowledge-to-implementation framework for Enhanced Aquifer Recharge" (RFA EPA-G2022-STAR-C1). I recognize the need to understand the interplay between economics, institutional, technical, and other aspects of Enhanced Aquifer Recharge, and to develop methods and tools that enable water managers and stakeholders to more effectively implement recharge in a range of contexts. I would be willing to engage with the University of California by helping to refine research questions, provide information through documents and interviews, and review drafts of written products, as appropriate. I look forward to participating with you in this project.

Respectfully,
Kern Water Bank Authority

Jonathan Parker,
General Manager

WATER FOUNDATION®

Michael Kiparsky
Director, Wheeler Water Institute
Center for Law, Energy & the Environment
UC Berkeley School of Law

via email, kiparsky@berkeley.edu

Dear Dr. Kiparsky:

The Water Foundation is pleased to support the research proposal entitled, "A knowledge-to-implementation framework for Enhanced Aquifer Recharge" (RFA EPA-G2022-STAR-C1). We have supported sustainable groundwater management for the past decade. We recognize the need to understand the interplay between economics, institutional, technical, and other aspects of Enhanced Aquifer Recharge, and to develop methods and tools that enable water managers and stakeholders to more effectively implement recharge in a range of contexts. We are pleased to collaborate with the University of California research team by helping to refine research questions, provide information through documents and interviews, and review drafts of written products, as appropriate. We look forward to participating with you in this project.

Respectfully,

Mike Myatt
Program Officer
Water Foundation

terranova
RANCH INC.

January 6, 2022

Michael Kiparsky
Director, Wheeler Water Institute
Center for Law, Energy & the Environment
UC Berkeley School of Law

via email, kiparsky@berkeley.edu

Dear Dr. Kiparsky:

I am pleased to support the research proposal entitled, "A knowledge-to-implementation framework for Enhanced Aquifer Recharge" (RFA EPA-G2022-STAR-C1). I recognize the need to understand the interplay between economics, institutional, technical, and other aspects of Enhanced Aquifer Recharge, and to develop methods and tools that enable water managers and stakeholders to more effectively implement recharge in a range of contexts. I would be delighted to see the University of California research team achieve its goals, and would be willing to engage with them by helping to refine research questions, provide information through documents and interviews, and review drafts of written products, as appropriate. I look forward to participating with you in this project.

Respectfully,

Don J. Cameron
Vice President-GM
Terranova Ranch Inc.

16729 W. Floral Ave. – P.O. Box 130, Helm, CA 93627-0130
Phone (559) 866-5644 – Fax (559) 866-5213

BUDGET INFORMATION - Non-Construction Programs

OMB Number: 4040-0006
Expiration Date: 02/28/2022

SECTION A - BUDGET SUMMARY

Grant Program Function or Activity (a)	Catalog of Federal Domestic Assistance Number (b)	Estimated Unobligated Funds		New or Revised Budget		
		Federal (c)	Non-Federal (d)	Federal (e)	Non-Federal (f)	Total (g)
1. LIFE-CYCLE ANALYSIS TO SUPPORT COST-EFFECTIVE ENHANCED AQUIFER RECHARGE	66.509	$	$	$ 2,000,000.00	$	$ 2,000,000.00
2.						
3.						
4.						
5. Totals		$	$	$ 2,000,000.00	$	$ 2,000,000.00

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SECTION B - BUDGET CATEGORIES

6. Object Class Categories	GRANT PROGRAM, FUNCTION OR ACTIVITY (1)	(2)	(3)	(4)	Total (5)
	LIFE-CYCLE ANALYSIS TO SUPPORT COST-EFFECTIVE ENHANCED AQUIFER RECHARGE	N/A	N/A	N/A	
a. Personnel	$ 183,785.00	$ 303,927.00	$ 195,631.35	$ 0.00	$ 683,343.35
b. Fringe Benefits	52,176.09	63,004.31	51,653.65	0.00	166,834.05
c. Travel	6,602.00	8,602.00	6,602.00	0.00	21,806.00
d. Equipment	0.00	0.00	0.00	0.00	0.00
e. Supplies	2,500.00	0.00	0.00	0.00	2,500.00
f. Contractual	0.00	0.00	0.00	0.00	0.00
g. Construction	0.00	0.00	0.00	0.00	0.00
h. Other	130,237.89	180,336.89	217,762.89	0.00	528,337.67
i. Total Direct Charges (sum of 6a-6h)	375,300.98	555,870.20	471,649.89	0.00	$ 1,402,821.07
j. Indirect Charges	161,572.39	247,036.23	188,570.31	0.00	$ 597,178.93
k. TOTALS (sum of 6i and 6j)	$ 536,873.37	$ 802,906.43	$ 660,220.20	$ 0.00	$ 2,000,000.00
7. Program Income	$ 0.00	$	$	$ 0.00	$ 0.00

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SECTION C - NON-FEDERAL RESOURCES

(a) Grant Program	(b) Applicant	(c) State	(d) Other Sources	(e)TOTALS
8. LIFE-CYCLE ANALYSIS TO SUPPORT COST-EFFECTIVE ENHANCED AQUIFER RECHARGE	$	$	$	$
9.				
10.				
11.				
12. TOTAL (sum of lines 8-11)	$	$	$	$

SECTION D - FORECASTED CASH NEEDS

	Total for 1st Year	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
13. Federal	$	$	$	$	$
14. Non-Federal	$				
15. TOTAL (sum of lines 13 and 14)	$	$	$	$	$

SECTION E - BUDGET ESTIMATES OF FEDERAL FUNDS NEEDED FOR BALANCE OF THE PROJECT

(a) Grant Program	FUTURE FUNDING PERIODS (YEARS) (b)First	(c) Second	(d) Third	(e) Fourth
16. LIFE-CYCLE ANALYSIS TO SUPPORT COST-EFFECTIVE ENHANCED AQUIFER RECHARGE	$ 536,873.37	$ 802,906.43	$ 660,220.20	$ 0.00
17.				
18.				
19.				
20. TOTAL (sum of lines 16 - 19)	$ 536,873.37	$ 802,906.43	$ 660,220.20	$ 0.00

SECTION F - OTHER BUDGET INFORMATION

21. Direct Charges: 1,402,823.27

22. Indirect Charges: 597,176.73

23. Remarks:

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Prescribed by OMB (Circular A -102) Page 2

EXHIBIT D

U.S. ENVIRONMENTAL PROTECTION AGENCY

Grant Agreement

GRANT NUMBER (FAIN): 84046301 **MODIFICATION NUMBER:** 0 **PROGRAM CODE:** RD	**DATE OF AWARD** 07/15/2022
TYPE OF ACTION New	**MAILING DATE** 07/20/2022
PAYMENT METHOD: ASAP	**ACH#** 0016

RECIPIENT TYPE:
State Institution of Higher Learning

Send Payment Request to:
Contact EPA RTPFC at: rtpfc-grants@epa.gov

RECIPIENT:
The Regents of the University of CA - Berkeley
1608 Fourth Street Suite 220
Berkeley, CA 94710-1749
EIN: 94-6002123

PAYEE:
Director
The Regents of the University of CA - Berkeley
2195 Hearst Avenue Room 130; Mail Code 1103
Berkeley, CA 94704-1103

PROJECT MANAGER	EPA PROJECT OFFICER	EPA GRANT SPECIALIST
Michael Kiparsky 391 Simon Hall Berkeley, CA 94720-0001 **Email:** kiparsky@berkeley.edu **Phone:** 510-643-6044	Jacquelyn Bell 1200 Pennsylvania Ave. NW, 8104R Washington, DC 20460 **Email:** bell.jacquelyn@epa.gov **Phone:** 202-564-4811	Jennifer Brooks 1200 Pennsylvania Ave. NW, 3903R Washington, DC 20460 **Email:** brooks.jennifer@epa.gov **Phone:** 202-564-6374

PROJECT TITLE AND DESCRIPTION

Developing Tools and Resources to Enable Economic, Institutional, and Technical Clarity in Support of Enhanced Aquifer Recharge Implementation

See attachment 1 for project description

BUDGET PERIOD	PROJECT PERIOD	TOTAL BUDGET PERIOD COST	TOTAL PROJECT PERIOD COST
09/01/2022 - 08/31/2025	09/01/2022 - 08/31/2025	$1,999,998.00	$1,999,998.00

NOTICE OF AWARD

Based on your Application dated 01/13/2022 including all modifications and amendments, the United States acting by and through the US Environmental Protection Agency (EPA) hereby awards $1,999,998.00. EPA agrees to cost-share 100.00% of all approved budget period costs incurred, up to and not exceeding total federal funding of $1,999,998.00. Recipient's signature is not required on this agreement. The recipient demonstrates its commitment to carry out this award by either: 1) drawing down funds within 21 days after the EPA award or amendment mailing date; or 2) not filing a notice of disagreement with the award terms and conditions within 21 days after the EPA award or amendment mailing date. If the recipient disagrees with the terms and conditions specified in this award, the authorized representative of the recipient must furnish a notice of disagreement to the EPA Award Official within 21 days after the EPA award or amendment mailing date. In case of disagreement, and until the disagreement is resolved, the recipient should not draw down on the funds provided by this award/amendment, and any costs incurred by the recipient are at its own risk. This agreement is subject to applicable EPA regulatory and statutory provisions, all terms and conditions of this agreement and any attachments.

ISSUING OFFICE (GRANTS MANAGEMENT OFFICE)	AWARD APPROVAL OFFICE
ORGANIZATION / ADDRESS	**ORGANIZATION / ADDRESS**
Environmental Protection Agency , Grants and Interagency Agreement 1200 Pennsylvania Ave, NW Mail code 3903R Washington, DC 20460	Environmental Protection Agency, OSAPE ORD - Office of Research and Development 1200 Pennsylvania Ave, NW Washington, DC 20460

THE UNITED STATES OF AMERICA BY THE U.S. ENVIRONMENTAL PROTECTION AGENCY

Digital signature applied by EPA Award Official for Jill Young - Chief - Grants Management Branch LaShaun Phillips - Associate Award Official	**DATE** 07/15/2022

EPA Funding Information

FUNDS	FORMER AWARD	THIS ACTION	AMENDED TOTAL
EPA Amount This Action	$0	$1,999,998	$1,999,998
EPA In-Kind Amount	$0	$0	$0
Unexpended Prior Year Balance	$0	$0	$0
Other Federal Funds	$0	$0	$0
Recipient Contribution	$0	$0	$0
State Contribution	$0	$0	$0
Local Contribution	$0	$0	$0
Other Contribution	$0	$0	$0
Allowable Project Cost	$0	$1,999,998	$1,999,998

Assistance Program (CFDA)	Statutory Authority	Regulatory Authority
66.509 - Science to Achieve Results (STAR) Program	Safe Drinking Water Act: Sec. 1442	2 CFR 200, 2 CFR 1500, 40 CFR 33 and 40 CFR 40

Fiscal									
Site Name	Req No	FY	Approp. Code	Budget Oganization	PRC	Object Class	Site/Project	Cost Organization	Obligation / Deobligation
-	222631M048	2122	C	2631000	000FK7XR4	4141	-	26A6A	$387,998
-	222631M048	2122	C	2631000	000FK7XR3	4141	-	26A6A	$1,612,000
									$1,999,998

Budget Summary Page

Table A - Object Class Category (Non-Construction)	Total Approved Allowable Budget Period Cost
1. Personnel	$689,499
2. Fringe Benefits	$169,044
3. Travel	$21,806
4. Equipment	$0
5. Supplies	$2,500
6. Contractual	$61,000
7. Construction	$0
8. Other	$464,337
9. Total Direct Charges	$1,408,186
10. Indirect Costs: 0.00 % Base See Term and Condition F	$591,812
11. Total (Share: Recipient 0.00 % Federal 100.00 %)	$1,999,998
12. Total Approved Assistance Amount	$1,999,998
13. Program Income	$0
14. Total EPA Amount Awarded This Action	$1,999,998
15. Total EPA Amount Awarded To Date	$1,999,998

Attachment 1 - Project Description

This project will strategically combine applied research, decision-support innovations, and public engagement to lower barriers to widespread adoption of enhanced aquifer recharge (EAR) and unlock its potential to provide multiple water security benefits.

This project will develop a life-cycle view of EAR to encompass three pillars of decision making: geochemical and physical considerations; legal and institutional considerations; and cost-benefit analysis and life-cycle assessment. The project will a) generalize and contextualize cutting edge research contributions, b) produce a comprehensive picture of the life cycle of EAR implementation, and c) create actionable recommendations for practitioners and develop and formalize best practices for EAR. The deliverables of this project include annual and final reports, as well as an EAR Lifecycle map that can be used as a tool for state and local decision-makers contemplating EAR projects and as a repository from which key resources and tools can be found and evaluated. Direct beneficiaries of this project will be water quality managers, state and local decision makers, and the general public, especially in areas susceptible to drought. The subaward to UC Davis ($82,259) is for research and synthesis on geophysical elements and technical methods for EAR. The subaward to UC Santa Cruz ($254,912) is for research and synthesis on geophysical elements and technical methods for EAR, as well as work on methods and considerations for managing water quality. The subaward to UC Hastings ($59,994) supports research on legal, policy and institutional topics.

Administrative Conditions

A. General Terms and Conditions

The recipient agrees to comply with the current EPA general terms and conditions available at: https://www.epa.gov/grants/epa-general-terms-and-conditions-effective-october-1-2021-or-later. These terms and conditions are in addition to the assurances and certifications made as a part of the award and the terms, conditions, or restrictions cited throughout the award.

The EPA repository for the general terms and conditions by year can be found at: https://www.epa.gov/grants/grant-terms-and-conditions#general.

B. Correspondence Condition

The terms and conditions of this agreement require the submittal of reports, specific requests for approval, or notifications to EPA. Unless otherwise noted, all such correspondence should be sent to the following email addresses:

- Federal Financial Reports (SF-425): rtpfc-grants@epa.gov and **brooks.jennifer@epa.gov**
- MBE/WBE reports (EPA Form 5700-52A): **Suzanne Hersh, DBE Coordinator; mbe.wbe@epa.gov**
- All other forms/certifications/assurances, Indirect Cost Rate Agreements, Requests for Extensions of the Budget and Project Period, Amendment Requests, Requests for other Prior Approvals, updates to recipient information (including email addresses, changes in contact information or changes in authorized representatives) and other notifications: **bell.jacquelyn@epa.gov**
- Payment requests (if applicable): **bell.jacquelyn@epa.gov**
- Quality Assurance documents, workplan revisions, equipment lists, programmatic reports and deliverables: **bell.jacquelyn@epa.gov**

C. Prompt Payment

In accordance with Section 2(d) of the Prompt Payment Act (P.L. 97-177), Federal funds may not be used by the recipient for the payment of interest penalties to contractors when bills are paid late nor may interest penalties be used to satisfy cost sharing requirements. Obligations to pay such interest penalties will not be obligations of the United States.

D. No Fed

The recipient understands that none of the funds for this project (including funds contributed by the recipient as cost sharing) may be used to pay for the travel of Federal employees or for other costs associated with Federal participation in this project. Except however, if a Federal agency is selected through the recipient's procurement process to carry out some of the work as a contractor to the recipient, funds may be used to allow necessary Federal travel and other costs associated with Federal participation in this project.

E. Payment to Consultants

EPA participation in the salary rate (excluding overhead) paid to individual consultants retained by recipients or by a recipient's contractors or subcontractors shall be limited to the maximum daily rate for a Level IV of the Executive Schedule (formerly GS-18), to be adjusted annually. This limit applies to consultation services of designated individuals with

specialized skills who are paid at a daily or hourly rate. As of January 1, 2022, the limit is $675.80 per day and $84.47 per hour. This rate does not include transportation and subsistence costs for travel performed (the recipient will pay these in accordance with their normal travel reimbursement practices). Subagreements with firms for services which are awarded using the procurement requirements in Subpart D of 2 CFR 200, are not affected by this limitation unless the terms of the contract provide the recipient with responsibility for the selection, direction and control of the individuals who will be providing services under the contract at an hourly or daily rate of compensation. See 2 CFR 1500.9.

F. Indirect Costs - Accep Lower Rate

The recipient's current indirect cost rate is **60.50%** of **$1,028,199**. However, in accordance with the application dated 1/13/2022, the lesser amount of **$591,812** is budgeted for indirect costs.

Programmatic Conditions

A. Standard Terms and Conditions for Research Awards

This award is subject to EPA's set of standard terms and conditions for research awards located at https://www.epa.gov/grants/grant-terms-and-conditions#office.

B. Quality Assurance

Organizations performing activities involving the use or generation of environmental data under covered assistance agreements shall provide the PO within 60 days of award: Quality documentation such as a quality management plan (QMP), and/or other documentation that demonstrates conformance to U.S. EPA quality program requirements found at www.epa.gov/quality ; and Demonstration of competency in the field(s) of expertise. Demonstration of competency may include (but not be limited to): Current participation in accreditation or certification programs that are applicable to the environmental data generated under the Agency-funded assistance; Ongoing participation by the organization in proficiency testing (PT) or round robin programs conducted by external organizations; Ongoing U.S. EPA accepted demonstrations and audits/assessments of proficiency; and Other pertinent documentation that demonstrates competency (e.g., past performance to similar statement of work [SOW]).

The recipient must also provide acceptable quality assurance and quality control documentation for each project under the assistance agreement to the EPA Project Officer within 90 days of award of this agreement. Acceptable documentation will be a Quality Assurance Project Plan (QAPP). Specific requirements for writing QAPPs may be found at https://www.epa.gov/quality/epa-qar-5-epa-requirements-quality-assurance-project-plans. Additional EPA Quality Guidance for Assistance Agreements may be found at https://www.epa.gov/quality/agency-wide-quality-system-documents#guidance.

The EPA Project Officer will provide the recipient with the EPA QA contact's information upon request for pre-submittal questions. The recipient will copy the PO on any communication with the EPA QA contact.

C. Cybersecurity Grant Condition for Other Recipients, Including Intertribal Consortia

(a) The recipient agrees that when collecting and managing environmental data under this assistance agreement, it will protect the data by following all applicable State or Tribal law cybersecurity requirements.

(b) (1) EPA must ensure that any connections between the recipient's network or information system and EPA networks used by the recipient to transfer data under this agreement, are secure. For purposes of this Section, a connection is

defined as a dedicated persistent interface between an Agency IT system and an external IT system for the purpose of transferring information. Transitory, user-controlled connections such as website browsing are excluded from this definition.

If the recipient's connections as defined above do not go through the Environmental Information Exchange Network or EPA's Central Data Exchange, the recipient agrees to contact the EPA Project Officer (PO) no later than 90 days after the date of this award and work with the designated Regional/Headquarters Information Security Officer to ensure that the connections meet EPA security requirements, including entering into Interconnection Service Agreements as appropriate. This condition does not apply to manual entry of data by the recipient into systems operated and used by EPA's regulatory programs for the submission of reporting and/or compliance data.

(2) The recipient agrees that any subawards it makes under this agreement will require the subrecipient to comply with the requirements in (b)(1) if the subrecipient's network or information system is connected to EPA networks to transfer data to the Agency using systems other than the Environmental Information Exchange Network or EPA's Central Data Exchange. The recipient will be in compliance with this condition: by including this requirement in subaward agreements; and during subrecipient monitoring deemed necessary by the recipient under 2 CFR 200.332(d), by inquiring whether the subrecipient has contacted the EPA Project Officer. Nothing in this condition requires the recipient to contact the EPA Project Officer on behalf of a subrecipient or to be involved in the negotiation of an Interconnection Service Agreement between the subrecipient and EPA.

D. Subaward Reporting Requirement

The recipient must report on its subaward monitoring activities under 2 CFR 200.332(d). Examples of items that must be reported if the pass-through entity has the information available are:

1. Summaries of results of reviews of financial and programmatic reports.

2. Summaries of findings from site visits and/or desk reviews to ensure effective subrecipient performance.

3. Environmental results the subrecipient achieved.

4. Summaries of audit findings and related pass-through entity management decisions.

5. Actions the pass-through entity has taken to correct deficiencies such as those specified at 2 CFR 200.332(e), 2 CFR 200.208 and 2 CFR 200.339.

E. Geospatial Data Standards

All geospatial data created must be consistent with Federal Geographic Data Committee (FGDC) endorsed standards. Information on these standards may be found at https://www.fgdc.gov/.

EXHIBIT E

EPA

Life-Cycle Analysis to Support Cost-Effective Enhanced Aquifer Recharge Grant

EPA's Science to Achieve Results Program (STAR) awarded $2 million in grant funding to the University of California, Berkeley for research to develop a cost-benefit tool to support enhanced aquifer recharge (EAR) as a viable, safe, and cost-effective water management strategy.

Using too much groundwater can lead to many issues that impact water quality and water security. EAR is the practice of using excess surface water to intentionally replenish and supplement existing groundwater supplies for storage, potential reuse, and augmenting water supplies. In many locations, EAR can be a cost-effective way to increase water resource resiliency to mitigate the impacts of drought exacerbated by climate change. It can also provide ways to reduce demand on drinking water utilities by supplying water for irrigation and industrial uses, among other benefits.

The goal of this research is to improve understanding of the life-cycle analysis of EAR and help decision-makers understand the costs and benefits of pursuing EAR strategies. Research to identify development needs and to further develop tools, models, and frameworks to support EAR implementation strategies will empower water professionals to make informed water management decisions.

University of California Berkeley – Berkeley, California

Award: $1,999,998

Project Title: A Knowledge-to-Implementation Framework for Enhanced Aquifer Recharge

Principal Investigator: Michael Kiparsky

Study Locations: University of California (UC) Berkeley, UC Davis, UC Santa Cruz, UC Hastings

This project aims to contribute to the nation's water-related human, environmental, and economic well-being by removing barriers, developing tools, and providing knowledge in service of implementation of Enhanced Aquifer Recharge (EAR). The project will conceptualize a life-cycle view of EAR to encompass three pillars of decision making for EAR: geochemical and physical considerations; legal & institutional considerations; and cost-benefit analysis & life-cycle assessment. The overarching hypothesis is that through strategically combining applied research, decision-support innovations, and public engagement, the team can lower barriers to widespread adoption of EAR and unlock its potential to provide multiple water security benefits. The main output of the project is an "EAR Lifecycle Map," which integrates and summarizes the results of and interconnections among all research components. It can be used by decision-makers contemplating EAR projects.

View the research abstract for this project <https://cfpub.epa.gov/ncer_abstracts/index.cfm/fuseaction/recipients.display/rfa_id/688/records_per_page/all>.

Last updated on July 23, 2024

EXHIBIT F

U.S. ENVIRONMENTAL PROTECTION AGENCY

Assistance Amendment

GRANT NUMBER (FAIN): 84046301 **MODIFICATION NUMBER:** 1 **PROGRAM CODE:** RD	**DATE OF AWARD** 05/07/2025
TYPE OF ACTION No Cost Amendment	**MAILING DATE** 05/07/2025
PAYMENT METHOD: ASAP	**ACH#** 0016

RECIPIENT TYPE:
State Institution of Higher Learning

Send Payment Request to:
Contact EPA RTPFC at: rtpfc-grants@epa.gov

RECIPIENT:
Regents of the University of California, The
1608 4th St Ste 220
Sponsored Projects Office
Berkeley, CA 94710-1749
EIN: 94-6002123

PAYEE:
Regents of the University of California, The
2195 Hearst Avenue Room 130; Mail Code 1103
Berkeley, CA 94704-1103

PROJECT MANAGER	EPA PROJECT OFFICER	EPA GRANT SPECIALIST
Michael Kiparsky 391 Simon Hall Berkeley, CA 94720-0001 **Email:** kiparsky@berkeley.edu **Phone:** 510-643-6044	Jacquelyn Harper 1200 Pennsylvania Ave. NW, 8104R Washington, DC 20460 **Email:** bell.jacquelyn@epa.gov **Phone:** 202-564-4811	Jennifer Brooks 1200 Pennsylvania Ave. NW, 3903R Washington, DC 20460 **Email:** brooks.jennifer@epa.gov **Phone:** 202-564-6374

PROJECT TITLE AND EXPLANATION OF CHANGES

Developing Tools and Resources to Enable Economic, Institutional, and Technical Clarity in Support of Enhanced Aquifer Recharge Implementation

This amendment is to stop work; terminate the agreement; reduce performance period duration; curtail scope of work; and waive certain reporting requirements. Administrative terms and conditions are added.

Per 2 CFR 200.340 and the Termination General Terms and Conditions of this agreement, EPA is terminating this award. Your organization shall immediately stop work and take all reasonable steps to minimize the incurrence of costs otherwise allocable to the assistance agreement. See terms and conditions.

BUDGET PERIOD	PROJECT PERIOD	TOTAL BUDGET PERIOD COST	TOTAL PROJECT PERIOD COST
09/01/2022 - 05/07/2025	09/01/2022 - 05/07/2025	$ 1,999,998.00	$ 1,999,998.00

NOTICE OF AWARD

Based on your Application dated 01/13/2022 including all modifications and amendments, the United States acting by and through the US Environmental Protection Agency (EPA) hereby awards $ 0.00. EPA agrees to cost-share 100.00% of all approved budget period costs incurred, up to and not exceeding total federal funding of $ 1,999,998.00. Recipient's signature is not required on this agreement. The recipient demonstrates its commitment to carry out this award by either: 1) drawing down funds within 21 days after the EPA award or amendment mailing date; or 2) not filing a notice of disagreement with the award terms and conditions within 21 days after the EPA award or amendment mailing date. If the recipient disagrees with the terms and conditions specified in this award, the authorized representative of the recipient must furnish a notice of disagreement to the EPA Award Official within 21 days after the EPA award or amendment mailing date. In case of disagreement, and until the disagreement is resolved, the recipient should not draw down on the funds provided by this award/amendment, and any costs incurred by the recipient are at its own risk. This agreement is subject to applicable EPA regulatory and statutory provisions, all terms and conditions of this agreement and any attachments.

ISSUING OFFICE (GRANTS MANAGEMENT OFFICE)	AWARD APPROVAL OFFICE
ORGANIZATION / ADDRESS	**ORGANIZATION / ADDRESS**
Environmental Protection Agency, Grants Management & Business Operations Division 1200 Pennsylvania Ave, NW Mail code 3903R Washington, DC 20460	Environmental Protection Agency, OSAPE ORD - Office of Research and Development 1200 Pennsylvania Ave, NW Washington, DC 20460

THE UNITED STATES OF AMERICA BY THE U.S. ENVIRONMENTAL PROTECTION AGENCY

Digital signature applied by EPA Award Official for Devon Brown - Branch Chief, GMB **by** Keva Lloyd - Award Official Delegate	**DATE** 05/07/2025

EPA Funding Information

FUNDS	FORMER AWARD	THIS ACTION	AMENDED TOTAL
EPA Amount This Action	$ 1,999,998	$ 0	$ 1,999,998
EPA In-Kind Amount	$ 0	$ 0	$ 0
Unexpended Prior Year Balance	$ 0	$ 0	$ 0
Other Federal Funds	$ 0	$ 0	$ 0
Recipient Contribution	$ 0	$ 0	$ 0
State Contribution	$ 0	$ 0	$ 0
Local Contribution	$ 0	$ 0	$ 0
Other Contribution	$ 0	$ 0	$ 0
Allowable Project Cost	$ 1,999,998	$ 0	$ 1,999,998

Assistance Program	Statutory Authority	Regulatory Authority
66.509 - Science to Achieve Results (STAR) Program	Safe Drinking Water Act: Sec. 1442	2 CFR 200, 2 CFR 1500, 40 CFR 33 and 40 CFR 40

Budget Summary Page

Table A - Object Class Category (Non-Construction)	Total Approved Allowable Budget Period Cost
1. Personnel	$ 689,499
2. Fringe Benefits	$ 169,044
3. Travel	$ 21,806
4. Equipment	$ 0
5. Supplies	$ 2,500
6. Contractual	$ 61,000
7. Construction	$ 0
8. Other	$ 464,337
9. Total Direct Charges	$ 1,408,186
10. Indirect Costs: 0.00 % Base	$ 591,812
11. Total (Share: Recipient 0.00 % Federal 100.00 %)	$ 1,999,998
12. Total Approved Assistance Amount	$ 1,999,998
13. Program Income	$ 0
14. Total EPA Amount Awarded This Action	$ 0
15. Total EPA Amount Awarded To Date	$ 1,999,998

Administrative Conditions

UNILATERAL TERMINATION

1. The Agency is asserting its right under 2 CFR 200.340 and the Termination General Term and Condition of this agreement to unilaterally terminate this award. This amendment serves as required notice under 2 CFR 200.341.

2. Consistent with 2 CFR 200.343 Effect of suspension and termination, costs to the recipient or subrecipient resulting from financial obligations incurred by the recipient or subrecipient after the termination of a Federal award are not allowable. Costs after termination are allowable if:

a. The costs result from financial obligations which were properly incurred by the recipient or subrecipient before the effective date of suspension or termination, and not in anticipation of it; and

b. The costs would be allowable if the Federal award was not suspended or expired normally at the end of the period of performance in which the termination takes effect.

c. The costs are reasonable and necessary termination costs consistent with 2 CFR 200.472.

3. Federal Financial Reporting (FFR) General Terms and Conditions is still in full force and effect. EPA recipients must submit the SF-425 no later than 120 calendar days after the end date of the period of performance of the award.

4. Programmatic Terms and Conditions. Performance reporting is still in full force and effect. The recipient must submit the final report no later than 120 calendar days after the period of performance.

In accordance with 2 CFR 200.329, the recipient agrees to submit performance reports that include information on each of the following areas:

a. A comparison of accomplishments to the outputs/outcomes established in the assistance agreement work plan for the reporting period;

b. Explanations on why established outputs/outcomes were not met; and

c. Additional information, analysis, and explanation of cost overruns or high-than-expected-unit costs.

5. Waiver of Reports

The following reports are waived:

a. Utilization of Disadvantaged Business Enterprises General Terms and Conditions, EPA Form 5700-52A.

b. Tangible Personal Property Report, SF-428, General Terms and Conditions.

6. Record Retention

Access to Records, 2 CFR 200.337, is still in full force and effect. The termination of this award does not affect the right of EPA to disallow costs and recover funds on the basis of a later audit or other reviews. Information regarding record retention, property disposition in accordance with EPA regulations, and other frequently asked questions can be accessed at https://www.epa.gov/grants/frequent-questions-about-closeouts.

All Administrative Conditions Remain the Same.

Programmatic Conditions

All Programmatic Conditions Remain the Same.

EXHIBIT G

OFFICE OF MISSION SUPPORT

WASHINGTON, D.C. 20460

May 7, 2025

MEMORANDUM

SUBJECT: Termination of EPA Assistance Agreement RD-84046301-1 under 2 CFR 200.340

FROM: EPA Award Official

TO: Peter Gudlewski, Contracts and Grants Officer
The Regents of the University of California

The purpose of this communication is to notify you that the U.S. Environmental Protection Agency (EPA) is hereby terminating Assistance Agreement No. RD-84046301-1 awarded to The Regents of the University of California. This EPA Assistance Agreement is terminated in its entirety effective immediately on the grounds that the award no longer effectuates the program goals or agency priorities. The objectives of the award are no longer consistent with EPA funding priorities.

The EPA Administrator has determined that, per the Agency's obligations to the constitutional and statutory law of the United States, this priority includes ensuring that the Agency's grants do not conflict with the Agency's policy of prioritizing merit, fairness, and excellence in performing our statutory functions. In addition to complying with the law, it is vital that the Agency assess whether all grant payments are free from fraud, abuse, waste, and duplication, as well as to assess whether current grants are in the best interests of the United States.

The grant specified above provides funding for programs that promote initiatives that conflict with the Agency's policy of prioritizing merit, fairness, and excellence in performing our statutory functions; that are not free from fraud, abuse, waste, or duplication; or that otherwise fail to serve the best interests of the United States. The grant is inconsistent with, and no longer effectuates, Agency priorities.

The process for closeout is generally outlined in 2 CFR 200.344. EPA is clarifying what reports are required and what reports are waived below. Other requirements are still in effect if applicable to your grant.

EPA is requiring the following closeout reports due within 120 days of closeout (2 CFR 200.344a:)

- Final Federal Financial Report, SF-425
- Final Technical Report
- Other programmatic reports identified in your terms and conditions

As part of this termination, EPA is waiving the following closeout reports:

- Property Report, SF-428
- Final Minority Business Enterprise/Woman Business Enterprise Utilization Under Federal Grants and Cooperative Agreements, EPA Form 5700-52A

The recipient may request payment from the Automated Standard Application Payments (ASAP) system for allowable costs incurred up to the date of this memo provided that such costs were contained in the approved workplan. Costs incurred by you after this termination are allowable only if (a) those costs were properly incurred by you before the effective date of this termination, and not in anticipation of it; and (b) those costs would be allowable if your federal award was not suspended or expired normally at the end of the period of performance in which the termination takes effect. *See* 2 C.F.R. § 200.343. You are encouraged to carefully review and discharge your closeout responsibilities set forth in 2 C.F.R. § 200.344-45 and your award agreement. Those responsibilities include, but are not limited to, your obligation to "promptly refund any unobligated funds" that have been paid out but "are not authorized to be retained." *See* 2 C.F.R. § 200.344(g).

Also, per 2 CFR 200.472, a recipient may use grant funds to properly closeout their grant including reasonable and necessary costs that might occur after the date of this memo. If the recipient drew down funds from ASAP for costs beyond the termination date or for costs that exceed the amount necessary to properly closeout their grant, the recipient must contact RTPFC at rtpfc-grants@epa.gov for instructions on how to return the excess funds.

The EPA Grants Management Office has issued an amendment to the agreement to document the termination.

If you wish to dispute this termination decision, the Disputes Decision Official (DDO), Schindel.Phillip@epa.gov, must receive the Dispute no later than 30 calendar days from the date this termination notice is electronically sent to you. Disputes must be sent electronically by email to the DDO, with a copy to the EPA Award Official, Lloyd.Keva@epa.gov within the 30-day period stated above. The Dispute submitted to the DDO must include: (1) A copy of the disputed Agency Decision; (2) A detailed statement of the specific legal and factual grounds for the Dispute, including copies of any supporting documents; (3) The specific remedy or relief you seek under the Dispute; and (4) The name and contact information, including email address, of your designated point of contact for the Dispute. *See* 2 CFR 1500.15

The requirements on post-closeout adjustments and continuing responsibilities, including audit and record retention requirements, at 2 CFR 200.345 remain in effect.

ATTACHMENT
Amendment Document

cc: Jennifer Brooks, EPA Grant Specialist
Jacquelyn Harper, EPA Project Officer
Michael Kiparsky, Grantee Program Manager

EXHIBIT H

COVID-19 Update: EPA is providing flexibilities to applicants experiencing challenges related to COVID-19. Please see the **Flexibilities Available to Organizations Impacted by COVID-19** clause in Section IV of EPA's Solicitation Clauses.

OVERVIEW INFORMATION

U.S. Environmental Protection Agency
Office of Science Advisor, Policy and Engagement
Office of Research and Development

NATIONAL PRIORITIES: WATER INNOVATION, SCIENCE, AND ENGAGEMENT TO ADVANCE WATER REUSE

This is the initial announcement of this funding opportunity.

Funding Opportunity Number: EPA-G2021-ORD-E1

Catalog of Federal Domestic Assistance (CFDA) Number: 66.511

Solicitation Opening Date: ***July 19, 2021***
Solicitation Closing Date: ***September 29, 2021***: 11:59:59 pm Eastern Time

Table of Contents

For Updates and Additional Information (https://www.epa.gov/research-grants/research-funding-opportunities)
Access Standard Forms (https://www.epa.gov/research-grants/research-funding-opportunities-how-apply-and-required-forms)
View research awarded under previous solicitations (https://www.epa.gov/research-grants/research-grant-areas)

SUMMARY OF PROGRAM REQUIREMENTS

Synopsis of Program:
The U.S. Environmental Protection Agency (EPA), is seeking applications proposing to accelerate water innovation, information availability, and engagement to advance clean and safe water reuse goals, promote better understanding of the Nation's water and wastewater treatment and infrastructure, and enhance the availability and efficient use of water resources through water reuse. This request for applications (RFA) is intended to address multiple water reuse sources and applications to support national efforts to reduce technological and institutional barriers for expanded water reuse.

This solicitation provides the opportunity for the submission of applications for projects that may involve human subjects research. Human subjects research supported by the EPA is governed by EPA Regulation 40 CFR Part 26 (Protection of Human Subjects). This includes the Common Rule at subpart A and prohibitions and additional protections for pregnant women and fetuses, nursing women, and children at subparts B, C, and D. Research meeting the regulatory

definition of intentional exposure research found in subpart B is prohibited by that subpart in pregnant women, nursing women, and children. Research meeting the regulatory definition of observational research found in subparts C and D is subject to the additional protections found in those subparts for pregnant women and fetuses (subpart C) and children (subpart D). All applications must include a Human Subjects Research Statement (HSRS, as described in Section IV.C.6.c of this solicitation), and if the project involves human subjects research, it will be subject to an additional level of review prior to funding decisions being made as described in Sections V.D and V.F of this solicitation.

Guidance and training for investigators conducting EPA-funded research involving human subjects may be obtained here:
https://www.epa.gov/osa/basic-information-about-human-subjects-research-0
https://www.ecfr.gov/cgi-bin/text-idx?tpl=/ecfrbrowse/Title40/40cfr26_main_02.tpl

Award Information:
Anticipated Type of Award: Cooperative Agreement
Estimated Number of Awards: Approximately 2 awards
Anticipated Funding Amount: Approximately $6,492,000 total in federal funds for all awards.
Potential Federal Funding per Award: Up to a total of $3,246,000 in federal funds, including direct and indirect costs, with a maximum duration of 4 years. **Each applicant must contribute a minimum 25% non-federal cost share/match of the federal funds awarded which may include in-kind contributions (see Section III.B. for more detail).**

Cost-sharing is required. Applications with budgets including a federal contribution exceeding the total maximum federal award limit will not be considered. Each applicant must contribute a minimum non-federal cost share/match of 25% of the federal funds awarded. This is equivalent at a minimum to 20% of the total project costs. Cost share may include in-kind contributions. In order to be eligible for funding consideration, applicants must demonstrate in their applications how they will meet the required minimum 25% cost share/match in accordance with 2 CFR §200.306. The minimum 25% non-federal cost share/match, equal to a minimum of $811,500 (assuming the applicant requests $3,246,000 in EPA funds) must be included. Including matching, total project costs can exceed $4,057,500 (if the applicant proposes more than the minimum required non-federal cost share/match), however the federally funded portion of the budget must not exceed $3,246,000.

Eligibility Information:
Public and private nonprofit institutions and public and private universities and colleges located in the United States and its territories or possessions are eligible. Foreign entities, States, the District of Columbia, State and local government departments, territories, possessions, and Federally Recognized Indian Tribal Governments of the U.S., are not eligible to apply under this Request for Applications (RFA). Profit-making firms and individuals are not eligible to receive assistance agreements from the EPA under this program. See full announcement for more details.

Application Materials:
To apply under this solicitation, use the application package available at Grants.gov (for further submission information see Section IV.F. "Submission Instructions and other Submission Requirements"). Note: With the exception of the current and pending support form (available at https://www.epa.gov/research-grants/research-funding-opportunities-how-apply-and-required-forms), all necessary forms are included in the electronic application package. Make sure to include the current and pending support form in your Grants.gov submission.

If your organization is not currently registered with Grants.gov, you need to allow approximately one month to complete the registration process. Please note that the registration process also requires that your organization have a DUNS number and a current registration with the System for Award Management (SAM) and the process of obtaining both could take a month or more. Applicants must ensure that all registration requirements are met in order to apply for this opportunity through Grants.gov and should ensure that all such requirements have been met well in advance of the submission deadline. This registration, and electronic submission of your application, must be performed by an authorized representative of your organization.

If you do not have the appropriate internet access to utilize the Grants.gov application submission process for this solicitation, see Section IV.A below for additional guidance and instructions.

Agency Contacts:
Technical Contact: Sarah Ludwig-Monty; phone: 202-566-1072; email: ludwig-monty.sarah@epa.gov
Eligibility Contact: Ron Josephson; phone: 202-564-7823; email: josephson.ron@epa.gov
Electronic Submissions Contact: Debra M. Jones; phone: 202-564-7839; email: jones.debram@epa.gov

I. FUNDING OPPORTUNITY DESCRIPTION

A. Introduction
Safe and reliable water supplies are critical for our Nation's public health, ecosystems, and economy. Communities, agriculture, and businesses are looking to diversify their supply portfolios to meet current and future needs. Water reuse (also commonly known as water recycling or water reclamation) represents a major opportunity to enhance the sustainability and efficient use of water resources to ensure the quality and quantity of existing water supplies. Water reuse is a well-established practice in some areas of the United States and internationally, yet substantial barriers exist to expand its consideration and application for different purposes and benefits. This National Priorities research RFA will solicit innovative research to further the acceptance and practice of water reuse in the United States.

Technology innovation and health-based risk assessment for water reuse applications are important to provide solutions that will advance the Nation's clean and safe water goals. Research is needed to inform future fit-for-purpose treatment specifications, which describe the level of treatment needed to protect public and environmental health and other needed end points

for specific use applications of reclaimed water. Source waters for potential reuse can contain a variety of chemical and microbial contaminants, which without treatment can result in adverse human, animal, and/or environmental health outcomes [1, 2]. While it is not possible to eliminate all risks, treatment technologies are available to generate water of sufficient quality for specific use applications that do not pose significant risks. Development and validation of new and innovative technologies is needed to establish effective pathways to utilizing water reuse for a variety of source waters and applications. Evaluation of innovative technologies that can incorporate future fit-for-purpose treatment applications are critical to building a more sustainable water system and help address risk management questions associated with water reuse.

Research is also needed to improve the national understanding of the water available for reuse and the critical impediments to advancing water reuse across the U.S., including public acceptance. The production and distribution of recycled water requires the participation and collaboration of numerous public and private entities. Integrated planning and implementation in managing finite water resources is critical for long-term resilience, reliability, and to meet both community and ecosystem needs. Key information gaps exist among the various applications of recycled water, which need to be systematically identified and a roadmap must be developed to bridge these gaps.

Additionally, communication and public engagement efforts are critically important means of increasing community awareness of and support for water reuse, which requires the minimization of concerns among the public and decision makers about the safety and economic feasibility of recycled water. Water resource managers need tools and information that support decision-making regarding water availability and quality for both human and ecological uses. Tools are also needed to enable stakeholders and communities to work across programs and jurisdictions in order to design and implement successful reuse projects.

The Office of Research and Development's (ORD) Consolidated Research/Training/Fellowships program supports research and development to: (1) determine the environmental effects of air quality, drinking water, water quality, hazardous waste, toxic substances, and pesticides; (2) identify, develop, and demonstrate effective pollution control techniques; (3) perform risk assessments to characterize the potential adverse health effects of human exposures to environmental hazards; and (4) facilitate training and program participant support in these areas. Awards made under this program further EPA's priorities supporting robust science for air quality, safe and sustainable water resources, sustainable and healthy communities, chemical safety, and human health risk assessment. The national priorities competition under this program supports high-priority water quality and availability research.

EPA recognizes that it is important to engage all available minds to address the environmental challenges the Nation faces. At the same time, EPA seeks to expand the environmental conversation by including members of communities which may have not previously participated in such dialogues to participate in EPA programs. For this reason, EPA strongly encourages all eligible applicants identified in Section III, including minority serving institutions (MSIs), to apply under this opportunity.

For purposes of this solicitation, the following are considered MSIs:

1. Historically Black Colleges and Universities, as defined by the Higher Education Act (20 U.S.C. § 1061(2)). A list of these schools can be found at Historically Black Colleges and Universities;

2. Tribal Colleges and Universities (TCUs), as defined by the Higher Education Act (20 U.S.C. § 1059c(b)(3) and (d)(1)). A list of these schools can be found at American Indian Tribally Controlled Colleges and Universities;

3. Hispanic-Serving Institutions (HSIs), as defined by the Higher Education Act (20 U.S.C. § 1101a(a)(5)). A list of these schools can be found at Hispanic-Serving Institutions;

4. Asian American and Native American Pacific Islander-Serving Institutions; (AANAPISIs), as defined by the Higher Education Act (20 U.S.C. § 1059g(b)(2)). A list of these schools can be found at Asian American and Native American Pacific Islander-Serving Institutions; and

5. Predominately Black Institutions (PBIs), as defined by the Higher Education Act of 2008, 20 U.S.C. 1059e(b)(6). A list of these schools can be found at Predominately Black Institutions.

B. Background

Approximately 33 billion gallons of municipal wastewater are produced each day in the United States [3]. Of that volume, approximately 2.2 billion gallons per day are recovered and reused leaving a major opportunity for reclamation and reuse. There are additional opportunities to reuse water from other sources, such as stormwater, agricultural flows, and industrial waters, and for other use applications. In recent years, Congress has also recognized the critical need to improve our Nation's water infrastructure, as reflected in recent legislative action, including:

1) Water Infrastructure Improvement for the Nation Act (WIIN) – December 2016
2) American's Water Infrastructure Act (AWIA) – October 2018
3) Additional Supplemental Appropriations for Disaster Relief Act (ASADRA) – June 2019
4) Water Infrastructure Improvement Act (WIIA) – January 2019

In February 2020, EPA released the *National Water Reuse Action Plan: Collaborative Implementation Version 1* (WRAP) [1] representing the coordinated and collaborative effort across the water user community. The WRAP includes 37 specific developed actions and over 200 implementation milestones supported by more than 80 partners across 11 strategic themes. The WRAP seeks to promote the consideration of water reuse by implementing actions that will help communities, policymakers, water resource planners and practitioners, and other stakeholders match potential sources of water that can be provided at a quantity and quality needed for identified applications. The scope of this RFA could generate information that addresses four of the eleven strategic themes in the WRAP:

1) Science and Specifications: Compile and refine fit-for-purpose specifications;

2) Technology Development and Validation: Promote technology development, deployment, and validation;
3) Water Information Availability: Improve availability of water (quality and quantity) information; and,
4) Integrated Research: Integrate and coordinate research on water reuse.

Water reuse represents a major opportunity to ensure the quality, availability, and effective use of water resources and its application can include integrated water resources management strategies and approaches. The major sources of water for potential reuse include municipal wastewater, industrial sources, agriculture runoff and return flows, and stormwater. Source waters to be reclaimed can be evaluated and treated with fit-for-purpose specifications for the reuse application desired. Examples of reuse applications include agriculture and irrigation, potable water supplies, groundwater storage and recharge, industrial processes, onsite non-potable use, saltwater intrusion barriers, and environmental restoration [2]. While innovative examples of water reuse are increasing, research can help expand its scope and efficiency. Integrated and coordinated research planning for water reuse can optimize its value, better identify critical institutional barriers and speed utilization at the national scale.

C. Authority and Regulations

The authority for this RFA and resulting awards is contained in the Safe Drinking Water Act, 42 U.S.C. 300j-1, Section 1442, the Clean Water Act, 33 U.S.C. 1254, Section 104(b)(3), the Solid Waste Disposal Act, 42 U.S.C. 6981, Section 8001, and the Consolidated Appropriations Act, 2021, Public Law 116–260.

For research with an international aspect, the above statutes are supplemented, as appropriate, by the National Environmental Policy Act, Section 102(2)(F).

Note that a project's focus is to consist of activities within the statutory terms of EPA's financial assistance authorities; specifically, the statute(s) listed above. Generally, a project must address the causes, effects, extent, prevention, reduction and elimination of air pollution, water pollution, solid/hazardous waste pollution, toxic substances control or pesticide control depending on which statute(s) is listed above. Further note applications dealing with any aspect of or related to hydraulic fracking will not be funded by EPA through this program.

Additional applicable regulations include: 2 CFR Part 200, 2 CFR Part 1500, and 40 CFR Part 40 (Research and Demonstration Grants).

D. Specific Areas of Interest/Expected Outputs and Outcomes

Note to applicant: The term "output" means an environmental activity, effort, and/or associated work products related to an environmental goal or objective, that will be produced or provided over a period of time or by a specified date. The term "outcome" means the result, effect or consequence that will occur from carrying out an environmental program or activity that is related to an environmental or programmatic goal or objective.

The activities to be funded under this announcement support EPA's FY 2018-22 Strategic Plan (https://www.epa.gov/planandbudget/strategicplan). Activities to be funded under this announcement support Goal 1: A Cleaner, Healthier Environment, Objective 1.2: Provide for Clean and Safe Water, of EPA's FY 2018-22 Strategic Plan. All applications must be for projects that support the goal and objective identified above. Awards made under this announcement will further the goals of the Consolidated Research/Training/Fellowships program by furthering EPA's priorities supporting robust science for safe and sustainable water resources and promoting high-priority water quality and availability research.

EPA also requires that grant applicants adequately describe environmental outputs and outcomes to be achieved under assistance agreements (see EPA Order 5700.7A1, Environmental Results under Assistance Agreements, https://www.epa.gov/grants/epa-order-57007a1-epas-policy-environmental-results-under-epa-assistance-agreements). Applicants must include specific statements describing the environmental results of the proposed project in terms of well-defined outputs and, to the maximum extent practicable, well-defined outcomes that will demonstrate how the project will contribute to the priorities described above.

The proposed research should be national in scope and address environmental problems associated with both water quality and availability. This funding opportunity is intended to incentivize research to unlock the potential of water reuse as a tool for national water security and resiliency, climate adaptation and mitigation, and environmental justice. Applications in response to this solicitation should clearly demonstrate how the proposed research will directly support the goals of this solicitation, and the expected impact of the research in advancing water availability and water quality through the consideration of water reuse at the national level.

There are two distinct research areas covered by this solicitation. **Applicants should address both research areas and cover all the topics of interest (A-E) listed below**. The research area and topic(s) of interest being addressed should clearly be indicated throughout the application.

Research Area 1: Science, Technology Development, and Validation for Water Reuse Applications

Research is needed to help inform the role of water reuse in the nation's priorities for securing water availability and water quality for user communities. Research gaps exist for future fit-for-purpose specifications using risk assessment strategies; brine reduction and disposal technologies and processes; development of real-time monitoring and control strategies for water treatment trains; and assessment, demonstration, and validation of novel or improved treatment technologies.

Topics of interest:

> **TOPIC A: *Health-Based Risk Assessment*:** *Any proposed research toward health based risk assessment and specifications should describe the state of the science, the gap being addressed, and how the proposed assessment is expected to have a broad impact on the*

Nation's ability to address real world water reuse challenges. Research under this topic may include:

- Characterize the quality of sources of water for potential reuse, which may include: (1) municipal wastewater, (2) industrial water such as process water and cooling water, (3) agriculture runoff and return flows, (4) stormwater, with a focus on the occurrence and density of pathogens and relevant chemicals of concern, and (5) other sources.
- Evaluate risk assessments and analysis methods that estimate or calculate fit-for-purpose treatment standards for different types of source waters, and water reuse treatment approaches/technologies to identify treatment levels needed to protect human health and the environment and meet regulatory standards, as appropriate, including for surface water and groundwater.
- Define treatment performance (e.g., log removal credits of representative pathogens) of existing and emerging unit processes both through mining existing information and generating data on critical gaps.
- Research on other topics of relevance related to health-based risk assessment and specifications to unlock the potential of water reuse as a tool for national water security and resiliency, climate adaptation and mitigation, and environmental justice.

TOPIC B: ***Technology Innovation:*** *Any proposed technology research should clearly describe the state of the science, the technology development context, and the gap being addressed. The technology research should be at a high Technology Readiness Level and clearly demonstrate the pathway from the proposed work to application in the real world toward addressing water reuse challenges. Research under this topic may include:*

- Identify and validate innovative technologies for the removal of chemical and microbial contaminants, including emerging pollutants, from various types of wastewater streams, to enable fit-for-purpose reuse or improved quality of discharged effluent.
- Research, develop and/or validate technologies or processes for disposal or other innovative use of concentrate from membrane treatment systems to reduce management costs and to mitigate public health and ecological risks.
- Research, develop and/or validate technologies for continuous monitoring and control or other innovative monitoring strategies to ensure reliability and adequate performance across reuse treatment trains.
- Identify, research, and/or develop low- and zero-energy water and wastewater treatment systems and expanded recovery of beneficial treatment byproducts.
- Analyze low-input treatment technologies for small, mid-size treatment plants as well as decentralized and onsite systems. "Low-input" is a term that describes a combination of low-energy, low-cost, and/or low-maintenance technologies over a technology's life cycle.
- Research on other topics of relevance related to technology innovation to unlock the potential of water reuse as a tool for national water security and resiliency, climate adaptation and mitigation, and to serve underserved communities.

Research Area 2: Social science, Information, Engagement, and Organizational barriers to Water Reuse

Research is needed to improve the national understanding of the water available for reuse and the critical impediments to advancing water reuse across the U.S., including public acceptance. Both social and organizational barriers contribute to the critical research gaps surrounding reuse, including, but not limited to potential policy, legal, regulatory, financial, and social impediments. More research is needed on the best approaches for improving cross-organizational engagement as well as approaches that increase public acceptance of water reuse.

Topics of interest:

TOPIC C: *Water Information and Availability*: *Any proposed research on current and future water availability should clearly identify the gap in current knowledge, and the actionable solution(s) toward addressing water reuse challenges within the water industry. Research under this topic may include:*

- Research and establish a methodology for identifying and quantifying the water currently being recycled, and available for potential future reuse, including municipal, agricultural, stormwater, industrial, and other sources of supply. This methodology should be capable of yielding data on reuse activity and potential at national, regional, state, and local scales.
- Characterize the drivers shaping future water planning decisions at the local and regional scales and identify solutions required to incorporate water reuse for long term water planning.
- Research on other topics of relevance related to current and future water availability to unlock the potential of water reuse as a tool for national water security and resiliency, climate adaptation and mitigation, and to serve underserved communities.

TOPIC D: *Organizational Barriers*: *Any proposed research on water sector policy, organizational structures, and legal/ financial/ regulatory barriers should identify the gap in the current knowledge, advance understanding of the problem, and/or clearly identify actionable solution(s) toward addressing water reuse challenges within the water industry. Research under this topic may include:*

- Understand and identify the current research efforts across the water sector to foster collaborations, prevent duplication of efforts, and inform a coordinated water reuse research strategy.
- Research and identify limitations on water reuse due to policy, legal/regulatory, financial, organizational/institutional, and social constraints for various sources of waters for potential reuse (e.g., municipal wastewater, industrial water such as process water and cooling water, agriculture runoff and return flows, and stormwater).

- Synthesize relevant research activities and findings to support and inform development of policies and strategies necessary to build water reuse capacity.
- Research on other topics of relevance related to water sector policy, organizational structures, and legal/ financial/regulatory barriers to unlock the potential of water reuse as a tool for national water security and resiliency, climate adaptation and mitigation, and to serve underserved communities.

TOPIC E*: Social Barriers*: *Any proposed research on public attitudes, perceptions, and acceptance should identify the gap in the current knowledge, advance understanding of the barrier, and/or clearly identify actionable solution(s) toward addressing water reuse challenges within the water sector. Research under this topic may include:*

- Compile and evaluate previously conducted community-based strategies to increase acceptance of reuse.
- Identify improved communication strategies to build public acceptance for different types of reuse sources and applications, accounting for differences in local water management interests, needs, and priorities.
- Develop qualitative research and evaluate existing research to understand the primary drivers affecting public acceptance of and user confidence in different types of water reuse.
- Research on other topics of relevance related to public attitudes, perceptions, and acceptance of water reuse to advance water reuse as a tool for national water security and resiliency, climate adaptation and mitigation, and to serve underserved communities.

Expected Outputs

The outputs of this project will assist communities, states, tribes, local governments, utilities, agriculture, and industry to more effectively incorporate innovation, applied research and other products to improve the Nation's water availability, quality, and infrastructure. Some examples of desirable outputs are listed below:

The cooperative agreements are expected to result in a variety of products that may include:

- Analyses
- Technical guidance documents
- Cost-effective technologies analysis
- Synthesis of research and evaluation efforts
- Best practices
- Partner convenings and reports
- Strategies for acting upon research results
- Communication materials
- Published research papers
- Technology demonstration or system operation

Example Outputs Research Area 1: Science, Technology Development, and Validation for Water Reuse Applications (non-exhaustive)

Health-Based Risk Assessment:

- Reports and or publications characterizing the quality of sources of water for potential reuse which may include information on the occurrence and density of pathogens and relevant chemicals of concern that will be relevant to informing the development of future fit-for-purpose specifications.
- Reports or publications addressing fit-for-purpose treatment standards and the ability of existing technologies to meet treatment standards for different types of reuse.

Technology Innovation:

- Demonstration scale test-bed, pilot processes in full-scale treatment facilities, or system test, launch or operation at a full-scale treatment facility of the relevant technology.
- Information for stakeholders to understand technologies available for continuous monitoring or other innovative monitoring and tracking methods.
- List of technologies that remove pollutants for a variety of end uses including information about their appropriate applications, strengths, and weaknesses.
- Economic analyses evaluating the feasibility, cost-effectiveness, life cycle costs, and operation and maintenance costs of treatment processes.
- Compilations and reviews of low-input treatment methods to be used by states, utilities, onsite system managers, and/or communities stressed by climate change.
- Compilations and reviews of low-input methods to reduce salinity and meet disinfection requirements that may foster greater adoption of reuse.
- Technology validation approaches and strategies that can be used to evaluate existing and future technologies and support needs of new technology adoption and permitting processes.
- Best practices for operations of reuse facilities, including as curricula for system operators' certification programs, or other mechanisms to support utility operations for reuse.

Example Outputs Research Area 2: Social science, Information, Engagement, and Organizational barriers to Water Reuse (non-exhaustive)

Water Information and Availability:

- One or more methodologies to identify and quantify existing and potential future reuse across various sources of water.
- A publicly available, centralized database with information on the amount of wastewater reused by state or tribe's reuse and stormwater capture, organized by state, tribal reservation, and jurisdiction levels.

- A report that quantifies the current practice of water reuse across states, tribes, regions, and/or nation-wide for various sources of water for potential reuse (i.e., municipal, industrial, agricultural, and stormwater).
- An interactive map of where water reuse is in place across states, regions, and the nation.
- Convening of experts to evaluate regional differences, drivers, and barriers to water reuse across different sources of water for potential reuse, and potential strategies for tailoring capacity building efforts that are sensitive to these differences.
- A portal that improves data sharing of information among states and allows for data sharing among stakeholders (as well as access to water quality data), including criteria for acceptable water quality. This could include sharing case studies and reuse planning frameworks.

Organizational Barriers:

- Report(s) that synthesizes research and relevant institutional stakeholder input concerning communication and outreach needs, challenges, and the adequacy of existing strategies and tools.
- Report(s) that compiles and evaluates effective communication strategies for a variety of users.
- Curricula to educate public health professionals, medical professionals, and others in the public health community about reuse generally and potential health risks associated with water reuse.

Social Barriers:

- Synthesis of research and relevant public stakeholder input concerning challenges with water reuse acceptance, communication and outreach needs, and the adequacy of existing strategies and tools, including those for underserved communities.
- Practical tools to assist in public and decision-maker risk communication and building consumer confidence in recycled water.
- Evidence-based outreach strategies around reuse tailored to various concerns and perceptions of diverse communities that highlight the benefits and successes of reuse while accounting for public health and environmental protection safeguards.

Expected Outcomes

Expected outcomes of this agreement will facilitate a holistic path forward to understanding the state and potential for reuse, as well as address the health risk concerns in municipal, agricultural, stormwater, and industrial sectors. Outcomes from this agreement will provide a better understanding of the available technologies to support reuse, their cost-effectiveness, and potential for holistic resource recovery within a changing climate. Additionally, the proposed research will develop tools needed to support local, state, and national communication efforts to reduce institutional barriers and improve public acceptance and understanding of reuse.

Environmental Justice

To the extent practicable, research applications must seek to incorporate environmental justice and underserved community considerations. Environmental justice (EJ) is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation and enforcement of environmental laws, regulations and policies. Fair treatment means no group of people should bear a disproportionate share of the negative environmental consequences resulting from industrial, governmental and commercial operations or policies. Meaningful involvement means people have an opportunity to participate in decisions about activities that may affect their environment and/or health; the public's contribution can influence the regulatory agency's decision; community concerns will be considered in the decision making process; and decision makers will seek out and facilitate the involvement of those potentially affected. For purposes of this competition and the evaluation of applications, "underserved communities" means people/communities of color, low income, tribal and indigenous populations, and other vulnerable populations such as the elderly, children, and those who pre-existing medical conditions."

In addressing the research areas and topics of interest above, applicants should demonstrate how the project will address the disproportionate and adverse human health, environmental, climate-related and other cumulative impacts, as well as the accompanying economic challenges of such impacts, resulting from industrial, governmental, commercial and/or other actions that have affected and/or currently affect the underserved communities. Applicants should also demonstrate how the project benefits the underserved communities including those that have experienced a lack of resources or other impediments to addressing the impacts identified above that affect their community.

Community Engagement Plan

Collaboration and cooperative partnerships are strongly encouraged in the design and execution of the proposed research. Therefore, applications must include a Community Engagement Plan. Applications should, at minimum, describe how: a) applicants will work in partnership with appropriate partners (MSIs, states, tribes, academia, industry groups, non-profit organizations, associations, and local communities/community-based organizations) to effectively design and implement the proposed project; b) applicants will, to the extent possible, coordinate with and/or complement other projects or activities being performed by others that will result in a greater positive impact; c) applicants will ensure substantive and cohesive collaboration between researchers tackling different disciplinary activities described within the two research areas and all five topics of interest (A-E) described in Section I.D; and (d) applicants will incorporate input of appropriate partners (MSIs, states, tribes, academia, industry groups, non-profit organizations, associations, and local communities/community-based organizations, underserved communities) in the definition of relevant research hypotheses, questions, design, and implementation plans.

For the purpose of this announcement, a "community-based organization" generally means a nongovernmental organization that has demonstrated effectiveness as a representative of a community or a significant segment of a community and that helps members of that community obtain environmental, educational, or other social services. A community-based organization must be a nonprofit or not for profit corporation in good standing under state or tribal law with

authority to enter into binding legal agreements. The community-based organization need not be tax exempt under the Internal Revenue Code but may use documentation of tax-exempt status to demonstrate that it is a nonprofit.

The community engagement plan should:

- Describe the type of collaboration/engagement proposed and what role it will play in the overall project including the degree of partner and/or community input or engagement in the conceptualization, hypothesis/question development, design, methods, analyses and implementation of the research. This includes describing how the project addresses engagement with underserved communities, especially local residents in these communities who will be affected by the project, to ensure their meaningful participation with respect to the design, project planning, and performance of the project.
- Describe how the collaboration/engagement will enhance the overall impact of the project such that the project results are applicable and useable by state/local agencies, utilities, and impacted communities. This includes the capacity of the project to more effectively communicate risk and translate scientific results into easily understandable outreach and education materials.
- Describe how activities of the project will be coordinated with related or complementary projects and studies.
- Describe how substantive and cohesive collaboration between researchers tackling different disciplinary activities detailed within the two research areas and all five topics of interest (A-E) described in Section I.D will be accomplished.
- Describe how the collaboration/engagement will materialize during project performance. Describe the partner(s)' intent to participate in the proposed research including evidence of support of an active partnership with MSIs, states, tribes, academia, industry groups, non-profit organizations, associations, and/or local communities/community-based organizations (e.g., letter(s) of intent or support from MSIs, community-based organizations, community leaders, state or local government agencies, non-government organizations, industry, water utility managers, site managers or operators). Any letters demonstrating evidence of collaboration and support should be included as part of section IV.C.10.a. Letters of Intent/Letters of Support.

Applicants that do not plan on collaborating/engaging with other groups in project performance must still include a community engagement plan in their application describing how they will be able to effectively perform and complete the project without such collaboration/engagement.

Innovation and Sustainability

To the extent practicable, research applications must embody innovation and sustainability. Innovation for the purposes of this RFA is defined as the process of making changes; a new method, custom or device. Innovative research can take the form of wholly new applications or applications that build on existing knowledge and approaches for new uses. Research applications must include a discussion on how the proposed research is innovative (see Section IV.C.6.a). The goal of sustainability, derived from the U.S. National Environmental Policy Act

of 1969 (NEPA), is to "create and maintain conditions, under which humans and nature can exist in productive harmony, that permit fulfilling the social, economic and other requirements of present and future generations." Research applications must include a discussion on how the proposed research will seek sustainable solutions that protect the environment and strengthen our communities (see Section IV.C.6.a). Reviewers will draw from all of the above-mentioned innovation and sustainability definitions in the review/evaluation process of research applications (see Section V.A).

E. References

(1) U.S. Environmental Protection Agency (USEPA). (2020). *National Water Reuse Action Plan.* (https://www.epa.gov/waterreuse/water-reuse-action-plan)

(2) United States Environmental Protection Agency (USEPA). (2012). *2012 guidelines for water reuse*. Washington, DC: U.S. EPA Office of Water, Office of Wastewater Management. https://www3.epa.gov/region1/npdes/merrimackstation/pdfs/ar/AR-1530.pdf

(3) Rauch-Williams, T; Marshall, MR; Davis, D. (2018). Baseline data to establish the current amount of resource recovery from WRRFs. (WSEC-2018-TR-003). https://www.wef.org/globalassets/assets-wef/direct-download-library/public/03---resources/WSEC-2018-TR-003

F. Special Requirements

It is EPA Policy to ensure that the results of EPA-funded extramural scientific research are accessible to the public to the greatest extent feasible consistent with applicable law; policies and Orders; the Agency's mission; resource constraints; and U.S. national, homeland and economic security. This entails maximizing, at no charge, access by the public to peer-reviewed, scientific research journal publications or associated author manuscripts, and their underlying digital research data, created in whole or in part with EPA funds, while protecting personal privacy; recognizing proprietary interests, confidential business information and intellectual property rights; and avoiding significant negative impact on intellectual property rights, innovation and U.S. competitiveness. EPA's *Policy for Increasing Access to Results of EPA-Funded Extramural Scientific Research* may be accessed at: https://www.epa.gov/research/non-epa-researcher-requirements. Terms and conditions implementing this policy may be accessed at: https://www.epa.gov/research/non-epa-researcher-requirements.

Applications submitted under this announcement shall include a Scientific Data Management Plan (SDMP) that addresses public access to EPA-funded scientific research data. See the SDMP clause in Section IV for details on the content of an SDMP. Applicants will also be asked to provide past performance information on whether journal publications or associated author manuscripts, and the associated underlying scientific research data and metadata, under prior assistance agreements were made publicly accessible. These items will be evaluated prior to award.

Reasonable, necessary and allocable costs for data management and public access as discussed in EPA's *Policy for Increasing Access to Results of EPA-Funded Extramural Scientific Research*, may be included in extramural research applications and detailed in the budget justification described in Section IV.

Agency policy and ethical considerations prevent EPA technical staff and managers from providing applicants with information that may create an unfair competitive advantage. Consequently, EPA employees will not review, comment, advise and/or provide technical assistance to applicants preparing applications in response to EPA RFAs. EPA employees cannot endorse any particular application.

Multiple Investigator applications may be submitted as: (1) a single Lead Principal Investigator (PI) application with Co-PI(s) or (2) a Multiple PI application (with a single Contact PI). If you choose to submit a Multiple PI application, you must follow the specific instructions provided in Sections IV. and V. of this RFA. For further information, please see the EPA Implementation Plan for Policy on Multiple Principal Investigators (https://www.epa.gov/research-grants/research-grants-guidance-and-policies).

This solicitation provides the opportunity for the submission of applications for projects that may involve human subjects research. All applications must include a Human Subjects Research Statement (HSRS; described in Section IV.C.6.c of this solicitation). If the project involves human subjects research, it will be subject to an additional level of review prior to funding decisions being made as described in Sections V.D and V.F of this solicitation.

Groups of two or more eligible applicants may choose to form a consortium and submit a single application for this assistance agreement. The application must identify which organization will be the recipient of the assistance agreement and which organizations(s) will be subawardees of the recipient.

These awards may involve the collection of "Geospatial Information," which includes information that identifies the geographic location and characteristics of natural or constructed features or boundaries on the Earth or applications, tools, and hardware associated with the generation, maintenance, or distribution of such information. This information may be derived from, among other things, a Geographic Positioning System (GPS), remote sensing, mapping, charting, and surveying technologies, or statistical data.

II. AWARD INFORMATION

It is anticipated that a total of approximately $6,492,000 million will be awarded under this announcement, depending on the availability of funds, quality of applications received and other applicable considerations. The EPA anticipates funding approximately 2 awards under this RFA. Requests for amounts in excess of a total of $3,246,000 in federal funds, including direct and indirect costs, will not be considered. In addition, a minimum 25% non-federal cost share/match of the federal funds awarded, which may include in-kind contributions (see Section III.B. for more details) equal to a minimum of $811,500 (assuming the applicant requests $3,246,000 in

EPA funds) must be included. Applications which do not demonstrate how the minimum 25% non-federal cost share/match will be met will not be considered. The total project period requested in an application submitted for this RFA may not exceed 4 years.

The EPA reserves the right to reject all applications and make no awards, or make fewer awards than anticipated, under this RFA. The EPA reserves the right to make additional awards under this announcement, consistent with Agency policy, if additional funding becomes available after the original selections are made. Any additional selections for awards will be made no later than six months after the original selection decisions.

In appropriate circumstances, EPA reserves the right to partially fund applications by funding discrete portions or phases of proposed projects. If EPA decides to partially fund an application, it will do so in a manner that does not prejudice any applicants or affect the basis upon which the application, or portion thereof, was evaluated and selected for award, and therefore maintains the integrity of the competition and selection process.

EPA will award *cooperative agreements* under this announcement. When addressing a research question/problem of common interest, collaborations between EPA and the institution's principal investigators are permitted under a cooperative agreement. These collaborations may include data and information exchange, providing technical input to experimental design and theoretical development, coordinating extramural research with in-house activities, the refinement of valuation endpoints, and joint authorship of journal articles on these activities. Cooperative agreements permit substantial involvement between the EPA and the selected applicants in the performance of the work supported. Although EPA will negotiate precise terms and conditions relating to substantial involvement as part of the award process, the anticipated Federal involvement proposed by EPA for this project will be:

- Sharing data from related projects.
- Training by EPA scientists on EPA methods and standard methods commonly used in EPA and state laboratories.
- Sample analysis by EPA laboratories with unique instrumentation and expertise not available to applicants. Concurrent or split sample analysis in cases where EPA has instrumentation.
- Quality assurance support including guidance with refining the applicants' Quality Assurance Project Plan (QAPP) to be written after award.
- Assisting in coordinating with other Federal Agencies and states to help grantees gain access to state and other agency/state/utility information.

Potential applicants should contact Sarah Ludwig-Monty; phone: 202-566-1072; email: ludwig-monty.sarah@epa.gov regarding questions pertaining to EPA's substantial involvement.

III. ELIGIBILITY INFORMATION

A. Eligible Applicants

This solicitation is available to public and private nonprofit institutions and public and private universities and colleges located in the United States and its territories or possessions. Foreign entities, States, the District of Columbia, State and local government departments, territories, possessions, and Federally Recognized Indian Tribal Governments of the U.S., are not eligible to apply under this RFA. Profit-making firms and individuals are not eligible to receive assistance agreements from the EPA under this program.

Non-profit organization, as defined by 2 CFR 200.1, means any corporation, trust, association, cooperative or other organization, not including institutions of higher education (IHEs), that: (1) is operated primarily for scientific, educational, service, charitable or similar purposes in the public interest; (2) is not organized primarily for profit; and (3) uses net proceeds to maintain, improve, or expand the operations of the organization. Note that 2 CFR 200.1 specifically excludes Institutions of Higher Education from the definition of non-profit organization because they are separately defined in the regulation. While not considered to be a non-profit organization(s) as defined by 2 CFR 200.1, public or nonprofit Institutions of Higher Education are, nevertheless, eligible to submit applications under this RFA. Hospitals that meet the definition of nonprofit at 2 CFR 200.1 are also eligible to apply as nonprofits. Hospitals operated by state, tribal, or local governments or that are instrumentalities of the unit of government depending on the applicable law are not eligible to apply. For-profit colleges, universities, trade schools, and hospitals are ineligible. Nonprofit organizations described in Section 501(c) (4) of the Internal Revenue Code that lobby are not eligible to apply.

National laboratories funded by Federal Agencies (Federally-Funded Research and Development Centers, "FFRDCs") may not apply. FFRDC employees may cooperate or collaborate with eligible applicants within the limits imposed by applicable legislation and regulations. They may participate in planning, conducting, and analyzing the research directed by the applicant, but may not direct projects on behalf of the applicant organization. The institution, organization, or governance receiving the award may provide funds through its assistance agreement from the EPA to an FFRDC for research personnel, supplies, equipment, and other expenses directly related to the research. However, salaries for permanent FFRDC employees may not be provided through this mechanism.

Federal Agencies may not apply. Federal employees are not eligible to serve in a principal leadership role on an assistance agreement. Federal employees may not receive salaries or augment their Agency’s appropriations through awards made under this program unless authorized by law to receive such funding.

The applicant institution may enter into an agreement with a Federal Agency to purchase or utilize unique supplies or services unavailable in the private sector to the extent authorized by law. Examples are purchase of satellite data, chemical reference standards, analyses, or use of instrumentation or other facilities not available elsewhere. A written justification for federal

involvement must be included in the application. In addition, an appropriate form of assurance that documents the commitment, such as a letter of intent from the Federal Agency involved, should be included.

Potential applicants who are uncertain of their eligibility should contact Ron Josephson in the Office of Research and Development (ORD), phone: 202-564-7823, email: josephson.ron@epa.gov.

B. Cost sharing

Each applicant must contribute a minimum non-federal cost share/match of 25% of the federal funds awarded. This is equivalent at a minimum to 20% of the total project costs. Cost share may include in-kind contributions. In order to be eligible for funding consideration, applicants must demonstrate in their applications how they will meet the required minimum 25% cost share/match in accordance with 2 CFR §200.306.

The cost share/match may be provided in cash or can come from in-kind contributions, such as the use of volunteers and/or donated time, equipment, etc., subject to the regulations governing matching fund requirements at 2 CFR §200.306. Cost share/matching funds are considered grant funds and are included in the total award amount.

All contributions, including cash and third party in-kind, shall be accepted as cost sharing or matching when such contributions meet all of the following criteria: (1) Are verifiable from the non-Federal entity's records; (2) Are not included as contributions for any other Federal award; (3) Are necessary and reasonable for proper and efficient accomplishment of project or program objectives; (4) Are allowable under Subpart E—Cost Principles of 2 CFR Part 200; (5) Are not paid by the Federal Government under another Federal award, except where the Federal statute authorizing a program specifically provides that Federal funds made available for such program can be applied to matching or cost sharing requirements of other Federal programs; (6) Are provided for in the approved budget when required by the Federal awarding agency; and (7) Conform to other provisions of 2 CFR Part 200, as applicable.

Any restrictions on the use of grant funds (examples of funding restrictions are described in Section IV.E of this announcement) also apply to the use of cost share/matching funds.

C. Other

Applications must substantially comply with the application submission instructions and requirements set forth in Section IV of this announcement or they will be rejected. In addition, where a page limitation is expressed in Section IV with respect to parts of the application, pages in excess of the page limit will not be reviewed. In addition, applications must be submitted through Grants.gov as stated in Section IV of this announcement (except in the limited circumstances where another mode of submission is specifically allowed for as explained in Section IV) on or before the application submission deadline published in Section IV of this announcement. Applicants are responsible for following the submission instructions in Section

IV of this announcement (see Section IV.F. "Submission Instructions and Other Submission Requirements" for further information) to ensure that their application is submitted timely. Applications submitted after the submission deadline will be considered late and deemed ineligible without further consideration unless the applicant can clearly demonstrate that it was late due to EPA mishandling or because of technical problems associated with Grants.gov or relevant SAM.gov system issues. An applicant's failure to timely submit their application through Grants.gov because they did not timely or properly register in SAM.gov or Grants.gov will not be considered an acceptable reason to consider a late submission.

In order to be deemed eligible, the application must include a Community Engagement Plan (see Section IV.C.6.e.) that demonstrates collaboration/engagement with partners in the design and execution of the proposed research or how the applicant will be able to effectively perform and complete the project without such collaboration/engagement.

In addition, applications which do not provide the required non-federal cost share/match will be deemed ineligible. Also, applications exceeding the funding limits or project period term described herein will be rejected without review. Further, applications that fail to demonstrate a public purpose of support or stimulation (e.g., by proposing research which primarily benefits a Federal program or provides a service for a Federal agency) will not be funded.

Applications deemed ineligible for funding consideration will be notified within fifteen calendar days of the ineligibility determination.

IV. APPLICATION AND SUBMISSION INFORMATION

Additional provisions that apply to this solicitation and/or awards made under this solicitation, including but not limited to those related to confidential business information, contracts and subawards under grants, and proposal assistance and communications, can be found at https://www2.epa.gov/grants/epa-solicitation-clauses.

These, and the other provisions that can be found at the website link, are important, and applicants must review them when preparing applications for this solicitation. If you are unable to access these provisions electronically at the website above, please communicate with the EPA contact listed in this solicitation to obtain the provisions.

Formal instructions for submission through Grants.gov are in Section F.

A. Grants.gov Submittal Requirements and Limited Exception Procedures

Applicants must apply electronically through Grants.gov under this funding opportunity based on the grants.gov instructions in this announcement. If your organization has no access to the internet or access is very limited, you may request an exception for the remainder of this calendar year by following the procedures outlined here. Please note that your request must be received at least 15 calendar days before the application due date to allow enough time to negotiate alternative submission methods. Issues with submissions with respect to this

opportunity only are addressed in section *F. Submission Instructions and Other Submission Requirements* below.

B. Application Package Information

Use the application package available at Grants.gov (see Section IV.F. "Submission Instructions and Other Submission Requirements"). Note: With the exception of the current and pending support form (available at https://www.epa.gov/research-grants/research-funding-opportunities-how-apply-and-required-forms), all necessary forms are included in the electronic application package. Make sure to include the current and pending support form in your Grants.gov submission.

An email will be sent by ORD to the Lead/Contact PI and the Administrative Contact (see below) to acknowledge receipt of the application and transmit other important information. The email will be sent from receipt.application@epa.gov; emails to this address will not be accepted. *If you do not receive an email acknowledgement within 10 calendar days of the submission closing date, immediately inform the Electronic Submissions Contact shown in this solicitation. Failure to do so may result in your application not being reviewed.* See Section IV.F. "Submission Instructions and Other Submission Requirements" for additional information regarding the application receipt acknowledgment.

C. Content and Form of Application Submission

The application is made by submitting the materials described below. **Applications must contain all information requested and be submitted in the formats described.**

1. Standard Form 424

The applicant must complete Standard Form 424. Instructions for completion of the SF424 are included with the form. However, note that EPA requires that the entire requested dollar amount appear on the SF424, not simply the proposed first year expenses. **Note that a minimum 25% non-federal cost share/match of the federal funds awarded must be included.** The form must contain the signature of an authorized representative of the applying organization.

Applicants are required to provide a DUNS number when applying for federal grants or cooperative agreements. Organizations may receive a DUNS number, at no cost, by calling the dedicated toll-free request line at 1-866-705-5711, or visiting the website at: https://www.dnb.com.

This program is eligible for coverage under E.O. 12372, "Intergovernmental Review of Federal Programs." An applicant should consult the office or official designated as the single point of contact in his or her State for more information on the process the State requires to be followed in applying for assistance, if the State has selected the program for review. EPA financial assistance programs and activities subject to intergovernmental review that have been selected for review under State single point of

contact procedures are identified at https://www.epa.gov/grants/epa-financial-assistance-programs-subject-executive-order-12372-and-section-204-demonstration. Applicants for programs or activities subject to Intergovernmental Review that have not been selected for State single point of contact review must provide directly affected State, areawide, regional, and local entities at least 60 days to review their application following notification by EPA that the application has been selected for funding as provided by 40 CFR 29.8(a) and (c).

2. Key Contacts

The applicant must complete the "Key Contacts" form found in the Grants.gov application package. An "Additional Key Contacts" form is also available at https://www.epa.gov/research-grants/research-funding-opportunities-how-apply-and-required-forms. The Key Contacts form should also be completed for major sub-agreements (i.e., primary investigators). Do not include information for consultants or other contractors. Please make certain that all contact information is accurate.

For Multiple PI applications: The Additional Key Contacts form ***must*** be completed (see Section I.F. for further information). *Note: The Contact PI must be affiliated with the institution submitting the application. EPA will direct all communications related to scientific, technical, and budgetary aspects of the project to the Contact PI; however, any information regarding an application will be shared with any PI upon request.* The Contact PI is to be listed on the Key Contact Form as the Project Manager/Principal Investigator (the term Project Manager is used on the Grants.gov form, the term Principal Investigator is used on the form located at https://www.epa.gov/research-grants/research-funding-opportunities-how-apply-and-required-forms). For additional PIs, complete the Major Co-Investigator fields and identify PI status next to the name (e.g., "Name: John Smith, Principal Investigator").

3. EPA Form 4700-4, Preaward Compliance Review Report for All Applicants and Recipients Requesting EPA Financial Assistance (available at https://www.epa.gov/research-grants/research-funding-opportunities-how-apply-and-required-forms).

4. Table of Contents
Provide a list of the major subdivisions of the application indicating the page number on which each section begins.

5. Abstract (1 page)

The abstract is a very important document in the review process. Therefore, it is critical that the abstract accurately describes the research being proposed and conveys all the essential elements of the research. Also, the abstracts of applications that receive funding will be posted on EPA's Research Grants website.

The abstract must include the information described below (a-h). Examples of abstracts for current grants may be found on EPA's Research Grants website.

a. Funding Opportunity Title and Number for this application.

b. Project Title: Use the exact title of your project as it appears in the application. The title must be brief yet represent the major thrust of the project. Because the title will be used by those not familiar with the project, use more commonly understood terminology. Do not use general phrases such as "research on."

c. Investigators: For applications with multiple investigators, state whether this is a single Lead PI (with co-PIs) or Multiple PI application (see Section I.F.). For Lead PI applications, list the Lead PI, then the name(s) of each co-PI who will significantly contribute to the project. For Multiple PI applications, list the Contact PI, then the name(s) of each additional PI. Provide a website URL or an email contact address for additional information.

d. Institution(s): In the same order as the list of investigators, list the name, city and state of each participating university or other applicant institution. The institution applying for assistance must be clearly identified.

e. Project Period and Location: Show the proposed project beginning and ending dates and the performance site(s)/geographical location(s) where the work will be conducted.

f. Project Cost: Show the total funding requested from the EPA (include direct and indirect costs for all years) as well as the non-federal cost share. Indicate how you will meet the required match requirement.

g. Project Summary: Provide three subsections addressing: (1) the objectives of the study (including any hypotheses that will be tested), (2) the experimental approach to be used (a description of the proposed project) and (3) the expected results (outputs/outcomes) of the project and how it addresses the research needs identified in the solicitation, including the estimated improvement in risk assessment or risk management that will result from successful completion of the proposed work.

h. Supplemental Keywords: Without duplicating terms already used in the text of the abstract, list keywords to assist database searchers in finding your research. A list of suggested keywords may be found at: https://www.epa.gov/research-grants/research-funding-opportunities-how-apply-and-required-forms.

6. Research Plan, Quality Assurance Statement, Human Subjects Research Statement, Scientific Data Management Plan, Community Engagement Plan, and References

a. Research Plan (20 pages)

Applications should clearly identify throughout the research plan which research areas and topics of interest are being addressed to adequately and clearly demonstrate that they meet the RFA requirements. Explicitly state the main hypotheses that you will investigate, the data you will

create or use, the analytical tools you will use to investigate these hypotheses or analyze these data and the results you expect to achieve. Research methods must be clearly stated so that reviewers can evaluate the appropriateness of your approach and the tools you intend to use. A statement such as: "we will evaluate the data using the usual statistical methods" is not specific enough for peer reviewers.

This description must not exceed twenty (20) consecutively numbered (bottom center), 8.5x11-inch pages of single-spaced, standard 12-point type with 1-inch margins. While these guidelines on page size, point type and margins establish the minimum type size requirements, applicants are advised that readability is of paramount importance and should take precedence in selection of an appropriate font for use in the application.

The description must provide the following information:

(1) Objectives: List the objectives of the proposed research and the hypotheses being tested during the project, and briefly state why the intended research is important, how it supports the Agency's research priorities and how it fulfills the requirements of the solicitation. This section should also include any background or introductory information that would help explain the objectives of the study. If this application is to expand upon research supported by an existing or former assistance agreement awarded under an EPA program, indicate the number of the agreement and provide a brief report of progress and results achieved under it.

(2) Approach/Activities: Outline the research design, methods and techniques that you intend to use in meeting the objectives stated above.

(3) Environmental Justice: Demonstrate how the project will address the disproportionate and adverse human health, environmental, climate-related and other cumulative impacts, as well as the accompanying economic challenges of such impacts, resulting from industrial, governmental, commercial and/or other actions that have affected and/or currently affect the underserved communities defined in Section I.D. Applicants should also demonstrate how the project benefits the underserved communities including those that have experienced a lack of resources or other impediments to addressing the impacts identified above that affect their community.

(4) a. Innovation: Describe how your project shifts current research or engineering paradigms by using innovative theoretical concepts, approaches or methodologies, instrumentation or interventions applicable to one or more fields of research.

b. Sustainability: Describe how your project embodies the principles of sustainability and seeks sustainable solutions that protect the environment and strengthen our communities. The sustainability primer (https://www.epa.gov/sites/production/files/2015-05/documents/sustainability_primer_v9.pdf) provides examples of research activities that promote and incorporate sustainability principles.

(5) Expected Results, Benefits, Outputs and Outcomes: Describe the expected outputs and outcomes resulting from the project. This section should also discuss how the research results will lead to solutions to environmental problems and improve the public's ability to protect the environment and human health. A clear, concise description will help ORD and peer reviewers understand the merits of the research.

(6) Project Management: Discuss other information relevant to the potential success of the project. This should include facilities, personnel expertise/experience, project schedules with associated milestones and target dates, proposed management, interactions with other institutions, etc. Describe the approach, procedures and controls for ensuring that awarded grant funds will be expended in a timely and efficient manner and detail how project objectives will be successfully achieved within the grant period. Describe how progress toward achieving the expected results (outputs and outcomes) of the research will be tracked and measured. Applications for multi-investigator projects must identify project management and the functions of each investigator in each team and describe plans to communicate and share data.

(7) Appendices may be included but must remain within the 20-page limit.

b. Quality Assurance Statement (3 pages)
For projects involving environmental data collection or processing, conducting surveys, modeling, method development or the development of environmental technology (whether hardware-based or via new techniques), provide a Quality Assurance Statement (QAS) regarding the plans for processes that will be used to ensure that the products of the research satisfy the intended project objectives. Follow the guidelines provided below to ensure that the QAS describes a system that complies with American National Standard ASQ/ANSI E4:2014: Quality management systems for environmental information and technology programs—Requirements with guidance for use, approved February 4, 2014. Do not exceed three consecutively numbered, 8.5x11-inch pages of single-spaced, standard 12-point type with 1-inch margins.

NOTE: If selected for award, applicants will be expected to provide additional quality assurance documentation.

Address each applicable section below by including the required information, referencing the specific location of the information in the Research Plan or explaining why the section does not apply to the proposed research. (Not all will apply)

(1) Identify the individual who will be responsible for the quality assurance (QA) and quality control (QC) aspects of the research along with a brief description of this person's functions, experience and authority within the research organization. Describe the organization's general approach for conducting quality research. *(QA is a system of management activities to ensure that a process or item is of the type and quality needed for the project. QC is a system of activities that measures the attributes and performance of a process or item against the standards defined in the project documentation to verify that*

they meet those stated requirements).

(2) Discuss project objectives, including quality objectives, any hypotheses to be tested, and the quantitative and/or qualitative procedures that will be used to evaluate the success of the project. Include any plans for peer or other reviews of the study design or analytical methods.

(3) Address each of the following project elements as applicable:

(a) Collection of new/primary data:
*(**Note:** In this case the word "sample" is intended to mean any finite part of a statistical population whose properties are studied to gain information about the whole. If certain attributes listed below do not apply to the type of samples to be used in your research, simply explain why those attributes are not applicable).*

(i) Discuss the plan for sample collection and analysis. As applicable, include sample type(s), frequency, locations, sample sizes, sampling procedures and the criteria for determining acceptable data quality (e.g., precision, accuracy, representativeness, completeness, comparability or data quality objectives).

(ii) Describe the procedures for the handling and custody of samples including sample collection, identification, preservation, transportation and storage, and how the accuracy of test measurements will be verified.

(iii) Describe or reference each analytical method to be used, any QA or QC checks or procedures with the associated acceptance criteria and any procedures that will be used in the calibration and performance evaluation of the analytical instrumentation.

(iv) Discuss the procedures for overall data reduction, analysis and reporting. Include a description of all statistical methods to make inferences and conclusions, acceptable error rates and/or power, and any statistical software to be used.

(b) Use of existing/secondary data (i.e., data previously collected for other purposes or from other sources):

(i) Identify the types of secondary data needed to satisfy the project objectives. Specify requirements relating to the type of data, the age of data, geographical representation, temporal representation and technological representation, as applicable.

(ii) Specify the source(s) of the secondary data and discuss the rationale for selection.

(iii) Establish a plan to identify the sources of the secondary data in all deliverables/products.

(iv) Specify quality requirements and discuss the appropriateness for their intended use. Accuracy, precision, representativeness, completeness and comparability need to be addressed, if applicable.

(v) Describe the procedures for determining the quality of the secondary data.

(vi) Describe the plan for data management/integrity.

(c) Method development:

*(**Note:** The data collected for use in method development or evaluation should be described in the QAS as per the guidance in section 3A and/or 3B above).*

Describe the scope and application of the method, any tests (and measurements) to be conducted to support the method development, the type of instrumentation that will be used and any required instrument conditions (e.g., calibration frequency), planned QC checks and associated criteria (e.g., spikes, replicates, blanks) and tests to verify the method's performance.

(d) Development or refinement of models:

*(**Note:** The data collected for use in the development or refinement of models should be described in the QAS as per the guidance in section 3A and/or 3B above).*

(i) Discuss the scope and purpose of the model, key assumptions to be made during development/refinement, requirements for code development and how the model will be documented.

(ii) Discuss verification techniques to ensure the source code implements the model correctly.

(iii) Discuss validation techniques to determine that the model (assumptions and algorithms) captures the essential phenomena with adequate fidelity.

(iv) Discuss plans for long-term maintenance of the model and associated data.

(e) Development or operation of environmental technology:

*(**Note:** The data collected for use in the development or evaluation of the technology should be described in the QAS as per the guidance in section 3A and/or 3B above).*

(i) Describe the overall purpose and anticipated impact of the technology.

(ii) Describe the technical and quality specifications of each technology component or process that is to be designed, fabricated, constructed and/or operated.

(iii) Discuss the procedure to be used for documenting and controlling design changes.

(iv) Discuss the procedure to be used for documenting the acceptability of processes and components and discuss how the technology will be benchmarked and its effectiveness determined.

(v) Discuss the documentation requirements for operating instructions/guides for maintenance and use of the system(s) and/or process(s).

(f) Conducting surveys:
(Note: The data to be collected in the survey and any supporting data should be described in the QAS as per the guidance in section 3A and/or 3B above).

Discuss the justification for the size of the proposed sample for both the overall project and all subsamples for specific treatments or tests. Identify and explain the rational for the proposed statistical techniques (e.g., evaluation of statistical power).

(4) Discuss data management activities (e.g., record-keeping procedures, data-handling procedures and the approach used for data storage and retrieval on electronic media). Include any required computer hardware and software and address any specific performance requirements for the hardware/software configuration used.

c. EPA Human Subjects Research Statement (HSRS) (4 pages)

Human subjects research supported by the EPA is governed by EPA Regulation 40 CFR Part 26 (Protection of Human Subjects). This includes the Common Rule at subpart A and prohibitions and additional protections for pregnant women and fetuses, nursing women and children at subparts B, C and D. While retaining the same notation, subparts B, C and D are substantively different in 40 CFR Part 26 than in the more commonly cited 45 CFR 46. Particularly noteworthy is that research meeting the regulatory definition of intentional exposure research found in subpart B is prohibited by that subpart in pregnant women, nursing women and children. Research meeting the regulatory definition of observational research (any research that is not intentional exposure research) found in subparts C and D is subject to the additional protections found in those subparts for pregnant women and fetuses (subpart C) and children (subpart D). These subparts also differ markedly from the language in 45 CFR 46. For more information, please see: https://www.epa.gov/osa/basic-information-about-human-subjects-research-0.

Procedures for the review and oversight of human research subject to 40 CFR Part 26 are also provided in EPA Order 1000.17A (https://www.epa.gov/osa/epa-order-100017-policy-and-procedures-protection-human-research-subjects-epa-conducted-or). These include review of projects for EPA-supported human research by the EPA Human Subjects Research Review Official (HSRRO). Additional requirements must be met and final approval must be received from the HSRRO before the human subjects' portion of the research can begin. When reviewing human observational exposure studies, EPA Order 1000.17A requires the HSRRO to apply the principles described in the SEAOES document

(https://nepis.epa.gov/Exe/ZyPDF.cgi/P10012LY.PDF?Dockey=P10012LY.PDF) and grant approval only to studies that adhere to those principles.

All applications submitted under this solicitation must include a HSRS as described below. For more information about what constitutes human subjects research, please see: https://www.epa.gov/osa/basic-information-about-human-subjects-research-0. For information on the prohibition on the inclusion of vulnerable subjects in intentional exposure research, please see: https://www.epa.gov/osa/basic-information-about-human-subjects-research-0.

Human Subjects Research Statement (HSRS) Requirements
If the proposed research **does not** involve human subjects as defined above, provide the following statement in your application package as your HSRS: "The proposed research does not involve human subjects." Applicants should provide a clear justification about how the proposed research does not meet the definition (for example, all samples come from deceased individuals OR samples are purchased from a commercial source and provided without identifiers, etc.).

If the proposed research **does** involve human subjects, then include in your application package a HSRS that addresses each applicable section listed below, referencing the specific location of the information in the Research Plan, providing the information in the HSRS or explaining why the section does not apply to the proposed research. (Not all will apply). Please note that even research that has been determined to be exempt from the human subjects regulations by an IRB must be reviewed by the EPA HSRRO. Therefore, consider exempt research to include human subjects work for this EPA solicitation. Do not exceed **four** consecutively numbered, 8.5x11-inch pages of single-spaced, standard 12-point type with 1-inch margins. The factors below are not intended to be exhaustive of all those needed for the HSRRO to provide the final approval necessary for research to be conducted but provide a basis upon which the human subjects oversight review may begin.

NOTE: Researchers must provide evidence of an assurance on file with the U.S. Department of Health and Human Services (HHS) or other Federal Agency that it will comply with regulatory provisions in the Common Rule. In special circumstances where there is no such assurance, EPA will work with investigators to obtain an assurance from HHS or another source.

Complete all items below for studies involving human subjects.
Protection of Human Subjects (*Adapted from National Institutes of Health Supplemental Instructions for PHS 398 and SF424 (R&R) II-10)
1. Risks to Human Subjects
    a. Human Subjects Involvement, Characteristics and Design
        • Describe and justify the proposed involvement of human subjects in the work outlined in the Research Strategy section.
        • Describe the characteristics of the subject population, including their anticipated number, age range and health status, if relevant.
        • Describe and justify the sampling plan, including retention strategies and the criteria for inclusion or exclusion of any subpopulation.

• Explain the rationale for the involvement of special vulnerable populations, such as pregnant women, children or others who may be considered vulnerable populations.
• If relevant to the proposed research, describe procedures for assignment to a study group. As related to human subject's protection, describe and justify the selection of an intervention's dose, frequency and administration.
• List any collaborating sites where human subjects research will be performed and describe the role of those sites and collaborating investigators in performing the proposed research. Explain how data from the site(s) will be obtained, managed and protected.

b. Sources of Materials

• Describe the research material obtained from living individuals in the form of specimens, records or data.
• Describe any data that will be collected from human subjects for the project(s) described in the application.
• Indicate who will have access to individually identifiable private information about human subjects.
• Provide information about how the specimens, records and/or data are collected, managed and protected as well as whether material or data that include individually identifiable private information will be collected specifically for the proposed research project.

c. Potential Risks

• Describe all the potential risks to subjects posed by participation in the research (physical, psychological, financial, legal or other), and assess their likelihood and seriousness to the human subjects.
• Where appropriate, describe alternative treatments and procedures, including the risks and potential benefits of the alternative treatments and procedures, to participants in the proposed research.

2. Adequacy of Protection Against Risks

a. Recruitment and Informed Consent

• Describe plans for the recruitment of subjects (where appropriate) and the process for obtaining informed consent. If the proposed studies will include children, describe the process for meeting requirements for parental permission and child assent.
• Include a description of the circumstances under which consent will be sought and obtained, who will seek it, the nature of the information to be provided to prospective subjects and the method of documenting consent. If a waiver of some or all of the elements of informed consent will be sought, provide justification for the waiver.

b. Protections Against Risk

• Describe planned procedures for protecting against or minimizing potential risks, including risks to privacy of individuals or confidentiality of data and assess their likely effectiveness.
• Research involving vulnerable populations, as described in the EPA regulations, Subparts B-D, must include additional protections. Refer to EPA guidance:

- Prohibition of Research Conducted or Supported by EPA Involving Intentional Exposure of Human Subjects who are Children or Pregnant or Nursing Women
  https://www.epa.gov/osa/basic-information-about-human-subjects-research-0

- Additional Protections for Pregnant Women and Fetuses Involved as Subjects in Observational Research Conducted or Supported by EPA

  https://www.epa.gov/osa/basic-information-about-human-subjects-research-0

- Additional Protections for Children Involved as Subjects in Observational Research Conducted or Supported by EPA

  https://www.epa.gov/osa/basic-information-about-human-subjects-research-0

• Where appropriate, discuss plans for ensuring necessary medical or professional intervention in the event of adverse effects to the subjects. Studies that involve clinical trials must include a general description of the plan for data and safety monitoring of the clinical trials and adverse event reporting to the IRB, the DSMB (if one has been established for the trial), the EPA and others, as appropriate, to ensure the safety of subjects.

3. Potential Benefits of the Proposed Research to Human Subjects and Others
   • Discuss the potential benefits of the research to research participants and others.
   • Discuss why the risks to subjects are reasonable in relation to the anticipated benefits to research participants and others.
   • Please note that financial compensation of subjects is not considered to be a benefit of participation in research.
4. Importance of the Knowledge to be Gained
   • Discuss the importance of the knowledge to be gained as a result of the proposed research.
   • Discuss why the risks to subjects are reasonable in relation to the importance of the knowledge that reasonably may be expected to result.

Note that an Interventional Study (or Clinical Trial) is a clinical study in which participants are assigned to receive one or more interventions (or no intervention) so that researchers can evaluate the effects of the interventions on biomedical or health-related outcomes; the assignments are determined by the study protocol.

d. Scientific Data Management Plan (2 pages)

Applications submitted in response to this solicitation must include a Scientific Data Management Plan (SDMP) that addresses public access to EPA-funded scientific research data by including the information below:

(1) If the proposed research described in the application is expected to result in the generation of scientific research data, the application must include a Scientific Data Management Plan (SDMP) of up to two single-spaced pages (this is in addition to any application page limits described in Section IV of this solicitation that apply to other parts of the application package) describing plans for providing long-term preservation of, and public access to, the scientific research data and accompanying metadata created and/or collected under the award (including data generated under subawards and contracts) funded in whole or in part by EPA. The SDMP should indicate that recipients will make accessible, at a minimum, scientific research data and associated metadata underlying their scientific research journal publications funded in whole or in part by EPA. SDMPs should reflect relevant standards and community best practices for data and metadata and make use of community-accepted repositories whenever practicable. The contents of the SDMP (or absence thereof) will be considered as part of the application review process for selected applicants as described in Section V and must be deemed acceptable for the applicant to receive an award. The SDMP should include the following elements (Note: If any of the items listed below do not apply, please explain why):

i. Types of scientific research data and metadata expected to be generated and/or collected under the award.
ii. The location where the data will be publicly accessible.
iii. The standards to be used for data/metadata format and content.
iv. Policies for accessing and sharing data including provisions for appropriate protection of privacy, security, intellectual property, and other rights or requirements consistent with applicable laws, regulations, rules, and policies.
v. Plans for digital data storage, archiving, and long-term preservation that address the relative value of long-term preservation and access along with the associated costs and administrative burden.
vi. Description of how data accessibility and preservation will enable validation of published results or how such results could be validated if data are not shared or preserved.
vii. Roles and responsibilities for ensuring SDMP implementation and management (including contingency plans in case key personnel leave the project).
viii. Resources and capabilities (equipment, connections, systems, software, expertise, etc.) requested in the research application that are needed to meet the stated goals for accessibility and preservation (reference can be made to the relevant section of the research application's budget justification).
ix. If appropriate, an explanation as to why data accessibility and/or preservation are not possible.

(2) If the proposed research is not expected to result in the generation of scientific research data, provide the following statement (not subject to any application page limits described in Section IV of this solicitation) in your application as the SDMP: "The proposed research is not expected to result in the generation of scientific research data." If scientific research data are generated after award, the recipient agrees to update the statement by providing EPA with a revised SDMP (see content of SDMP described above) describing how scientific research data and

accompanying metadata created and/or collected under the award (including data generated under subawards and contracts) will be preserved and, as appropriate, made publicly accessible.

e. Community Engagement Plan (5 pages, not including letters of intent/support)

Provide a plan to detail strategies for promoting and/or obtaining collaboration/engagement and support from appropriate partners such as MSIs, states, tribes, academia, industry groups, non-profit organizations, associations, and local communities/community-based organizations. Applicants should document the following:

- Describe the type of collaboration/engagement proposed and what role it will play in the overall project including the degree of partner and/or community input or engagement in the conceptualization, hypothesis/question development, design, methods, analyses and implementation of the research. This includes describing how the project addresses engagement with underserved communities, especially local residents in these communities who will be affected by the project, to ensure their meaningful participation with respect to the design, project planning, and performance of the project.
- Describe how the collaboration/engagement will enhance the overall impact of the project such that the project results are applicable and useable by state/local agencies, utilities, and impacted communities. This includes the capacity of the project to more effectively communicate risk and translate scientific results into easily understandable outreach and education materials.
- Describe how activities of the project will be coordinated with related or complementary projects and studies.
- Describe how substantive and cohesive collaboration between researchers tackling different disciplinary activities detailed within the two research areas and all five topics of interest (A-E) described in Section I.D will be accomplished.
- Describe how the collaboration/engagement will materialize during project performance. Describe the partner(s)' intent to participate in the proposed research including evidence of support of an active partnership with MSIs, states, tribes, academia, industry groups, non-profit organizations, associations, and/or local communities/community-based organizations (e.g., letter(s) of intent or support from MSIs, community-based organizations, community leaders, state or local government agencies, non-government organizations, industry, water utility managers, site managers or operators). Any letters demonstrating evidence of collaboration and support should be included as part of section IV.C.10.a. Letters of Intent/Letters of Support.
- Applicants that do not plan on collaborating/engaging with other groups in project performance should describe how they will be able to effectively perform and complete the project without such collaboration/engagement.
- Allocate appropriate resources as needed to the research partners to ensure success of the collaboration, e.g., delineating funds under the project's budget for community participation. Examples include:
    - i. travel/stipends for partners and community members to participate in advisory group meetings, workshops, and focus groups,

ii. subawards to eligible organizations for their involvement in the proposed research.

EPA requires that estimated amounts for subawards and individual participant support costs be classified as "Other" for the purposes of the budget table (aka SF-424A). Please see (EPA Solicitation Clauses) for EPA guidance on competition for contractors (including consulting contracts) and acceptable noncompetitive subawards. Applicants may provide subawards to partners to enhance project effectiveness and/or efficiency. Note that applicants, not EPA, will select their subawardees and the applicants must demonstrate in their application that the organization(s) or other groups are willing to accept the subaward and have the capacity to effectively administer and perform the agreement. The selected applicant who proposes to make subawards, including those to partners must follow proper procedures in making subawards and will be expected to make the subawards consistent with their application.

f. References: References cited are in addition to other page limits (e.g., research plan, quality assurance statement).

7. Budget and Budget Justification

a. Budget

Prepare a master budget table using "SF-424A Budget Information for Non-Construction Programs" (aka SF-424A), available in the Grants.gov electronic application package and also at https://www.epa.gov/research-grants/research-funding-opportunities-how-apply-and-required-forms. Provide the federal funds being requested and non-federal cost share being contributed in "Section A-Budget Summary" under the "New or Revised Budget" heading. In "Section B-Budget Categories", provide the object class budget category (a. - k.) amounts for each budget year under the "Grant Program, Function or Activity" heading. Each column reflects a separate budget year. For example, Column (1) reflects budget year 1. The total budget will be automatically tabulated in column (5).

Please note that a minimum 25% non-federal cost-share/match of the federal funds awarded is required. Cost shared amounts must be listed in the SF-424A and described in the budget justification.

Applicants may not use subagreements to transfer or delegate their responsibility for successful completion of their EPA assistance agreement. Please refer to https://www2.epa.gov/grants/epa-solicitation-clauses#Contracts and Subawards if your organization intends to identify specific contractors, including consultants, or subrecipients in your application.

b. Budget Justification *[3 pages in addition to the Section IV.C.6 page limitations]*

Identify the amount requested for each budget category and describe the basis for calculating the personnel, fringe benefits, travel, equipment, supplies, contractual support and other costs identified in the SF-424A. **Cost shared amounts must be described in the budget justification**

under each applicable category. The budget justification should not exceed three consecutively numbered (bottom center), 8.5x11-inch pages of single-spaced, standard 12-point type with 1-inch margins. EPA provides detailed guidance on preparing budgets and budget justifications in the Agency's Interim General Budget Development Guidance for Applicants and Recipients of EPA Financial Assistance.

Budget information must be supported at the level of detail described below:

(1) Personnel: List all staff positions by title. Give annual salary, percentage of time assigned to the project, total cost for the budget period, project role and specify any annual cost of living adjustments. Compensation paid for employees engaged in grant activities must be consistent with payments for similar work within the applicant organization. Note that for salaries to be allowable as a direct charge to the award, a justification of how that person will be directly involved in the project must be provided. General administrative duties such as answering telephones, filing, typing or accounting duties are not considered acceptable.

Below is a sample computation for Personnel:

Position/Title	**Annual Salary**	**% of Time Assigned to Project**	**Year 1**	**Year 2***	**Year 3***	**Total**
Project Manager	$70,000	50%	$35,000	$36,050	$37,132	$108,182
Env. Specialist	$60,000	100%	$60,000	$61,800	$63,654	$185,454
Env. Health Tech (cost share)	$45,000	100%	$45,000	$46,350	$47,741	$139,091
Total Personnel Request			**$95,000**	**$97,850**	**$100,786**	**$293,636**
Total Personnel Cost Share			**$45,000**	**$46,350**	**$47,741**	**$139,091**
Total Personnel (EPA + Cost Share)			**$140,000**	**$144,200**	**$148,527**	**$432,727**

***There is a 3% increase after Year 1 for all personnel for cost of living adjustments**

Note this budget category is limited to persons employed by the applicant organization ONLY. Those employed elsewhere are classified as subawardees, program participants, contractors or consultants. Contractors and consultants should be listed under the "Contractual" budget heading. Subawards made to eligible subrecipients are listed under the "Other" budget heading. Participant support costs such as stipends or travel assistance for trainees (e.g. interns or fellows) are listed under the "Other" budget heading.

(2) Fringe Benefits: Identify the percentage used and the basis for its computation. Fringe benefits are for the personnel listed in budget category (1) above and only for the percentage of time devoted to the project. Fringe benefits include but are not limited to the cost of leave, employee insurance, pensions and unemployment benefit plans. The

applicant should not combine the fringe benefit costs with direct salaries and wages in the personnel category.

Below is a sample computation for Fringe Benefits:

Position/Title	Base Fringe % Rate	Costs			Total
		Year 1	*Year 2*	*Year 3*	
Project Manager	47.22%	$16,527	$17,022	$17,533	$51,082
Env. Specialist	50.83%	$30,498	$31,413	$32,355	$94,266
Project Manager (cost share)	49.16%	$22,122	$22,786	$23,469	$68,377
Total Fringe Benefits Request					$145,348
Total Fringe Benefits Cost-share					$68,377
Total Fringe (EPA + Cost Share)					$213,725
*An annual inflation rate of 3% has been factored into years 2 and 3 of the fringe benefits.					

(3) Travel: In a table format, specify the estimated number of trips, purpose of each trip, number of travelers per trip, destinations and other costs for each type of travel for applicant employees. Travel costs for program participants should be specified in the "Other" budget category. Explain the need for any travel, paying particular attention to travel outside the United States. Foreign travel includes trips to Mexico and Canada but does not include trips to Puerto Rico, the U.S. territories or possessions. **If EPA funds will not be used for foreign travel, the budget justification must expressly state that the applicant will not use EPA funds for foreign travel without approval by EPA.** Include travel funds for annual progress reviews (estimate for two days in Washington, D.C.) and a final workshop to report on results.

Below is a sample computation for Travel:

Purpose of Travel	**Location**	**Item**	**Computation**	**Cost**
EPA Progress Review	Washington DC	Lodging	4 people x $100 per night x 2 nights	$800
		Airfare	4 people x $500 round trip	$2,000
		Per Diem	4 people x 50 per day x 2 days	$400
Total Travel				**$3,200**

(4) Equipment: Identify all tangible, non-expendable personal property to be purchased that has an acquisition cost of $5,000 or more per unit and a useful life of more than one year. Equipment also includes accessories and services included with the purchase price necessary for the equipment to be operational. It does not include: (1) equipment planned

to be leased/rented; or (2) separate equipment service or maintenance contracts. Details such as the type of equipment, cost and a brief narrative on the intended use of the equipment for project objectives are required. Each item of equipment must be identified with the corresponding cost. Particular brands of equipment should not be identified. General-purpose equipment (office equipment, etc.) must be justified as to how it will be used on the project. (Property items with a unit cost of less than $5,000 are considered supplies).

(5) Supplies: "Supplies" are tangible property other than "equipment" with a per item acquisition cost of less than $5,000. Include a brief description of the supplies required to perform the work. Costs should be categorized by major supply categories (e.g. office supplies, computing devices, monitoring equipment) and include the estimated costs by category.

(6) Contractual: List the proposed contractual activities along with a brief description of the scope of work or services to be provided, the proposed duration of the contract/procurement, the estimated cost and the proposed procurement method (competitive or non-competitive). **Any procurement of services from individual consultants or commercial firms (including space for workshops) must comply with the competitive procurement requirements of 2 CFR Part 200.317-200.326. Please see https://www2.epa.gov/grants/epa-solicitation-clauses#Contracts and Subawards for more details.** EPA provides detailed guidance on procurement requirements in the Agency's Best Practice Guide for Procuring Services, Supplies, and Equipment Under EPA Assistance Agreements.

Examples of Contractual costs include:

i. Consultants – Consultants are individuals with specialized skills who are paid at a daily or hourly rate. EPA's participation in the salary rate (excluding overhead) paid to individual consultants retained by recipients or by a recipient's contractors or subcontractors is limited to the maximum daily rate for a Level IV of the Executive Schedule (formerly GS-18), to be adjusted annually.

ii. Speaker/Trainer Fees – Information on speakers should include the fee and a description of the services they are providing.

(7) Other: List each item in sufficient detail for the EPA to determine the reasonableness of its cost relative to the research to be undertaken. "Other" items may include equipment rental, telephone service and utilities and photocopying costs. Note that subawards, such as those with other universities or nonprofit research institutions for members of the research team, are included in this category. **Provide the total costs proposed for subawards as a separate line item in the budget justification and brief description of the activities to be supported for each subaward or types of subawards if the subrecipients have not been identified.** Subawards may not be used to acquire services from consultants or commercial firms. Please see https://www2.epa.gov/grants/epa-solicitation-clauses#Contracts and Subawards for more details. The "Other" budget category also includes participant support costs such as stipends or travel assistance for

trainees (e.g. interns or fellows). **Provide the total costs proposed for participant support costs as a separate line item in the budget justification and brief description of the costs. If EPA funds will not be used for foreign travel by program participants, the budget justification must expressly state that the applicant will not use EPA funds for foreign travel without approval by EPA.**

Below is a sample computation for Other:

Item	Description	Cost			Total
		Year 1	Year 2	Year 3	
Publication costs	The costs incurred will be for dissemination of results in peer reviewed journal publications.	$0	$3,000	$3,000	$6,000
Tuition Cost-share	Graduate students (2)	$15,000	$15,000	$15,000	$45,000
Subaward to X University	To conduct all work related to evaluation of experimental mouse models	$100,000	$100,000	$100,000	$300,000
Subaward to Y University – cost share	To conduct fish models	$20,000	$20,000	$20,000	$60,000
Other: Participant Support Costs	Participant Incentives (100 x $25)				$2,500
Other: Participant Support Cost-Share	Participant Incentives (100 x $25)				$2,500
Total Publication Request					$6,000
Total Tuition– Cost Share					$45,000
Total Subaward Request					$300,000
Total Subaward– Cost Share					$60,000
Total Participant Support Request					$2,500
Total Participant Support– Cost Share					$2,500
Total Other Request					$308,500
Total Other – Cost Share					$107,500
Total Other (EPA + Cost Share)					$416,000

(8) Indirect Costs: For additional information pertaining to indirect costs, please see the IDC Competition Clause at Additional Provisions for Applicants Incorporated into the Solicitation.

8. Resumes

Provide resumes for each investigator and important co-worker. You may include resumes from staff of subawardees such as universities. Do not include resumes of consultants or other contractors. The resume is not limited to traditional materials but should provide materials to clearly and appropriately demonstrate that the investigator has the knowledge needed to perform their component of the proposed research. The resume for each individual must not exceed two consecutively numbered (bottom center), 8.5x11-inch pages of single-spaced, standard 12-point type with 1-inch margins.

Alternative to a standard resume, you may use a profile such as an NIH BioSketch that can be generated in SciENcv (see https://grants.nih.gov/grants/forms/biosketch.htm for information on the BioSketch; also see https://www.nlm.nih.gov/pubs/techbull/so13/so13_sciencv.html for information on SciENcv). These materials should generally conform to the requirements for a resume (e.g., content and page number).

9. Current and Pending Support

Complete a current and pending support form (provided at https://www.epa.gov/research-grants/research-funding-opportunities-how-apply-and-required-forms) for each investigator and important co-worker. Do not include current and pending support for consultants or other contractors. Include all current and pending research regardless of source.

Note to all prospective applicants requiring multiple Current and Pending Support Form pages: Due to a limitation in Adobe Acrobat's forms functionality, additional pages cannot be directly inserted into the original PDF form and preserve the form data on the subsequent pages. Multiple page form submissions can be created in Acrobat 8 and later using the "PDF Package" option in the "Create PDF from Multiple Files" function. If you have an earlier version of Adobe Standard or Professional, applicants will need to convert each PDF page of the form to an EPS (Encapsulated Post Script) file before creating the PDF for submission. The following steps will allow applicants with earlier versions of Adobe Standard or Professional to create a PDF package:

1. Populate the first page of the PDF and save it as an EPS (Encapsulated Post Script) file.
2. Reopen the form and populate it with the data for page 2. Save this page as a different EPS file. Repeat for as many pages as necessary.
3. Use Acrobat Distiller to convert the EPS files back to PDF.
4. Open Acrobat Professional and combine the individual pages into a combined PDF file.

10. Guidelines, Limitations, and Additional Requirements

a. Letters of Intent/Letters of Support

Letters of intent to provide resources for the proposed research or to document intended interactions are limited to one brief paragraph committing the availability of a resource (e.g., use of a person's time or equipment) or intended interaction (e.g., sharing of data, as-needed consultation) that is described in the Research Plan. Letters of intent are to be included as an addition to the budget justification documents. EPA employees are not permitted to provide letters of intent for any application.

Letters of support do not commit a resource vital to the success of the application. A letter of support is written by businesses, organizations or community members stating their support of the applicant's proposed project. EPA employees are not permitted to provide letters of support for any application.

Note: Letters of intent or support must be part of the application; letters submitted separately will not be accepted. Any letter of intent or support that exceeds one brief paragraph (excluding letterhead and salutations), is considered part of the Research Plan and is included in the 20-page Research Plan limit. Any transactions between the successful applicant and parties providing letters of intent or support financed with EPA grant funds are subject to the contract and subaward requirements described here https://www2.epa.gov/grants/epa-solicitation-clauses#Contracts and Subawards.

b. Funding Opportunity Number(s) (FON)
At various places in the application, applicants are asked to identify the FON.

The Funding Opportunity Number for this RFA is:
EPA-G2021-ORD-E1, NATIONAL PRIORITIES: WATER INNOVATION, SCIENCE, AND ENGAGEMENT TO ADVANCE WATER REUSE

c. Confidentiality

By submitting an application in response to this solicitation, the applicant grants the EPA permission to make limited disclosures of the application to technical reviewers both within and outside the Agency for the express purpose of assisting the Agency with evaluating the application. Information from a pending or unsuccessful application will be kept confidential to the fullest extent allowed under law; information from a successful application may be publicly disclosed to the extent permitted by law.

D. Submission Dates and Times

Applications **must be transferred to Grants.gov no later than 11:59:59 pm Eastern Time** on the solicitation closing date. Applications transferred after the closing date and time will be

returned to the sender without further consideration. EPA will not accept any changes to applications after the closing date.

It should be noted that this schedule may be changed without prior notification because of factors not anticipated at the time of announcement. In the case of a change in the solicitation closing date, a new date will be posted on EPA's Research Grants website (https://www.epa.gov/research-grants) and a modification posted on Grants.gov.

Solicitation Closing Date: **September 29, 2021, 11:59:59** pm Eastern Time (applications ***must*** be submitted to Grants.gov by this time, see Section IV.F "Submission Instructions and Other Submission Requirements" for further information).

NOTE: Customarily, applicants are notified about evaluation decisions within six months of the solicitation closing date. Awards are generally made 9-12 months after the solicitation closing date.

E. Funding Restrictions

The funding mechanism for all awards issued under ORD solicitations will consist of assistance agreements from the EPA. All award decisions are subject to the availability of funds. In accordance with the Federal Grant and Cooperative Agreement Act, 31 U.S.C. 6301 et seq., the primary purpose of an assistance agreement is to accomplish a public purpose of support or stimulation authorized by federal statute, rather than acquisition for the direct benefit or use of the Agency. The EPA will monitor research progress through annual reports provided by grantees and other contacts, including site visits (as needed), with the Principal Investigator(s).

EPA award recipients may incur allowable project costs 90 calendar days before the Federal awarding agency makes the Federal award. Expenses more than 90 calendar days pre-award require prior approval of EPA. All costs incurred before EPA makes the award are at the recipient's risk. EPA is under no obligation to reimburse such costs if for any reason the recipient does not receive a Federal award or if the Federal award is less than anticipated and inadequate to cover such costs.

If you wish to submit applications for more than one EPA funding opportunity you must ensure that the research proposed in each application is significantly different from any other that has been submitted to the EPA or from any other financial assistance you are currently receiving from the EPA or other federal government agency.

Collaborative applications involving more than one institution must be submitted as a single administrative package from one of the institutions involved.

Each proposed project must be able to be completed within the project period and with the initial award of funds. Applicants should request the entire amount of money needed to complete the project. Recipients should not anticipate additional funding beyond the initial award of funds for a specific project.

F. Submission Instructions and Other Submission Requirements

Please read this entire section before attempting an electronic submission through Grants.gov.

If you do not have the appropriate internet access to utilize the Grants.gov application submission process for this solicitation, see Section IV.A above for additional guidance and instructions.

Note: Grants.gov submission instructions are updated on an as-needed basis. Please provide your Authorized Organizational Representative (AOR) with a copy of the following instructions to avoid submission delays that may occur from the use of outdated instructions.

1. Preparing for Submission: The electronic submission of your application must be made by an official representative of your institution who is registered with Grants.gov and is authorized to sign applications for Federal assistance. For more information on the registration requirements that must be completed in order to submit an application through Grants.gov, go to https://www.grants.gov/ and click on "Register" at the top right corner of the page. If your organization is not currently registered with Grants.gov, please encourage your office to designate an Authorized Organization Representative (AOR) and ask that individual to begin the registration process as soon as possible. Please note that the registration process also requires that your organization have a DUNS number and a current registration with the System for Award Management (SAM) and the process of obtaining both could take a month or more. Applicants must ensure that all registration requirements are met in order to apply for this opportunity through Grants.gov and should ensure that all such requirements have been met well in advance of the submission deadline. Registration on Grants.gov, SAM.gov and DUNS number assignment is FREE. Please see RAIN-2021-G01 for information about EPA's implementation of the upcoming Government-wide transition from DUNS to Unique Entity Identifier (UEI).

Applicants need to ensure that the AOR who submits the application through Grants.gov and whose DUNS number is listed on the application is an AOR for the applicant listed on the application. Additionally, the DUNS number listed on the application must be registered to the applicant organization's SAM account. If not, the application may be deemed ineligible.

To begin the application process under this grant announcement, go to https://www.grants.gov/ and click on "Applicants" on the top of the page and then "How to Apply for Grants" from the drop-down menu and then follow the instructions accordingly. Please note: To apply through Grants.gov, you must use Adobe Reader software and download the compatible Adobe Reader version. For more information about Adobe Reader, to verify compatibility, or to download the free software, please visit https://www.grants.gov/web/grants/applicants/adobe-software-compatibility.html.

You may also be able to access the application package for this announcement by searching for the opportunity on https://www.grants.gov/. Go to https://www.grants.gov/ and click "Search Grants" at the top of the page and enter the Funding Opportunity Number, EPA-G2021-ORD-

E1, or the CFDA number that applies to the announcement (66.511), in the appropriate field under "Basic Search Criteria" and click the Search button.

Note: All applications must now be submitted through Grants.gov using the "Workspace" feature. Information on the Workspace feature can be found at the Grants.gov Workspace Overview Page.

2. Acknowledgement of Receipt: The complete application must be transferred to Grants.gov no later than 11:59:59 pm Eastern Time on the solicitation closing date (see "Submission Dates and Times"). Applications submitted through Grants.gov will be time and date stamped electronically. Grants.gov provides an on-screen notification of successful initial transfer as well as an email notification of successful transfer from Grants.gov to EPA. While it is advisable to retain copies of these Grants.gov acknowledgements to document submission, *the only official documentation that the application has been received by ORD is the email acknowledgement sent by ORD to the Lead/Contact PI and the Administrative Contact.* This email will be sent from receipt.application@epa.gov; emails to this address will not be accepted. ***If an email acknowledgment from*** receipt.application@epa.gov ***has not been received within 10 calendar days of the solicitation closing date, immediately inform the Electronic Submissions Contact shown in this solicitation. Failure to do so may result in your application not being reviewed.***

3. Application Package Preparation: Your organization's AOR must submit your complete application package electronically to EPA through Grants.gov (https://www.grants.gov/) no later than **September 29, 2021,** 11:59:59 pm Eastern Time. Please allow for enough time to successfully submit your application and allow for unexpected errors that may require you to resubmit.

Please submit all of the application materials described below using the Grants.gov application package accessed using the instructions above.

The application package consists of the following mandatory documents.

(a) Application for Federal Assistance (SF 424): Complete the form except for the "competition ID" field.

(b) EPA Key Contacts Form 5700-54: Complete the form. If additional pages are needed, see (e) below.

(c) EPA Form 4700-4, Preaward Compliance Review Report for All Applicants and Recipients Requesting EPA Financial Assistance: Complete the form.

(d) SF-424A, Budget Information for Non-Construction Programs: Provide the federal funds being requested and non-federal cost share being contributed in "Section A-Budget Summary" under the "New or Revised Budget" heading. In "Section B-Budget Categories," provide the object class budget category (a. - k.) amounts for each budget

year under the "Grant Program, Function or Activity" heading. Each column reflects a separate budget year.
(e) Project Narrative Attachment Form (click on "Add Mandatory Project Narrative"): Attach a single electronic PDF file labeled "Application" that contains the items described in Section IV.C.4. through IV.C.10.a [Table of Contents, Abstract, Research Plan, Quality Assurance Statement, Human Subjects Research Statement, Scientific Data Management Plan, Community Engagement Plan, References, Budget Justification, Resumes, Current and Pending Support, and Letters of Intent/Support] of this solicitation. *In order to maintain format integrity, this file must be submitted in Adobe Acrobat PDF.* Please review the PDF file for conversion errors prior to including it in the electronic application package; requests to rectify conversion errors will not be accepted if made after the solicitation closing date and time. If Key Contacts Continuation pages (see https://www.epa.gov/research-grants/research-funding-opportunities-how-apply-and-required-forms) are needed, place them before the EPA Form 4700-4, Preaward Compliance Review Report for All Applicants and
Recipients Requesting EPA Financial Assistance (Section IV.C.3.).

Once the application package has been completed, the "Submit" button should be enabled. If the "Submit" button is not active, please call Grants.gov for assistance at 1-800-518-4726. Applicants who are outside the U.S. at the time of submittal and are not able to access the toll-free number may reach a Grants.gov representative by calling 606-545-5035. Investigators should save the completed application package with two different file names before providing it to the AOR to avoid having to re-create the package should submission problems happen, or a revised application needs to be submitted. Note: Revised applications must be submitted before the solicitation closing date and time.

4. Submitting the application: The application package must be transferred to Grants.gov by an AOR. The AOR should close all other software before attempting to submit the application package. Click the "submit" button of the application package. Your Internet browser will launch and a sign-in page will appear. ***Note: Minor problems are not uncommon with transfers to Grants.gov. It is essential to allow sufficient time to ensure that your application is submitted to Grants.gov BEFORE 11:59:59 pm Eastern Time on the solicitation closing date.*** The Grants.gov support desk operates 24 hours a day, seven days a week, except Federal Holidays.

A successful transfer will end with an on-screen acknowledgement. For documentation purposes, print or screen capture this acknowledgement. If a submission problem occurs, reboot the computer – turning the power off may be necessary – and re-attempt the submission.

Note: Grants.gov issues a "case number" upon a request for assistance.

5. Transmission Difficulties: If transmission difficulties that result in a late transmission, no transmission or rejection of the transmitted application are experienced and following the above instructions do not resolve the problem so that the application is submitted to Grants.gov by the deadline date and time, follow the guidance below. The Agency will make a decision concerning each late submission on a case-by-case basis as to whether it should be forwarded for peer

review. All emails, as described below, are to be sent to jones.debram@epa.gov with the FON in the subject line.

Be aware that EPA will only consider accepting applications that were unable to transmit due to Grants.gov or relevant www.Sam.gov system issues or for unforeseen exigent circumstances, such as extreme weather interfering with internet access. Failure of an applicant to submit timely because they did not properly or timely register in SAM.gov or Grants.gov is not an acceptable reason to justify acceptance of a late submittal.

Please note that if the application you are submitting is greater than 70 MB in size, please call or send an email message to the Electronic Submissions Contact listed for this RFA. The Agency may experience technical difficulty downloading files of this size from Grants.gov. Therefore, it is important that the Agency verify that the file can be downloaded. The Agency will provide alternate submission instructions if the file cannot be downloaded.

(a) If you are experiencing problems resulting in an inability to upload the application to Grants.gov, it is essential to call Grants.gov for assistance at 1-800-518-4726 before the application deadline. Applicants who are outside the U.S. at the time of submittal and are not able to access the toll-free number may reach a Grants.gov representative by calling 606-545-5035. Be *sure* to obtain a case number from Grants.gov. If the problems stem from unforeseen exigent circumstances unrelated to Grants.gov, such as extreme weather interfering with internet access, contact Debra M. Jones (jones.debram@epa.gov).

(b) Unsuccessful transfer of the application package: If a successful transfer of the application cannot be accomplished even with assistance from Grants.gov due to electronic submission issues or unforeseen exigent circumstances, send an email message to Debra M. Jones (jones.debram@epa.gov) by 11:59:59 pm Eastern Time on the solicitation closing date. The email message must document the problem and include the Grants.gov case number as well as the entire application in PDF format as an attachment.

(c) Grants.gov rejection of the application package: If a notification is received from Grants.gov stating that the application has been rejected for reasons other than late submittal, promptly send an email to Debra M. Jones (jones.debram@epa.gov) with the FON in the subject line within one business day of the closing date of this solicitation. The email should include any materials provided by Grants.gov and attach the entire application in PDF format.

Please note that successful submission through Grants.gov or via email does not necessarily mean your application is eligible for award.

V. APPLICATION REVIEW INFORMATION

A. Peer Review

All eligible grant applications are reviewed by appropriate external technical peer reviewers based on the criteria and process described below. This review is designed to evaluate each application according to its scientific merit. The individual external peer reviewers include non-EPA scientists, engineers, social scientists and/or economists who are accomplished in their respective disciplines and proficient in the technical subjects they are reviewing.

Prior to the external technical peer review panel meeting, all reviewers will receive access to electronic copies of all applications. Each application will be assigned to a minimum of three primary peer reviewers, one of whom will be assigned the role of Rapporteur. Each reviewer will be assigned up to approximately 10 applications on which to serve as a primary reviewer. During the review period leading up to the panel meeting, primary reviewers read the entire application package for each application they are assigned. The primary reviewers will also prepare a written individual evaluation for each assigned application that addresses the peer review criteria described below and rate the application with a score of excellent, very good, good, fair or poor. To promote a better panel discussion, all reviewers must, at a minimum, read the abstracts of all applications.

At the beginning of the panel meeting, each primary reviewer will report their ratings for the applications they reviewed. Those applications receiving at least two ratings of *Very Good* or one rating of *Excellent* from among the primary reviewers will then be further discussed by the entire panel in terms of the peer review criteria below. In addition, if there is one *Very Good* rating among the primary reviewers of an application, the primary reviewer, whose initial rating is the *Very Good*, may request discussion of the application by the peer review panel. All other applications will be declined for further consideration.

After the discussion of an application by the panel, the primary reviewers may revise their initial ratings and if they do so, this will also be documented. The final ratings of the primary reviewers will then be translated by EPA into the final peer review score (excellent, very good, good, fair or poor) for the application. This is reflected in a peer review results document developed by the Rapporteur which combines the individual initial and final evaluations of the primary reviewers and captures any substantive comments from the panel discussion. This score will be used to determine which applications undergo the internal relevancy and past performance review discussed below. A peer review results document is also developed for applications that are not discussed. However, this document is a consolidation of the individual primary reviewer initial evaluations, with an average of the scores assigned by the primary reviewers.

Peer reviewers consider an application's merit based on the extent to which the application demonstrates the criteria below. Criteria are listed in descending order of importance (i.e., Criteria 1 has the heaviest weight).

1. Research Merits (subcriteria are in descending order of importance):

    a. The degree to which the application demonstrates that the research is original and contributes to the scientific knowledge in the topic area. And the degree to which the

application demonstrates that the project (and its approach) is defensible and technically feasible, and uses appropriate and adequate research methods.

b. The degree to which the application demonstrates that the project results will produce benefits to the public (such as improvements to the environment or human health) and will be disseminated to enhance scientific and technological understanding.

2. Responsiveness: The degree to which the application demonstrates that the research is responsive to the objectives, research needs and special considerations specified by the RFA, including whether the research is national in scope and whether it addresses the two research areas and all five topics of interest (A-E) described in Section I.D.

3. Project Management (subcriteria are equally weighted):

a. Investigators: The degree to which the application demonstrates that the Principal Investigator(s) and other key personnel have the appropriate qualifications (including research training, demonstrated knowledge of pertinent literature, experience and publication records).

b. Management: The degree to which the application demonstrates that the project will be adequately managed to ensure the timely and successful achievement of objectives using appropriate project schedules and milestones. And the degree to which the application demonstrates the applicant will adequately track and measure progress toward achieving expected results (outputs and outcomes).

c. Quality Assurance (QA): The degree to which the application includes an appropriate and adequate QA Statement.

d. Resources and Cost Controls: The degree to which the application demonstrates that the facilities, equipment and budget are appropriate, adequate and available. And the degree to which the application demonstrates that well-defined and acceptable approaches, procedures and controls are used to ensure timely and efficient expenditure of awarded grant funds.

4. Environmental Justice: The degree to which the application demonstrates how the project will address the disproportionate and adverse (see below) human health, environmental, climate-related and other cumulative impacts, as well as the accompanying economic challenges of such impacts, resulting from industrial, governmental, commercial and/or other actions that have affected and/or currently affect the underserved communities described in Section I of the solicitation. As part of this evaluation, applications will be evaluated based on how the project benefits the underserved communities including those that have experienced a lack of resources or other impediments to addressing the impacts identified above that affect their community.

Note: Disproportionate and adverse environmental, human health, climate-related and other cumulative impacts, as well the accompanying economic challenges of such impacts, may result when greater pollution burdens and/or consequences, and the impact of them, are more likely to affect or have affected the underserved communities described in this solicitation. The impacts may result from various factors including but not limited to being a function of historical trends and policy decisions.

Factors that may indicate disproportionate and adverse impacts as referenced above include: differential proximity and exposure to adverse environmental hazards; greater susceptibility to adverse effects from environmental hazards (due to causes such as age, chronic medical conditions, lack of health care access, or limited access to quality nutrition); unique environmental exposures because of practices linked to cultural background or socioeconomic status (for example, subsistence fishing or farming); cumulative effects from multiple stressors; reduced ability to effectively participate in decision-making processes (due to causes such as lack of or ineffective language access programs, lack of programs to make processes accessible to persons with disabilities, inability to access traditional communication channels, or limited capacity to access technical and legal resources); and degraded physical infrastructure, such as poor housing, poorly maintained public buildings (e.g., schools), or lack of access to transportation.

5. Community Engagement Plan (subcriteria are equally weighted):

   a. The degree to which the Plan clearly describes the type of collaboration/engagement proposed, and what role it will play in the overall project including the degree of partner and/or community input or engagement in the conceptualization, hypothesis/question development, design, methods, analyses and implementation of the research. This includes the degree to which the Plan addresses engagement with underserved communities, especially local residents in these communities who will be affected by the project, to ensure their meaningful participation with respect to the design, project planning, and performance of the project. If an applicant does not plan on collaborating/engaging with other groups in project performance, the degree to which the Plan clearly describes how the applicant will be able to effectively perform and complete the project without such collaboration/engagement will be evaluated.

   b. The degree to which the Plan clearly describes how the collaboration/engagement will: 1) enhance the overall impact of the project such that project results are useable by state/local agencies, utilities, and impacted communities; 2) effectively communicate risk and translate scientific results into easily understandable outreach and education materials; and, 3) ensure substantive and cohesive collaboration between researchers tackling different disciplinary activities detailed within the two research areas and all five topics of interest (A-E) described in Section I.D. If an applicant does not plan on collaborating/engaging with other groups in project performance, the degree to which the Plan clearly describes how the aforementioned activities will be effectively performed and completed without such collaboration/engagement will be evaluated.

c. The degree to which the Plan clearly describes how project activities will be coordinated with related or complementary projects and studies.

d. The degree to which the Plan clearly describes how the proposed collaboration/engagement will materialize during the project along with evidence of the partner(s)' intent to participate. If an applicant does not intend to collaborate/engage with respect to the project, then the applicant will be evaluated based on how well it demonstrates that it can effectively perform and complete the project without such collaboration/engagement.

6. Other Factors (subcriteria are equally weighted):

(a) Innovation: The degree to which the application demonstrates that the research will challenge and seek to shift current research or engineering paradigms by using innovative theoretical concepts, approaches or methodologies, instrumentation or interventions applicable to one or more fields of research.

(b) Sustainability: The degree to which the application demonstrates that the research will embody the principles of sustainability and seek sustainable solutions that protect the environment and strengthen our communities. The sustainability primer (see link) provides examples of research activities that promote and incorporate sustainability principles (https://www.epa.gov/sites/production/files/2015-05/documents/sustainability_primer_v9.pdf).

B. Relevancy Review

Applications receiving final peer review scores of excellent or very good will then undergo an internal relevancy review, as described below, conducted by experts from the EPA, including individuals from the Office of Research and Development (ORD) and program and regional offices involved with the science or engineering proposed. All other applications are automatically declined. The purpose of the relevancy review is to ensure an integrated research portfolio for the Agency and help determine which applications to recommend for award.

Prior to the relevancy review panel meeting, all relevancy reviewers will receive electronic copies of all applications that passed peer review as well as a full set of abstracts for the applications. Each application will be assigned to a minimum of three primary relevancy reviewers, one of whom will be assigned the role of Rapporteur. Each reviewer will be assigned up to approximately 10 applications on which to serve as a primary relevancy reviewer. During the review period leading up to the relevancy review panel meeting, all reviewers will be instructed to read the full set of abstracts and the entire application package for each application

they are assigned. They will also prepare a written individual evaluation for each assigned application that addresses the relevancy review criteria described below and rate the application with a score of A, high relevance to EPA mission; B, relevant to EPA mission; C, moderately relevant to EPA mission; D, possibly relevant to EPA mission; or E, not relevant to EPA mission.

All applications that pass peer review will be discussed by the relevancy review panel with the Rapporteur initiating the discussion. If the primary relevancy reviewers revise their initial scores after the discussion by the panel they will document the reasons for the revisions. After the discussion, the primary relevancy reviewers will provide their final score for the applications they are assigned. The final ratings of the primary reviewers will then be translated by EPA into the final relevancy review score (A, B, C, D, or E) for the application.

The final relevancy review score (A, B, C, D, or E) and final peer review score (Excellent or Very Good) will be used to place each application in one of 6 ranking tiers: Tier 1 = A/Excellent; Tier 2 = A/Very Good or B/Excellent; Tier 3 = B/Very Good or C/Excellent; Tier 4 = C/Very Good or D/Excellent; Tier 5 = D/Very Good; Tier 6 = E/Excellent or E/Very Good.

The internal relevancy review panel will assess the relevancy of the proposed research to the EPA's mission and priorities based on the following criteria that are listed in descending order of importance (i.e., Criteria 1 has the heaviest weight):

1. The degree to which the proposed research is relevant to EPA's priorities (as described in Goal 1: A Cleaner, Healthier Environment, Objective 1.2: Provide for Clean and Safe Water, of the EPA's FY2018-2022 Strategic Plan).

2. The degree to which results (i.e., outputs/outcomes) of the research have broad application or affect large segments of society.

3. The degree to which the research is designed to produce data and methods that can immediately and/or with little to no translation be utilized by the public, states and tribes to better assess or manage environmental problems.

C. Past Performance History Review

Those applicants who received final scores of excellent or very good as a result of the peer review process will also be asked to provide additional information for the past performance history review pertaining to the proposed Lead PI's (in the case of Multiple-PI applications, the Contact PI's) "Past Performance and Reporting History." The applicant must provide the EPA with information on the proposed Lead/Contact PI's past performance and reporting history under prior Federal agency assistance agreements (assistance agreements include grants and cooperative agreements but not contracts) in terms of: (i) the level of success in managing and completing each agreement, (ii) history of meeting the reporting requirements and documenting progress towards achieving the expected results (outputs/outcomes) under each agreement and (iii) whether journal publications or author manuscripts associated with the journal publications,

and the associated underlying scientific research data and metadata, resulting from those agreements were made publicly accessible.

This information is required only for the proposed Lead/Contact PI's performance under Federal assistance agreements performed within the last five years that were similar in size and scope to the proposed project.

Past performance history review scores are satisfactory (S), nothing to report (NTR) or unsatisfactory (U). For purposes of consideration of an award, scores of S will be considered favorable, NTR will be considered neither favorable nor unfavorable and scores of U will be considered unfavorable and unlikely to result in an award recommendation. Scores of S and U must be justified by the reviewer, with scores of U clearly documented to explain why past performance history cannot be considered satisfactory.

The specific information required for each agreement is shown below and must be provided within one week of EPA's request. A maximum of three pages will be permitted for the response; excess pages will not be reviewed. **Note: If no prior past performance information and/or reporting history exists, you will be asked to so state.**

1. Name of Granting Agency
2. Grant/Cooperative agreement number
3. Grant/Cooperative agreement title
4. Grantee Institution
5. Brief description of the grant/cooperative agreement
6. A description of how the agreement is similar in size and scope to the proposed project and whether or not it was successfully managed and completed; if not successfully managed and completed, provide an explanation
7. Information relating to the proposed Lead/Contact PI's past performance in reporting on progress towards achieving the expected results (outputs/outcomes) under the agreement and meeting reporting requirements under the agreement. Include the history of submitting acceptable and timely progress/final technical reports, describe how progress towards achieving the expected results was reported/documented and if such progress was not being made, provide an explanation of whether and how this was reported
8. Information relating to whether journal publications or author manuscripts associated with the journal publications, and the associated underlying scientific research data and metadata, resulting from those agreements were made publicly accessible (and if not, explain why not; or explain why this requirement does not apply) to the extent permissible under applicable laws and regulations
9. Total (all years) grant/cooperative agreement dollar value
10. Project period
11. Technical contact (project officer), telephone number and Email address (if available)

In evaluating applicants under the past performance history factor, EPA will consider the information provided by the applicant and may also consider relevant information from other sources, including information from EPA files and from current/prior grantors (e.g., to verify

and/or supplement the information provided by the applicant). **If you do not have any relevant or available past performance or past reporting information, please indicate this in your response and you will receive a nothing to report (NTR) score for these factors. If you do not provide any response for these items, you may receive an unsatisfactory (U) score for these factors.**

The past performance history review will be conducted by the EPA and will assess the following criteria which are of equal weight:

1. History of successfully managing and completing these prior Federal assistance agreements, including whether there is a satisfactory explanation for any lack of success.

2. History in meeting reporting requirements under the prior agreements and reporting progress toward achieving results (outputs/outcomes) under these agreements, including the proposed Lead/Contact PI's history of submitting acceptable and timely progress/final technical reports that adequately describe the progress toward achieving the expected results under the agreements. Any explanation of why progress toward achieving the results was not made will also be considered.

3. History of whether journal publications or author manuscripts associated with the journal publications, and the associated underlying scientific research data and metadata, resulting from these prior assistance agreements were made publicly accessible, and if not whether the Lead/Contact PI adequately explained why not, or the Lead/Contact PI explained why the requirement does not apply.

D. Human Subjects Research Statement (HSRS) Review

Applications being considered for funding after the Relevancy and Past Performance Review that involve human subjects research studies will have their HSRS reviewed prior to award. The local EPA Human Subjects Officer (HSO) will review the information provided in the HSRS and the Research Plan to determine if the ethical treatment of human subjects is described in a manner appropriate for the project to move forward. The HSO may consult with the EPA Human Subjects Research Review Official (HSRRO) as appropriate. The HSRRO may determine that an application cannot be funded if it is inconsistent with EPA’s regulations at 40 CFR Part 26.

E. Evaluation of the Scientific Data Management Plan

EPA will evaluate the merits of the SDMPs for those applications recommended for award. The SDMPs for those applications not recommended for award will not be reviewed. The SDMPs of all applications recommended for award will be evaluated to ensure they are appropriate and adequate (e.g., describe the types of scientific research data and metadata to be collected and/or generated under the proposed research award and include plans for providing long-term preservation of, and public access to, the scientific research data and metadata). SDMPs that indicate the proposed research will not result in the generation and/or collection of scientific research data will also be evaluated to ensure the proposed research will not result in the

generation and/or collection of scientific research data and therefore not require a more comprehensive SDMP. Applicants may be contacted regarding their SDMP if additional information is needed or if revisions are required prior to award. If upon review of the SDMP, EPA identifies any issues with the plan, EPA will raise these issues to the applicant, so they may be addressed. Applicants with an unsatisfactory SDMP will not receive an award.

F. Funding Decisions

Final funding decisions are made by the ORD selection official based on the ranking tier, the past-performance history review, the evaluation of the SDMP, and, where applicable, the assessment of the applicant's human subjects research (see Section IV.C.6.c). In addition, in making the final funding decisions, the ORD selection official may also consider program balance and available funds. Applicants selected for funding will be required to provide additional information listed below under "Award Notices." The application will then be forwarded to EPA's Grants and Interagency Agreement Management Division for award in accordance with the EPA's procedures.

G. Additional Provisions for Applicants Incorporated into the Solicitation

Additional provisions that apply to this solicitation and/or awards made under this solicitation including the clause on Reporting and Use of Information Concerning Recipient Integrity and Performance can be found at EPA Solicitation Clauses. These, and the other provisions that can be found at the website link, are important, and applicants must review them when preparing applications for this solicitation. If you are unable to access these provisions electronically at the website above, please communicate with the EPA contact listed in this solicitation to obtain *the provisions*.

VI. AWARD ADMINISTRATION INFORMATION

A. Award Notices

Customarily, applicants are notified about evaluation decisions within six months of the solicitation closing date. Applicants to be recommended for funding will be required to submit additional certifications and an electronic version of the revised project abstract. They may also be asked to provide responses to comments or suggestions offered by the peer reviewers and/or submit a revised budget. EPA Project Officers will contact the Lead PI/Contact PI to obtain these materials. Before or after an award, applicants may be required to provide additional quality assurance documentation.

The official notification of an award will be made by the Agency's Grants and Interagency Agreement Management Division. Applicants are cautioned that only a grants officer is authorized to bind the Government to the expenditure of funds; preliminary selection by the ORD selection official does not guarantee an award will be made. For example, statutory authorization, funding or other issues discovered during the award process may affect the ability

of EPA to make an award to an applicant. The award notice, signed by an EPA grants officer, is the authorizing document and will be provided through electronic or postal mail.

B. Disputes

Assistance agreement competition-related disputes will be resolved in accordance with the dispute resolution procedures published in 70 FR (Federal Register) 3629, 3630 (January 26, 2005) which can be found at Grant Competition Dispute Resolution Procedures. Copies of these procedures may also be requested by contacting the person listed in Section VII of the announcement. Note, the FR notice references regulations at 40 CFR Parts 30 and 31 that have been superseded by regulations in 2 CFR parts 200 and 1500. Notwithstanding the regulatory changes, the procedures for competition-related disputes remains unchanged from the procedures described at 70 FR 3629, 3630, as indicated in 2 CFR Part 1500, Subpart E.

C. Administrative and National Policy Requirements

Additional provisions that apply to this solicitation and/or awards made under this solicitation, including but not limited to those related to DUNS number assignment, SAM, copyrights, disputes, and administrative capability, can be found at https://www2.epa.gov/grants/epa-solicitation-clauses.

These, and the other provisions that can be found at the website link, are important, and applicants must review them when preparing applications for this solicitation. If you are unable to access these provisions electronically at the website above, please communicate with the EPA contact listed in this solicitation to obtain the provisions.

Expectations and responsibilities of ORD grantees and cooperative agreement recipients are summarized in this section, although the terms grants and cooperative agreements are used interchangeably.

1. Meetings: Principal Investigators will be expected to budget for, and participate in, All-Investigators Meetings (also known as progress reviews) approximately once per year with EPA scientists and other grantees to report on research activities and discuss issues of mutual interest.

2. Approval of Changes after Award: Prior written approval of changes may be required from EPA. Examples of these changes are contained in 2 CFR 200.308. Note: prior written approval is also required from the EPA Award Official for incurring costs more than 90 calendar days prior to award.

3. Human Subjects: A grant applicant must agree to comply with all applicable provisions of EPA Regulation 40 CFR Part 26 (Protection of Human Subjects). In addition, grant applicants must agree to comply with EPA's procedures for oversight of the recipient's compliance with 40 CFR Part 26, as given in EPA Order 1000.17A (Policy and Procedures on Protection of Human Research Subjects in EPA Conducted or Supported Research). As per this Order, no human subject may be involved in any research conducted under this assistance agreement, including

recruitment, until the research has been approved or determined to be exempt by the EPA Human Subjects Research Review Official (HSRRO) after review of the approval or exemption determination of the Institutional Review Board(s) (IRB(s)) with jurisdiction over the research under 40 CFR Part 26. Following the initial approvals indicated above, the recipient must, as part of the annual report(s), provide evidence of continuing review and approval of the research by the IRB(s) with jurisdiction, as required by 40 CFR 26.109(e).

Guidance for investigators conducting EPA-funded research involving human subjects may be obtained here:
https://www.epa.gov/osa/basic-information-about-human-subjects-research-0
https://www.ecfr.gov/cgi-bin/text-idx?tpl=/ecfrbrowse/Title40/40cfr26_main_02.tpl

4. Data Access and Information Release: EPA's requirements associated with data access and information release as well as copyrights, may be accessed here:
https://www.epa.gov/grants/epa-solicitation-clauses.

Congress, through OMB, has instructed each federal agency to implement Information Quality Guidelines designed to "provide policy and procedural guidance...for ensuring and maximizing the quality, objectivity, utility, and integrity of information, including statistical information, disseminated by Federal agencies." The EPA's implementation may be found at https://www.epa.gov/quality/guidelines-ensuring-and-maximizing-quality-objectivity-utility-and-integrity-information. These procedures may apply to data generated by grant recipients if those data are disseminated as described in the Guidelines.

5. Reporting: A grant recipient must agree to provide annual performance progress reports, with associated summaries, and a final report with an executive summary. The summaries will be posted on EPA's Research Grants website. The reports and summaries should be submitted electronically to the Technical Contact named in Section VII of this announcement.

A grant recipient must agree to provide copies of, or acceptable alternate access to (e.g., web link), any peer reviewed journal article(s) resulting from the research during the project period. In addition, the recipient should notify the ORD Project Officer of any papers published after completion of the grant that were based on research supported by the grant. ORD posts references to all publications resulting from a grant on EPA's Research Grants website.

6. Acknowledgement of EPA Support: EPA's full or partial support must be acknowledged in journal articles, oral or poster presentations, news releases, interviews with reporters and other communications. The acknowledgement to be included in any documents developed under this agreement that are intended for distribution to the public or inclusion in a scientific, technical or other journal will be provided in the award's terms and conditions.

VII. AGENCY CONTACTS

Further information, if needed, may be obtained from the EPA contacts indicated below. Information regarding this RFA obtained from sources other than these Agency Contacts may not be accurate. Email inquiries are preferred.

Technical Contact: Sarah Ludwig-Monty phone: 202-566-1072; email: ludwig-monty.sarah@epa.gov
Eligibility Contact: Ron Josephson; phone: 202-564-7823; email: josephson.ron@epa.gov
Electronic Submissions Contact: Debra M. Jones; phone: 202-564-7839; email: jones.debram@epa.gov

EXHIBIT I

Application for Federal Assistance SF-424

* 1. Type of Submission:	* 2. Type of Application:	* If Revision, select appropriate letter(s):
❍ Preapplication	● New	
● Application	❍ Continuation	* Other (Specify)
❍ Changed/Corrected Application	❍ Revision	

* 3. Date Received:	4. Applicant Identifier:
09/29/2021	

5a. Federal Entity Identifier:	* 5b. Federal Award Identifier:

State Use Only:

6. Date Received by State:	7. State Application Identifier:

8. APPLICANT INFORMATION:

* a. Legal Name: Iowa State University of Science and Technology

* b. Employer/Taxpayer Identification Number (EIN/TIN):	* c. Organizational DUNS:
426004224	005309844

d. Address:

* Street1:	1138 Pearson Hall
Street2:	505 Morrill Road
* City:	Ames
County:	Story
* State:	IA: Iowa
Province:	
* Country:	USA: UNITED STATES
* Zip / Postal Code:	50011-2103

e. Organizational Unit:

Department Name:	Division Name:
Office of Sponsored Programs	Vice President for Research

f. Name and contact information of person to be contacted on matters involving this application:

Prefix:		* First Name:	Sara
Middle Name:			
* Last Name:	Fonseca Ricke		
Suffix:			

Title: Pre-Award Administrator

Organizational Affiliation:

Iowa State University of Science and Technology

* Telephone Number:	515-294-5225	Fax Number:	515-294-8000

* Email: egrants@iastate.edu

Application for Federal Assistance SF-424

9. Type of Applicant 1: Select Applicant Type:

H: Public/State Controlled Institution of Higher Education

Type of Applicant 2: Select Applicant Type:

Type of Applicant 3: Select Applicant Type:

* Other (specify):

*** 10. Name of Federal Agency:**

Environmental Protection Agency

11. Catalog of Federal Domestic Assistance Number:

66.511

CFDA Title:

Office of Research and Development Consolidated Research/Training/Fellowships

*** 12. Funding Opportunity Number:**

EPA-G2021-ORD-E1

* Title:

NATIONAL PRIORITIES: WATER INNOVATION, SCIENCE, ENGAGEMENT TO ADVANCE WATER REUSE

13. Competition Identification Number:

NONE

Title:

None

14. Areas Affected by Project (Cities, Counties, States, etc.):

*** 15. Descriptive Title of Applicant's Project:**

Accelerating technical and community readiness for beneficial water reuse in small systems

Attach supporting documents as specified in agency instructions.

Application for Federal Assistance SF-424

16. Congressional Districts Of:

* a. Applicant IA-004 * b. Program/Project: IA-004

Attach an additional list of Program/Project Congressional Districts if needed.

17. Proposed Project:

* a. Start Date: 05/01/2022 * b. End Date: 04/30/2026

18. Estimated Funding ($):

* a. Federal	3,246,000.00
* b. Applicant	811,500.00
* c. State	0.00
* d. Local	0.00
* e. Other	0.00
* f. Program Income	0.00
* g. TOTAL	4,057,500.00

*** 19. Is Application Subject to Review By State Under Executive Order 12372 Process?**

❍ a. This application was made available to the State under the Executive Order 12372 Process for review on .

❍ b. Program is subject to E.O. 12372 but has not been selected by the State for review.

● c. Program is not covered by E.O. 12372.

*** 20. Is the Applicant Delinquent On Any Federal Debt? (If "Yes", provide explanation and attach.)**

❍ Yes ● No

21. *By signing this application, I certify (1) to the statements contained in the list of certifications and (2) that the statements herein are true, complete and accurate to the best of my knowledge. I also provide the required assurances** and agree to comply with any resulting terms if I accept an award. I am aware that any false, fictitious, or fraudulent statements or claims may subject me to criminal, civil, or administrative penalties. (U.S. Code, Title 218, Section 1001)**

☑ **** I AGREE**

** The list of certifications and assurances, or an internet site where you may obtain this list, is contained in the announcement or agency specific instructions.

Authorized Representative:

Prefix: * First Name: Sara

Middle Name:

* Last Name: Fonseca Ricke

Suffix:

* Title: Pre-Award Administrator

* Telephone Number: 515-294-5225 Fax Number: 515-294-8000

* Email: egrants@iastate.edu

* Signature of Authorized Representative: Sara Fonseca Ricke * Date Signed: 09/29/2021

Prescribed by OMB Circular A-102

Attachments

AreasAffected

File Name	Mime Type

AdditionalProjectTitle

File Name	Mime Type

AdditionalCongressionalDistricts

File Name	Mime Type

DebtExplanation

File Name	Mime Type

Form Approved OMB N0:2030-0020

EPA KEY CONTACTS FORM

Authorized Representative: *Original awards and amendments will be sent to this individual for review and acceptance, unless otherwise indicated.*

*** Name:**	Sara Fonseca Ricke
Title:	Pre-Award Administrator
*** Complete Address:**	1138 Pearson Hall 505 Morrill Road Ames IA: Iowa 50011-2103 USA: UNITED STATES
*** Phone Number:**	515-294-5225
Fax Number:	515-294-8000
Email:	egrants@iastate.edu

Payee: *Individual authorized to accept payments.*

*** Name:**	Mindy Ann Stensland
Title:	Fiscal and Operational Officer
*** Complete Address:**	2521 University Blvd, Suite 124 Ames IA: Iowa 50010 USA: UNITED STATES
*** Phone Number:**	515-294-1576
Fax Number:	
Email:	mindyas@iastate.edu

Administrative Contact: *Individual from Sponsored Programs Office to contact concerning administrative matters (i.e., indirect cost rate computation, rebudgeting requests etc).*

*** Name:**	SaraFonseca Ricke
Title:	Pre-Award Administrator
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Preaward Compliance Review Report for

All Applicants and Recipients Requesting EPA Financial Assistance

I. A. Applicant/Recipient (Name, Address, City, State, Zip Code)

Name: Iowa State University of Science and Technology

Address: 1138 Pearson Hall 505 Morrill Road

City: Ames

State: IA: Iowa Zip Code: 50011-2103

B. DUNS No. 005309844

II. Is the applicant currently receiving EPA Assistance? [X] Yes [ ] No

III. List all civil rights lawsuits and administrative complaints pending against the applicant/recipient that allege discrimination based on race, color, national origin, sex, age, or disability. (Do not include employment complaints not covered by 40 C.F.R. Parts 5 and 7.)

Dept of Education Office of Civil Rights #05-19-2093 filed on 6/13/2019, currently pending review; complaint based on sex
Dept of Education Office of Civil Rights #05-20-2311 filed on 11/25/2020, currently pending review; complaint based on sex
Iowa Civil Rights Commission #08-21-77014, EEOC#26A-2021-00716C filed on 8/17/2021, currently pending review; complaint based on sex, age; retaliation
Iowa Civil Rights Commission #08-21-76963, EEOC#26A-2021-00685C filed on 8/5/2021, currently pending review; complaint based on national origin, disability; retaliation

IV. List all civil rights lawsuits and administrative complaints decided against the applicant/recipient within the last year that allege discrimination based on race, color, national origin, sex, age, or disability and enclose a copy of all decisions. Please describe all corrective actions taken. (Do not include employment complaints not covered by 40 C.F.R. Parts 5 and 7.)

None

V. List all civil rights compliance reviews of the applicant/recipient conducted by any agency within the last two years and enclose a copy of the review and any decisions, orders, or agreements based on the review. Please describe any corrective action taken. (40 C.F.R. § 7.80(c)(3))

None

VI. Is the applicant requesting EPA assistance for new construction? If no, proceed to VII; if yes, answer (a) and/or (b) below.

[ ] Yes [X] No

a. If the grant is for new construction, will all new facilities or alterations to existing facilities be designed and constructed to be readily accessible to and usable by persons with disabilities? If yes, proceed to VII; if no, proceed to VI(b).

[ ] Yes [ ] No

b. If the grant is for new construction and the new facilities or alterations to existing facilities will not be readily accessible to and usable by persons with disabilities, explain how a regulatory exception (40 C.F.R. 7.70) applies.

VII. Does the applicant/recipient provide initial and continuing notice that it does not discriminate on the basis of race, color, national origin, sex, age, or disability in its program or activities? (40 C.F.R 5.140 and 7.95) [X] Yes [ ] No

a. Do the methods of notice accommodate those with impaired vision or hearing? [X] Yes [ ] No

b. Is the notice posted in a prominent place in the applicant's offices or facilities or, for education programs and activities, in appropriate periodicals and other written communications? [X] Yes [ ] No

c. Does the notice identify a designated civil rights coordinator? [X] Yes [ ] No

VIII. **Does the applicant/recipient maintain demographic data on the race, color, national origin, sex, age, or handicap of the population it serves? (40 C.F.R. 7.85(a))** [X] Yes [ ] No

IX. **Does the applicant/recipient have a policy/procedure for providing access to services for persons with limited English proficiency? (40 C.F.R. Part 7, E.O. 13166)** [X] Yes [ ] No

X. **If the applicant is an education program or activity, or has 15 or more employees, has it designated an employee to coordinate its compliance with 40 C.F.R. Parts 5 and 7? Provide the name, title, position, mailing address, e-mail address, fax number, and telephone number of the designated coordinator.**

Margo Foreman, Interim Vice President for Diversity and Inclusion and Equal Opportunity, 2680 Beardshear Hall, Ames, IA 50011-2103, eooffice@iastate.edu, Ph: 515-294-7612

XI. **If the applicant is an education program or activity, or has 15 or more employees, has it adopted grievance procedures that assure the prompt and fair resolution of complaints that allege a violation of 40 C.F.R. Parts 5 and 7? Provide a legal citation or Internet Address for, or a copy of, the procedures.**

https://www.policy.iastate.edu/policy/discrimination

For the Applicant/Recipient

I certify that the statements I have made on this form and all attachments thereto are true, accurate and complete. I acknowledge that any knowingly false or misleading statement may be punishable by fine or imprisonment or both under applicable law. I assure that I will fully comply with all applicable civil rights statutes and EPA regulations.

A. Signature of Authorized Official	B. Title of Authorized Official	C. Date
	Pre-Award Administrator	09/29/2021

Project Narrative File(s)

FileName	MimeType
Merged_coPI_updated_printed1031419452.pdf	application/pdf
EPA_G2021_ORD_E1_ISU_narrative_final1031419454.pdf	application/pdf
153205_Justification_Ikuma_final1031419455.pdf	application/pdf
CVs_all1031419449.pdf	application/pdf
CPS_all_printed1031419450.pdf	application/pdf
LOI_all1031419451.pdf	application/pdf

OMB Control No. 2030-0020
Approval expires 06/30/2024

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(Use as many sheets as needed.)

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TABLE OF CONTENTS

ABSTRACT

Funding Opportunity Title: National Priorities: Water Innovation, Science, and Engagement to Advance Water Reuse
Number: EPA-G2021-ORD-E1
Project Title: Accelerating technical and community readiness for water reuse in small systems
Investigators: Kaoru Ikuma (lead PI; kikuma@iastate.edu); co-PIs: Joe Charbonnet, Lu Liu, Antonio Arenas Amado, Yu Wang, Chris Rehmann, Say Kee Ong, Joseph Goodwill, Vinka Oyanedel-Craver, Todd Guilfoos, Michael Kiparsky
Institutions: Iowa State University of Science and Technology, Ames, IA (main institution applying for assistance); University of Rhode Island, Kingston, RI; University of California, Berkeley, CA
Project Period and Location: 5/01/2022 to 4/30/2026, Iowa, Rhode Island, California, Colorado
Project Cost: Funding requested from the EPA: $3,246,000; non-federal cost share: $811,500. Total: $4,057,500.

Project Summary
Objectives: Water reuse is an increasingly important response to water stress; however, major advancements in water reuse have neglected small, rural communities that comprise most public water systems. The objective of this project is to accelerate water reuse adoption in rural communities by increasing technical and community readiness. The general hypothesis is that community readiness for water reuse in small systems can be accelerated by a convergence of technical, informational, social, and institutional innovation. Also, we hypothesize that severe water scarcity need not be a prerequisite for water reuse implementation, given careful attention to windows of opportunity that integrate multiple community concerns.

Approach: Barriers to water reuse adoption are intertwined and complex. Therefore, our proposed work will be an integrated research and engagement program in which we: (1) address knowledge gaps and generate frameworks for overcoming these barriers, and (2) use research outputs to evaluate and accelerate community readiness for reuse in five case studies. Both general activities will be execute in parallel such that knowledge can be co-produced with decision-makers. Specific methods to address knowledge gaps include, community surveys, the use of a prototype calculation engine, and desktop, bench-scale and pilot-scale evaluations of treatment technologies. Specific methods to accelerate community readiness include legal and policy analyses and case-study evaluations of five small water systems.

Expected results: This project is expected to produce outputs and outcomes that lead to acceleration of community readiness for reuse in small systems. Specifically, key results include modular, decision support tools such as water inventories, technology databases, cost and demand curves for reuse. These outputs will be integrated into institutional and regulatory decision-making processes in small, rural, underserved communities with results made available to communities through workshops, outreach events, and publications. We will go through many iterative processes throughout the project in which feedback from small community members and stakeholders will inform the modifications of tools and outputs so that they are indeed meaningful and useful to small communities facing unique challenges.

Keywords: water reuse, environmental justice, small systems, technology validation, public acceptance

RESEARCH PLAN

Introduction

Major advances in water reuse have historically focused on large, urban, and well-resourced systems. Although such focus has been appropriate for a range of reasons related to resources and technology innovation, it can overlook the potential for implementation in the underserved small, rural, or low-capacity communities. The systems serving these communities are individually small (serving 10,000 people or fewer [1]), but they comprise over 97% of all active public water systems in the US [2]. The need for attention to advancing water management in these vast areas of the country is increasingly urgent: climate change [3], increasing scarcity of groundwater and surface water supplies [4], deteriorating water quality [5], increasing pressure from population growth and land use change, changing societal expectations, and other stressors make clear that many rural communities must change how they relate to water-related services. Traditional, fragmented approaches to water supply and wastewater treatment will no longer meet community needs for water-related services; water reuse in all of its forms will need to be part of the solution.

Water reuse could have profound and multi-faceted benefits in small communities, but small communities often lack the resources and expertise to evaluate alternatives and take appropriate actions on reuse [6]. Actualizing the potential of reuse will require refinements in water reuse technologies to increase their affordability and fitness for rural application, combined with tools and knowledge that address real and perceived institutional and social barriers to widespread adoption.

Our **overarching hypothesis** for this proposed work is that *community readiness for water reuse in small systems can be accelerated by a convergence of technological, informational, social, and institutional innovation*. In addition, we hypothesize that severe water scarcity need not be a prerequisite for water reuse implementation, given careful attention to windows of opportunity that integrate multiple community concerns.

Overcoming barriers to the broad legitimization of water reuse for small and rural communities [7], and thus barriers to systemic change for water and environmental management at the national scale, will require greater clarity of the interplays within and between the Research Areas and Topics of the RFA as outlined below. Specifically, implementation of water reuse in small systems will likely face the following **major barriers**:

1. Lack of easily accessible information on availability of different source waters for reuse [RFA Topic C]
2. Lack of clear guidance on appropriate reuse technologies that can provide water of adequate quality for a given combination of source water and end-use [RFA Topics and B]
3. Lack of a framework to clarify costs and benefits of water reuse tailored to small systems [RFA Topics A, B, C]
4. Lack of information on the level of public acceptance and willingness to pay for water reuse in small and rural communities [RFA Topic E]
5. Need for institutional innovations that support consideration of water reuse by decision makers in small and rural communities [RFA Topic D]

These barriers are interrelated and intertwined, complicating decision-making processes in the face of limited local capacity [8-13]. We propose an integrated research and engagement program through which we: (1) address knowledge gaps and generate frameworks for overcoming these barriers through the following Objectives 1-5, and (2) use research outputs to evaluate and

accelerate community readiness for reuse in five case studies (Objective 6), and crucially, 3) develop both of these activities in parallel such that knowledge can be co-produced with decision makers [14] (Figure 1), ensuring our outputs will be relevant and broadly applicable.

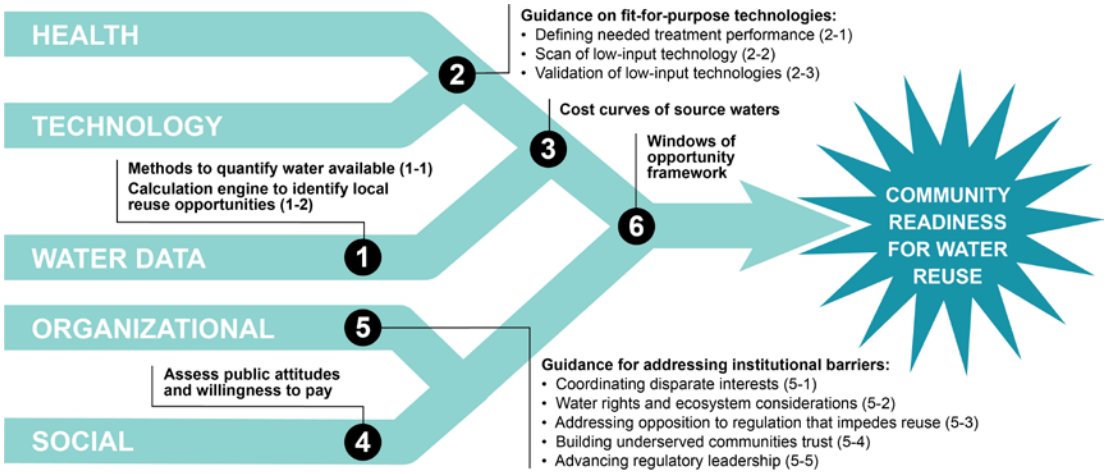


Figure 1. Project framework for accelerating water reuse implementation in small systems with 6 objectives to converge technological, informational, social, and institutional innovation.

***Objective 1*: Develop water inventory to overcome the water information barrier**

Comprehensive assessment of water reuse requires an inventory of water available water from various sources, including rainwater, municipal wastewater, stormwater, agricultural runoff and return flow and water produced from extracting natural resources. In some cases, data are readily available, such as historic daily precipitation data [15] and an inventory of municipal wastewater for the US [16]. In other cases, further calculation and processing are necessary. For example, in urban settings not covered by the EPA's National Stormwater Calculator [17] and agricultural areas, stormwater will need to be estimated from runoff models.

A challenge in collecting information on water availability is assembling data in a way that is useful and useable for decision makers in small communities [18]. Although the datasets on water from different sources are valuable, the data are stored in different formats, and the temporal and spatial resolutions of different datasets do not necessarily align [19]. Most communities do not have the resources to devote to overcoming this data barrier. We hypothesize that *the lack of an organized inventory inhibits the adoption of water reuse*. Therefore, a tool that collects and reconciles available data, estimates unmeasured components such as stormwater, and compiles an inventory would allow communities to focus on higher-level decisions regarding water reuse.

Climate change exacerbates these issues. Estimates of historic volumes of water available for reuse must be complemented with predictions of volumes under climate change. Climate change threatens both the quantity and quality of drinking water throughout the U.S. [20]. For example, the index of [21] identifies 70% of counties in the U.S. at potential risk for water shortage, and increased temperatures alter myriad factors that control water quality [22]. As a result, planning for water reuse must account for these changes.

To address these research gaps, Obj. 1 will produce a prototype calculation engine for developing an inventory of water available for reuse. We will engage five case-study communities, identified in Obj. 6, in co-developing this engine so that it addresses actual needs and produces output useful for their decisions. These activities will benefit the case-study communities directly and help to generalize the engine to be useful for other communities as well.

***Objective 2*: Develop validated list of fit-for-purpose technologies to overcome lack of guidance on appropriate technologies**

Water reuse can increase water system sustainability and resilience, but it also increases health-based risk to community members due to inherently impaired nature of water previously consumed by human activities [23]. For example, stormwater for irrigation may contain more pathogens or contaminants of emerging concern (CECs) than groundwater or surface waters; reusing this stormwater to irrigate a recreational area carries often undefined risk. Water treatment technologies can physically or chemically address this health risk for pathogens and CECs [24]. However, a persistent and problematic gap remains between new technologies and health-based risk assessment for water reuse [25]. Innovative technologies often fail to consider the scale and operational limitations of small systems. Similarly, typical methods of water reuse risk assessment use broad water quality guidance for a range of potential reuse applications. For community leaders, engineering service providers, and regulators, determining appropriate technology and assessing health risks can be prohibitively complex. We hypothesize that *a subset of existing technologies is appropriate for small systems, and can be rapidly advanced to full scale*.

The goal of Obj. 2 is to close this gap between innovation and health-based risk assessment in water reuse for small systems. We will do so by screening appropriate technologies based on treatment performance and validating newer technologies to allow for diverse potential fit-for-purpose technology options in small, rural systems. Completion of this objective will provide clarity to small systems on appropriate, fit-for-purpose technology options, thereby increasing water reuse adaptation while decreasing public health risk.

***Objective 3*. Construct projected cost curves that incorporate environmental benefits**

A lack of available cost comparisons specific to the interests of small communities limits adoption of water reuse [26]. Time- and resource-stressed small and rural communities cannot perform comprehensive benefit-cost analyses derived from academic research. Streamlining production of cost curves to facilitate economic comparison across water management options for small communities would remove a significant hurdle for broader adoption of water reuse.

A challenge in producing cost curves for different water sources lies in the monetization of damages and benefits associated with water sources and end uses. Extensive qualitative literature highlights benefits of water reuse [27], but quantitative assessments are lacking. The complex fate and transport of water pollution in receiving waters and varied impacts on downstream ecosystem services can skew economic assessment [26]. Climate change complicates analysis by influencing the marginal cost of meeting additional water demand from traditional sources. Internalizing damages associated with conventional water supply, and including the benefits of avoiding these damages, can help develop more robust cost curves for water reuse. Precise estimates of the social cost of water pollution require extensive research with integrated assessment models [28] and are out of reach for small communities. We propose to fill the knowledge gap with contingent valuation surveys to estimate people's willingness to pay and the value of water reuse relative to non-reuse system expansion (Obj. 4).

We hypothesize that *broader consideration of costs and benefits can demonstrate that water reuse can be a viable option even absent current water stress*. Incorporating environmental benefits may change estimates of the true cost for water. We will develop a framework to construct cost curves for fit-for-purpose water reuse for small systems. This research will produce a decision tool for benefit-cost analysis tailored for small systems, enabling comparison among water reuse and conventional approaches, considering both tangible and intangible benefits of reuse.

***Objective 4*. Identify ways to overcome social barriers to public acceptance**

Communities will weigh water reuse projects against other options such as limiting water consumption or expanding traditional supplies. When choosing an appropriate solution, decision-makers, stakeholders, and residents need data and information on the acceptance of water reuse and the willingness to pay (WTP) for such programs. We will develop and implement survey methods to inform decision-makers about existing public support for water reuse programs, and tools to engage and community members to build support.

Social acceptance is one of the most significant factors for successful implementation of water reuse programs [29,30]. Previous surveys have found significant differences in the acceptance of reclaimed water for different end-uses. In general, high public support (>80%) is found for non-potable uses with limited human contact such as firefighting, irrigation of non-crop lands, and cooling power plants. However, support for reused water drops dramatically (<50%) for end-uses with higher human contact, such as irrigation for edible crops, laundry, bathing, and drinking [29-32]. Social, psychological, economic, and demographic factors affect acceptance, including disgust, perceived health risks, perceived water scarcity, attitude toward science, trust in authorities, and water fees [29-33]. Financial incentives can increase the support for water reuse, especially in cases of potable uses [30,31], and willingness to pay for water reuse increases with the potential to avoid usage restrictions or high water fees [34].

Important questions remain unanswered, because rural residents have been shown less likely to support water reuse [31], but existing literature does not detail their specific concerns. We hypothesize that *residents in small communities will support and be willing to pay for only a subset of the available source water and end-use combinations for water reuse*.

To better inform decision makers, we will survey communities with small water systems. The purposes of the survey are to understand the need and support of small communities regarding (1) support among various source waters and uses; (2) comparing health, psychological, and economic concerns; (3) WTP among water reuse programs, compared with other scenarios; and (4) ways to increase public support for water reuse.

***Objective 5*. Foster institutional innovation to overcome organizational barriers**

Small and rural communities face unique institutional challenges in developing water reuse. Previous EPA-funded research conducted by the UCB team (EPA grant EPR91601-0001, [35-37]) demonstrated the importance of institutional aspects in the substance and process of innovation in the wastewater sector. We expect analogous issues to apply to water reuse, but research is needed to understand the institutional challenges specific to expanding water reuse in small and rural communities and how to address them successfully. We theorize that technological advances are necessary but not sufficient to make water reuse viable for many small and rural communities: institutional innovations will be crucial in enabling the broader adoption and diffusion of a range of fit-for-purpose water reuse approaches. More specifically, we hypothesize that (1) *aligning common interests among and within organizations with distinct missions may unlock new opportunities for economic and political support of multi-benefit water reuse projects*; (2) *water rights and effluent-dependent ecosystems may be impediments to reuse in some states, but thoughtful approaches can be developed for navigating these constraints*; (3) *regulators may need to respond differently to organized resistance to regulation according to its motivation and form*; (4) *distrust of water reuse in underserved communities may be particularly intense, and active, ongoing engagement of community members in decision making may be needed to generate trust and legitimacy*; and, finally, (5) *regulatory leadership will be critical in identifying and*

addressing institutional barriers to water reuse in small and rural communities. We define *regulatory leadership* as a proactive approach by regulators that goes beyond demands for compliance with standards to create viable pathways for achieving integrative solutions. Regulatory leadership is especially pertinent for water reuse in small communities because of the importance of integrating multiple benefits to make water reuse projects viable, which requires acknowledging, leveraging, and expanding communities' windows of opportunity to do so.

We propose to explore these interconnected and mutually reinforcing hypotheses using case studies and legal and policy analysis to draw lessons for regulators and local decision makers. To accelerate real world impact, we will complement our research activities with an engagement program designed to highlight and inspire regulatory leadership.

***Objective 6*. Conduct case studies to accelerate community readiness for water reuse in five small communities across the US**

Scaling the adoption and diffusion of water reuse in small communities presents particular challenges. For federal and state regulators seeking to encourage compliance with regulatory standards through forward-thinking and integrative projects, meaningful engagement and assessment is resource intensive because small/rural communities are geographically fragmented. For communities facing water and wastewater challenges, budgets are often limited by small tax bases, attention of decision makers is stretched among many competing priorities, and technical assistance from consultants and non-governmental organizations (NGOs) can lack the visionary support necessary for implementing non-standard approaches. These issues are particularly salient for underserved communities, including communities of color with histories of environmental injustice in their water services.

The perceived barriers for water reuse implementation in small systems are in part because of an assumption that increased complexity and cost of water reuse, especially to the extent where reuse involves novel or integrative technical methods, may not be matched by technical, managerial, and financial (TMF) capacity that could enable small communities to evaluate, implement, and operate such systems effectively. Though small community water systems are indeed expected to present unique TMF challenges in decision making about water reuse projects, we hypothesize that *understanding and systematizing water and wastewater decision-making processes for regulators and community representatives, and broadening the scope of these processes to explicitly and systematically include water reuse as an option, could accelerate the adoption of water reuse across the nation's rural landscape*.

In Obj. 6, we will test this hypothesis through case studies of five small/rural communities across the US. Results from all previous Obj. 1-5 will be tailored specifically to these five small systems to aid in the decision-making process with the aim of accelerating community readiness for water reuse. In particular, unique windows of opportunity for water reuse adoption will be evaluated with the goal of providing generalizable guidance for small systems throughout the US.

Approach and Activities

To meet the objectives stated above, we will complete the following activities as described below.

Objective 1

Task 1-1: Develop methods to quantify the amount of water available for beneficial reuse

Inventories of water available for reuse will consider historic and projected data on four sources: rainwater, municipal wastewater, stormwater, and agricultural runoff and return flow. Historic precipitation will come from Daymet [9], and precipitation projected to 2099 will come

from the downscaled phase five of the Coupled Model Intercomparison Project (CMIP5,[38]). Stormwater availability will come from community-collected stormwater data [39], EPA's National Stormwater Calculator [11], CMIP5, and estimates from rainfall runoff methods, such as the Natural Resources Conservation Service curve number method [40]. The inventory of available municipal wastewater will be built using data from the EPA Clean Watersheds Needs Survey [41]. Agricultural runoff will also be estimated with the curve number method.

These data will be consolidated across attributes such as format, type, spatial and temporal resolution, and time frame will ensure a data product of consistency and of sufficient granularity for small communities. For example, because the inventory of municipal wastewater in [16] was developed for watersheds larger than the typical small system, we will retrieve data in [41] but at scales relevant for small communities. We will document methods for scholarly review and validation and capture these methods in the prototype calculation engine of the next task in "how to" guidance for application by consulting engineers and other practitioners.

Task 1-2: Develop a prototype calculation engine

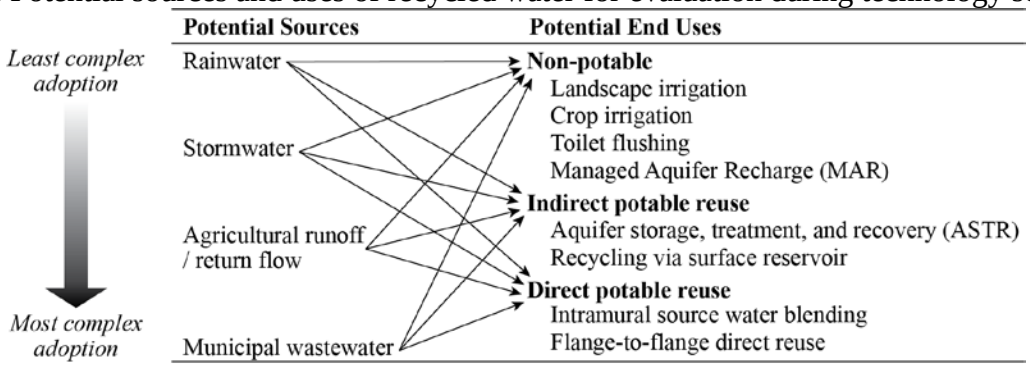
To enable development of water reuse inventories for small and rural communities across the US, we will translate the results of Task 1-1 into a calculation engine for practitioners and decision makers to identify water reuse opportunities within their communities. This engine will be designed to automatically compute the amount of current and projected source waters with predefined input data, refined through data available from community-based sources. The content, functionality and outputs of the engine will be refined through interviews with community stakeholders and consultants in Obj. 6. Further effort may include designing a web-based data query platform to facilitate communities with limited resources.

Objective 2

Task 2-1: Define treatment performance necessary for different end uses

How well water reuse technologies can remove microbiological, chemical, and physical hazards depends on the source water and treatment combinations, which will then dictate the appropriate end uses of the produced water (Table 1). The water quality required for each end use is typically determined by regulatory standards; however, standards for water reuse, particularly non-potable reuse, are largely unclear and not as well defined in most states.

Table 1. Potential sources and uses of recycled water for evaluation during technology scans



We will first perform a literature review on appropriate health-based standards for direct and indirect potable reuse as well as various non-potable reuse scenarios. This will include synthesis review of existing water quality standards for water reuse across the world, including California Title 22, relevant Texas Administrative Codes, European standards, and World Health

Organization guidance. A resulting assessment of removal efficiency of select microbial and chemical hazards, linked to previously identified pollutants in source water, will be incorporated into Task 2-2 [42-47]. The removal rates will be compared to various existing regulatory standards; this comparison will be a component of the "technology readiness" gate used in Task 2-2.

Task 2-2: Scan of low-input technologies appropriate for water reuse in small systems

We will identify technologies that are most appropriate and impactful for small systems. In particular, we seek "low-input" technologies—those that require chemical and energy inputs that small systems can consistently supply. We propose to conduct a strategic technology scan (STS) to evaluate and identify appropriate technologies for application in water reuse in small systems. The STS will impartially evaluate prospective water recycling technologies in a process adapted from transportation infrastructure and broadly informed by the LIFT Technology Scan [48]. Three key differences between our STS the LIFT approach will be 1) a greater depth and rigor of technical evaluation, 2) independence from technology provider/inventor initiation and 3) the focus on the applicability to small water systems, which have received insufficient attention to date, and which present distinct challenges and opportunities [49].

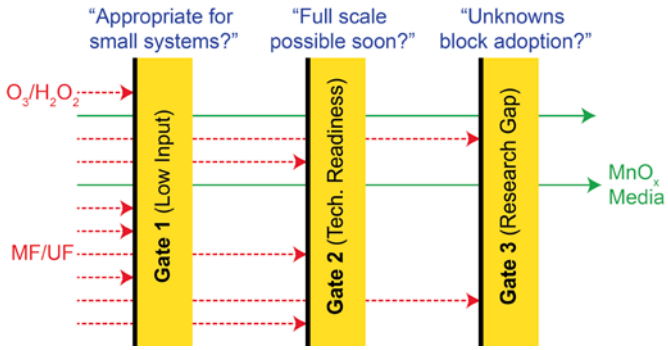


Figure 2. Conceptual flow diagram of strategic technology scan approach.

The STS will identify water treatment technologies for near-term adoption in small systems (e.g., within 5 years). The STS will critically review existing literature on various water treatment processes, meaning the PIs use their technical expertise to examine claims and expose research gaps. The STS will focus on answering three key questions, each of which is a technology scan Gate (Figure 2): [Gate 1] Is the technology low-input? [Gate 2] Is the technology currently at a high level of technical readiness? [Gate 3] Do unknowns in performance currently block adoption?

The technology scan starts with identification of known water treatment processes technology that could potentially be used in a water treatment regime, resulting in a broad collection of approaches. Gate 1 examines candidates for small system appropriateness through a low input screen. Assessment of appropriateness will also include qualitative input on design best practices from consultants specializing in small systems (see LOI – Tighe & Bond), proving a "real world" perspective. Gate 2 assesses technical readiness, quantifying the technical readiness level (TRL) of each technology passing Gate 1 using definitions adapted from NASA [50]. Technologies with a TRL of less than 4 or greater than 7 will be rejected, and technologies with a TRL ranging from 4 to 7 will be accepted. Gate 3 evaluates research gaps preventing current use. The assessment of significant gaps will rest on PI expertise, as well as input from a State Regulatory Primacy Agency (see LOI – RI Department of Health). Treatment approaches with research unknowns will be included in the next phase of the STS. For example, membrane micro/ultrafiltration (MF/UF) is widely accepted and not blocked by research gaps.

The technologies scanned will include those capable of treating water from a range of sources (Table 1). The technologies will be evaluated for appropriateness to a suite of non-potable and potable end uses, ranging from landscape irrigation to flange-to-flange direct potable reuse

(Table 1). Technologies will be scored at each gate, quantifying the extent to which they satisfied the requirements and allowing application of different decision criteria for different communities.

Task 2-3: Validate low-input technologies

Technologies passing the STS will face detailed validation. The goal is to close research gaps by developing performance data. The validation approach will consist of testing each treatment process with input water representative of all appropriate sources. Validation will quantify the removal of contaminants of concern from source waters in larger scale, continuous flow experiments (e.g., piloting), using a general approach similar to prior work executed by the PIs [51]. The demonstrated removal of these contaminants and long-term performance of these treatment technologies in representative source water streams will be geared to address the knowledge gaps that hinder full scale adoption by small communities. Because research and demonstration are crucial to recruiting early adopters of new technologies in the water sector [52], this targeted research will address a key bottleneck in the innovation lifecycle.

We will test the performance of each selected technology in four source water matrices, each with distinct and representative water quality, matrix constituents, and contaminants of concern. To ensure repeatability and broad geographic applicability of the results, we use real waters collected from the field along with simulated source water matrices. A pilot-scale treatment system will be used to evaluate active treatment technologies (e.g., ferrate), while mesoscale (i.e., 1 m-long) columns will be used to evaluate passive treatment technologies (e.g., manganese oxide media). Each technology will be screened for removal or inactivation of select model/surrogate contaminants spiked into each source water, including viral and bacterial pathogens, metals, nutrients, pesticides, plasticizers, pharmaceuticals, antibiotics, per-/polyfluoroalkyl substances, and total dissolved and suspended solids. Each configuration of treatment technology and source water will be evaluated over a 4-week period of continuous operation. Trends in treatment performance will help assess longevity of each technology and enable estimates of maintenance required in various water reuse applications. The PIs have extensive experience with similar bench/pilot-scale experiments to test water technologies and all analytical methods needed.

Upon completion of these technology validation efforts, a more complete STS, with research gaps addressed through Task 2-3, will be available for broader use in small communities. A simplified open-access, web-based spreadsheet will be constructed to enable rapid search for appropriate combinations of water sources, technologies, and end-uses for each given scenario.

Objective 3

Task 3: Construct cost curves of source waters for beneficial reuse

We will develop cost curves as a tool for benefit-cost analysis, enabling comparison of water reuse options with conventional water systems, and allowing consideration of both monetized and unmonetized benefits of fit-for-purpose reuse. We propose to (1) collect data on capital investment and operational and management (O&M) costs for technologies identified in Task 2-2; (2) monetize the benefits of water reuse by source water and end use purpose; and (3) construct a cost curve for fit-for-purpose water reuse, differentiated by end-use, for each small system identified in the study (Figure 3).

Select treatment technologies: Output from Task 2-2 will provide a list of treatment technologies or measures aimed at water reuse for small systems.

Calculate financial costs: Financial costs of water reuse implementation include capital investment costs, O&M costs, and treatment costs. This information will be collected for each

small system-measure pair based on literature data search and technology scanning (Task 2-2). The financial costs will be presented in the form of present values [53] based on 2021 prices and analyzed over a 50-year time horizon (2022 to 2071), which corresponds to the typical lifetime of wastewater treatment plants, considering reinvestment or depreciation [54] as necessary.

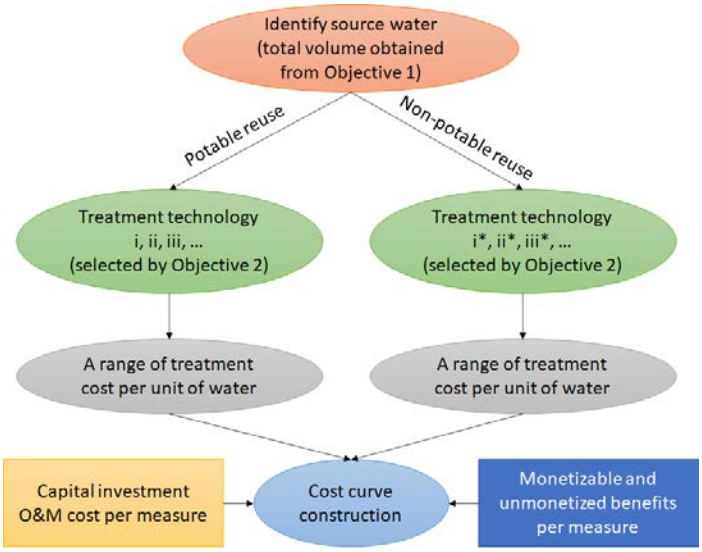


Figure 3. Steps to identify measures for fit-for-purpose water reuse for cost curve construction. Choice of end use shown is simplified for clarity.

Measure cost savings and perform benefit-cost analysis: Water reuse can provide a range of monetizable and unmonetized benefits, including water supply augmentation, supply reliability, reduction of treated wastewater effluent disposal, reduced maintenance and deferred construction of new facilities, increase public health protection, reduced environmental impacts, increase inland surface water flow, increase groundwater recharge, and many other benefits. To monetize and quantify the benefits of water reuse, we will perform the analysis in two steps.

First, we will measure cost savings generated by water reuse in the form of tangible benefits. We will focus on supply side benefits with monetary values: displacing a fraction of current freshwater supply; reduced maintenance, savings on construction of new freshwater supply facilities; sales of treated water, etc. Literature data will be compiled to quantify a range of values for these and other benefits. These values will be incorporated as opportunity costs (see below), adjustable given economy of scale and other factors for a specific community.

Second, we will measure cost savings including environmental (unmonetized) benefits derived using contingent valuation (see Task 4, below). We will use data and methods from attempts to estimate the social cost of water pollution [28] to generate values for people's willingness to pay for cleaner water. Meanwhile, Task 4 will provide environmental benefit estimates through valuation surveys.

A sample cost curve for water reuse is presented in Figure 4. Each bar represents a specific measure identified for each type of source water. The width of the bar indicates the volume of water and the height of the bar indicates the amortized marginal cost of implementing the specific measure. Monetized benefits are computed as the sum of monetizable and environmental benefits. Marginal cost can be calculated by dividing net cost by the total volume of reused water from measure i. By incorporating existing data

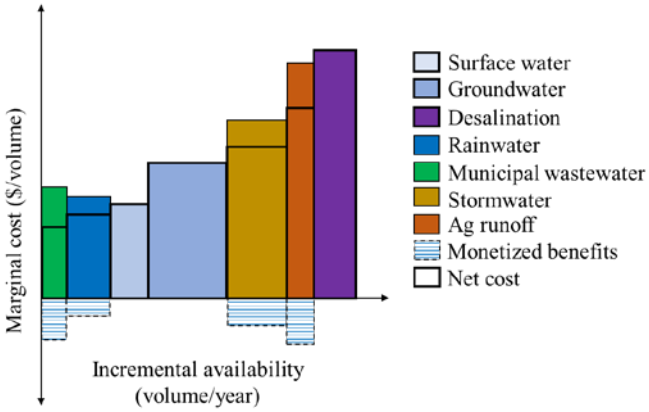


Figure 4. Hypothetical example cost curve for fit-for-purpose reuse for a small system.

with new estimates in a cost curve, we will provide a structured way for decision makers to 1) estimate a first order approximation of economic viability for a range of technologies and 2) compare water reuse options against other supply options in a unifying economic framework.

Objective 4

Task 4: Assess public attitudes and willingness to pay (WTP) on water reuse

We will conduct a national survey to determine what end-uses people are willing to accept, the willingness to pay (WTP) for a water reuse program, and the value of recycled water relative to alternative sources of water. The survey targets towns in rural areas with population smaller than 10,000, while also including a small sample of urban populations for comparison. The survey instrument will be designed to answer the following questions:

1. Do people accept water reuse from some sources better than other sources?
2. How does support for water recycling vary with end use (e.g., firefighting, irrigation of edible/non-edible crops, groundwater/surface water augmentation) in small communities?
3. How do concerns around water reuse (e.g., health, psychological, economic) compare?
4. How do factors such as disgust, information, perceived health risks, trust, perceived water scarcity, environmental concerns, and water price affect the support of water reuse?
5. What is the WTP for recycled water? We will use the contingent valuation method [55,56] with dichotomous choice questions to estimate WTP for water reuse programs, compared with a non-reuse system expansion option.

Combined online/mail surveys will be used to collect responses from a representative national sample of rural populations. Respondents will be randomly assigned to one of the treatment groups (Table 2) to test the effect of health risk information, framing (environmental benefits versus water scarcity), water reuse programs, and incentive.

Table 2. Survey experiment of information and framing.

	Treatment 1 - Information	
Treatment 2 - Framing	Information on health risk, Environmental benefits	No-information, Environmental benefits
	Information on health risk, Water scarcity	No-information, Water scarcity

We will build on previous survey studies for water reuse focusing on (a) public acceptance, and (b) WTP. The survey instrument (Figure 5) will be designed for a national representative sample of small, rural communities, with tailored versions targeting the specific communities in Colorado and California (Obj. 5) and the five US case study communities (Obj. 6). The survey questionnaire tailored for the Colorado case studies will have information on relevant institutional and regulatory elements, while those in the five US case study communities will address specific technological options surfaced in Obj. 6. Survey instruments will be tested with focus groups before distribution. Information collected by the survey will be used to:

- identify the sources of water and end-uses with high acceptance to inform the scan and selection of water reuse technologies in Task 2-2
- estimate environmental benefits of reclaimed water by comparing with a non-reuse system expansion, and support the cost estimates from Task 4 for benefit-cost analysis
- generate demand curves for reused water, which can be scaled and integrated with cost curves
- understand the factors influencing acceptance to help identify barriers to adopting water reuse in small communities, provide information on potential ways to increase public support, and recommendations for appropriate policy actions (Task 5-1)

Each of these outputs will contribute to a clearer economic view of water reuse options, and jointly will produce a coordinated suite of information that can help guide both local level decision making on water reuse, and policies to support broader adoption in small communities.

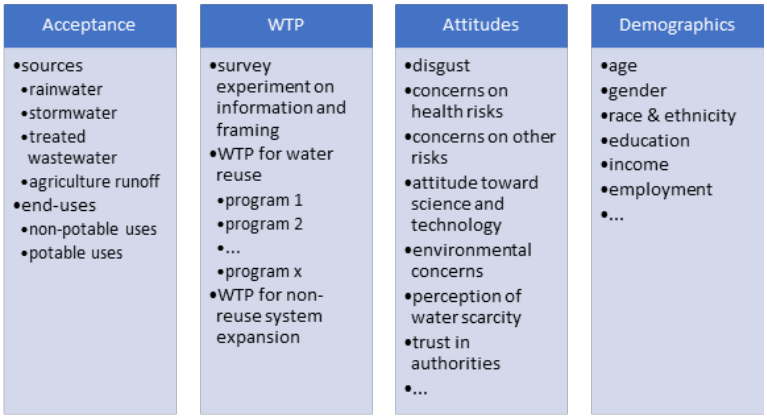


Figure 5. Survey instrument design.

Objective 5

We will anchor our research on institutional aspects of water reuse for small and rural communities around detailed case studies in Colorado, augmented by comparative research in other areas. The Colorado Department of Public Health and Environment (CDPHE) has developed more stringent regulatory standards for wastewater discharges in recent years and is shifting increasing attention toward compliance in small and rural communities (see LOI - CDPHE). In the face of organized opposition to regulatory activity among rural communities in the state, CDPHE is actively exploring how to engage more effectively with these communities to help them understand their water quality responsibilities and what resources are available to help them build needed capacities. In parallel, CDPHE is developing new water reuse regulations. Further, Colorado's water rights system presents opportunities and challenges for water reuse that fall largely outside CDPHE's jurisdiction. We will use semi-structured interviews, stakeholder workshops, document analysis, and legal and policy analysis to develop case studies in Colorado and other states, draw comparative lessons, and inform recommendations for regulators and local decision makers through five interconnected and mutually reinforcing tasks, outlined below.

Task 5-1: Analyze opportunities for coordinating disparate interests

Some water reuse projects will be justifiable based on water supply benefits alone, but many more may only be economically or politically viable when taking multiple benefits into account. Examples include projects that combine groundwater recharge and stormwater management, agricultural water supply augmentation and reduction of nutrient loading to receiving waters, water supply availability and habitat creation [57], etc. However, water management and regulation are typically fragmented institutionally, making accounting for and incorporating multiple benefits dependent on effective coordination among multiple entities with disparate interests [58]. Therefore, we will complement the cost-benefit analysis of Obj. 3 by examining mechanisms for coordination around water reuse. Case studies in Colorado and California will analyze the complementary and conflicting interests within a single regulatory agency and among local stakeholders, highlighting potential alignment and coordination.

Task 5-2: Clarify implications of water rights and effluent-dependent ecosystems

In Western states, decisions to reuse wastewater effluent that was previously discharged to surface water could affect downstream water rights or diminish instream flows that support ecosystems. Potential reuse proponents may not appreciate the importance of these tensions, or may incorrectly perceive them as insurmountable barriers to water reuse. We will use stakeholder

workshops and case studies to enumerate potential barriers to water reuse arising from water rights and ecosystem needs and protections, highlight creative solutions that appropriately navigate these tensions, and generate recommendations for policy actions that respect water rights, support ecosystems, and enable holistic management of water through reuse. We will augment in-depth case studies with comparative analysis of western water rights and water reuse to suggest where and how water rights and ecosystems may need special attention from water reuse proponents.

Task 5-3: Assess how to address collective opposition to regulation

Necessary regulation, such as implementing regulatory standards that adequately protect public and environmental health, is sometimes perceived as contrary to the interests of small and rural communities. Resistance to regulation may be motivated by different combinations of factors (e.g., perceptions of high cost, perceptions of risk, political ideology), can take different forms (e.g., formal opposition via industry groups vs. communities loosely acting in concert), and may involve seemingly independent third parties (e.g., consultants serving multiple communities). It can be particularly challenging in distributed situations, such as when opposition spreads through a rural region, and can impede the integrative thinking necessary to fulfill the promise of water reuse. To understand how regulators can address collective opposition appropriately with the right mixture of carrots and sticks, we will conduct case studies of organized resistance to regulation (e.g., Colorado rural communities' resistance to increasingly stringent nutrient regulations, pushback by wastewater industry groups, etc. and relevant regulatory responses. We will give particular attention to effective communication and engagement, means of incentivizing regulatory compliance given resource limitations, and the perceived costs and benefits of water reuse.

Task 5-4: Identify ways to build underserved communities' trust

Even where water reuse may help underserved communities address water challenges, they may distrust proposed solutions and their water system's capacity for successful implementation. Many have histories of race- and class-motivated underinvestment resulting in inadequate water and wastewater service and unsafe, unpalatable, or unreliable drinking water, with tangible and lasting repercussions for economic and public health. We will interview community members in underserved communities to document sources of distrust and develop recommendations for legitimizing reuse. Our goal will be to identify and expand windows of opportunity for pursuing water reuse while establishing clear mechanisms for building accountability and trust0.

Task 5-5: Clarify opportunities to advance regulatory leadership

Prior EPA-funded research by the UCB team highlighted the importance of regulatory relationships when wastewater utilities are seeking to adopt innovative technologies. The work identified five interconnected characteristics of regulatory relationships that, individually and collectively, appear to facilitate innovation (see Figure 6) [59]. Large, well-resourced, and sophisticated utilities can be expected to shoulder significant responsibility for cultivating effective regulatory relationships around reuse. By contrast, a more proactive approach (regulatory leadership) may be needed to make reuse accessible to small and rural communities, including new means of coordination, outreach, engagement, education, and assistance. We propose to clarify the potential for regulators to increase progress toward meeting regulatory goals through more actively identifying and addressing barriers to socially and environmentally beneficial innovation, as well as cultivating more effective regulatory relationships to accelerate appropriate adoption of water reuse. We will use workshops with key thought leaders from the regulator and

regulated communities to augment lessons from Tasks 5-1 to 5-4. To highlight insights from Objective 5, will disseminate policy-focused research results, centered around a "virtual road show" that calls on proven leaders to highlight the institutional aspects of successful (and failed) water reuse projects and the role of regulatory leadership.

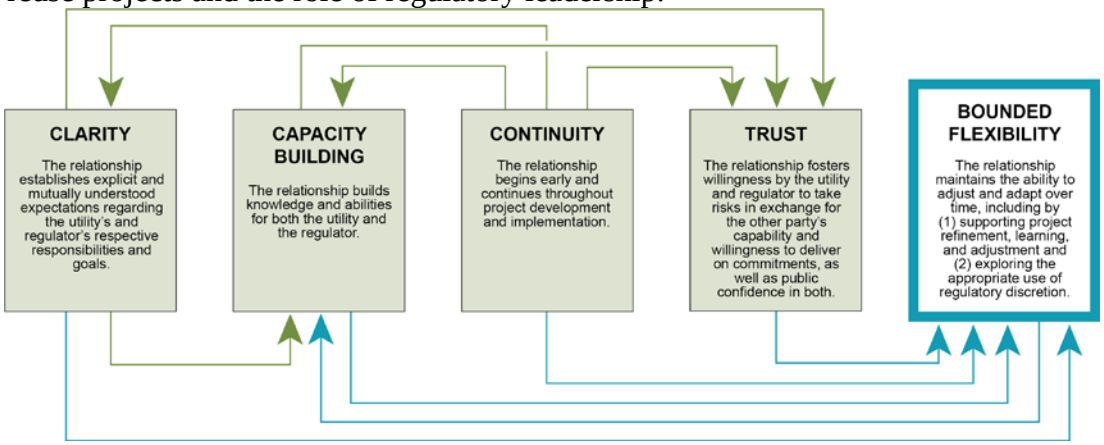


Figure 6. Characteristics of effective regulatory relationships around innovation

Objective 6

Task 6: Conduct case studies of five small communities to construct implementation roadmaps centered around windows of opportunity for water reuse.

We propose to examine decision making for water reuse in small and rural communities, taking a broader view of TMF concerns and opportunities than is typically considered in water-related planning. Our goal is to distill and systematize key considerations for water reuse with a focus on highlighting "windows of opportunity," which we define as points where communities can identify connections among a range of physical, social, and institutional priorities that together support implementation of water reuse. Ultimately, the windows of opportunity approach will become a tool to foster implementation of appropriate reuse technologies by highlighting areas where communities can leverage integration across disparate goals for multiple benefits.

We will anchor our work in five case studies in which detailed engineering assessments are mated with institutional analysis to produce a holistic picture of suitability for water reuse. Community engagement will be infused throughout this process and fed back into the technical elements of the proposal, supporting the co-production of useful and useable results [60]. We will draw directly from Obj. 1 (water availability), 2 (technology screening), 3 (cost curves), 4 (WTP), and 5 (regulatory leadership) for methodology and data inputs, with the goal of using and building on existing EPA guidance (Figure 7, [61]). Our efforts will produce an implementation roadmap with clear guidance for regulators, funding agencies, public stakeholders, and the private sector on where, when, and how water reuse can be successfully implemented.

Our team will collaborate closely with key staff from American Water Works Association (AWWA) and Engineers Without Borders (see LOI - AWWA). These organizations have deep, relevant experience with water engineering and planning for small and rural communities. Both, especially through AWWA's Community Engineering Corps, have deep networks of professional

trainers and advisors, on which to draw, including volunteers who regularly contribute TMF capacity to small and rural communities to advance water system performance. AWWA staff will consult on project selection and implementation, and work closely with a postdoctoral scholar on our team.

We will develop five case studies in parallel, using a four stage process: case study screening and selection, infrastructure and organizational assessment, windows of opportunity framework, and landscape analysis. Our ultimate goals will be to assist these five communities, and in so doing to develop a generalizable framework for applying such assessment in other rural communities

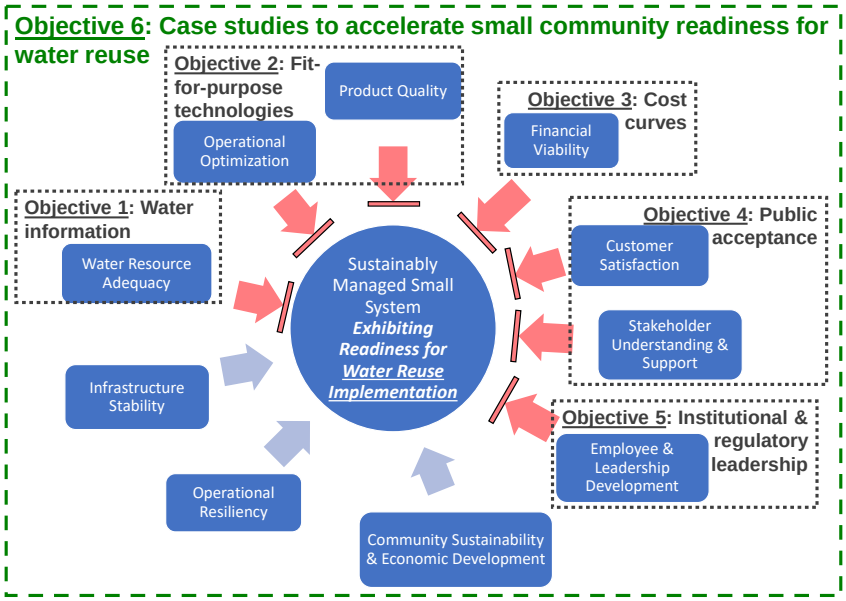


Figure 7. Framework for Obj. 6 case studies and incorporating outputs from Obj. 1-5. Major barriers identified in this proposed work are shown in red arrows; Obj. 1-5 outputs will help overcome these barriers. Adapted from the Rural and Small Systems Guidebook to Sustainable Utility Management [61].

Preliminary design of screening criteria: Formal assessments of small water system suitability often rely on deterministic technical assessments that consider standard methodology [62,63]. Crucially, they often lack a the ability to reflect decision makers' full range of priorities. Sole reliance on engineering-based analysis can limit outcomes for communities [64]. For the first step towards producing a broader windows of opportunity framework, we will produce a conceptual model for screening criteria based on interviews with regulators and experts within Small Systems Division and the Water Reuse Committee within AWWA. Criteria will include a range of factors such as physical geography and infrastructure characteristics, existing water and wastewater infrastructure and its condition, water demand and available supply (Obj. 1); regulatory compliance or lack thereof, existing and potential funding and financing mechanisms, financial stability of the community and the system, and access to critical expertise or materials, access to labor and material value chains, metrics of social and cultural acceptability (Obj. 4), a regulatory environment that would foster stakeholder collaboration for implementation, and so forth.

Case study selection: Preliminary criteria will be used to identify five target communities for reuse evaluation, in coordination with stakeholder agencies, local partnerships, and through the AWWA network of volunteers. At least two of the communities will be identified as underserved, defined, for example, by a mean household income (MHI) less than 80% of the statewide MHI.

Infrastructure and organizational assessment: Drawing on the criteria developed above, we will conduct a broad-spectrum infrastructure assessment in each of the five communities to

determine the technical feasibility of reuse, drawing on research and methods described in Objectives 1-5. The infrastructure assessment will examine the current state of water, wastewater, and – crucially - related infrastructure within the five selected communities, in parallel with institutional elements. We will collaborate on this assessment with regulators and an engineering consulting firm that services small systems (Tighe & Bond). The goals of this exercise will be to a) produce an assessment report of reuse potential for each of the case studies to inform decision makers in each community of their options for reuse, b) refine and expand the criteria developed above, c) draw connections between criteria to support a windows of opportunity framework.

The technical carrying capacity (the amount and complexity of infrastructure the community can be expected to support long term) of the selected communities will be evaluated using quantitative and qualitative techniques. Quantitative inputs into the carrying capacity assessment will include (1) the frequency and nature of any water quality violations, (2) the complexity of existing treatment processes, and (3) the number and grade of water system operator licenses held by the community. Qualitative inputs from the implementation analysis will be gathered through document analysis and interviews with identified community partners. Target interviewees will include include public works directors, water superintendents, and head operators. Our team will also engage with utility advisory boards or town council members for broader community stakeholder perspective. Interview questions during these meetings will focus on technology needs, current and future supply line status, operational capabilities, and overall community perspective on water reuse. In addition, we will use input from these meetings to help define and refine decision support tools developed through this proposed work.

Windows of opportunity framework: Building on the assessment reports, and in collaboration with regulators and community leaders, we will highlight windows of opportunity where technical, social, financial, organizational, and regulatory elements can *combine* to produce favorable conditions for water reuse options. Windows of opportunity will be revealed through mapping linkages among (often seemingly disparate) priorities to yield ideas for creative combinations of drivers. For example, a small utility struggling with phosphate removal from wastewater and drought-driven receding groundwater levels might combine these two factors as an opportunity to adopt an engineered biochar percolation system that decreases phosphate levels while also redistributing effluent to groundwater recharge. A key focus of windows of opportunity will be looking for opportunities to leverage disparate funding sources. For example, joining a grant to upgrade a distribution system with planned road repair could change the cost-benefit for both.

A synthesis report, highlighting the five case studies, a final set of criteria, and the windows of opportunity framework will be used to develop a generalized framework and decision support tool geared to help regulators, stakeholders, consultants, and community decision makers holistically evaluate their reuse readiness. The report will outline strategies for regulators and stakeholders to effectively present appropriate reuse technologies. The synthesis report will also demonstrate the interconnectivity between public and private sector partners, equipment vendors, and technical resources, and define roles and responsibilities of associated parties in creating successful and sustainable implementations of reuse.

The synthesis report will serve as a tool for national analysis of water reuse potential. An important assumption underlying our overarching approach to this proposal is the uniqueness of each small water system and the context within which it resides. Given this, the synthesis report

will be geared not towards a coarse assessment of country-wide readiness for reuse, but towards empowering regulators, stakeholders, and local decision makers to evaluate the role reuse could play in achieving multiple benefits for any given community, and generating pathways to realistically actualize them. The ultimate integrative result of our work will be a flexible method for evaluation of a community's water reuse readiness, applicable at a national scale (i.e., the landscape). Our approach will be packaged as a final report submitted to the EPA, providing recommendations for ways to incentivize water reuse in small communities. The EPA can then modify and incorporate this appraoch into its technical guidance offerings for small and rural communities to improve decision making capacity at a national scale.

Responsiveness to EPA National Water Reuse Action Plan (WRAP)

The following section summarizes ways the proposed research responds to calls for action in WRAP. Only WRAP Action numbers are noted for brevity.

- **Objective 1:** *Primary:* Action 5.5; *Related and supporting:* Actions 8.5, 1.2, 10.3, 3.4
- **Objective 2:** *Primary:* Actions 3.6, and 4.7; *Related and supporting:* Actions 3.1, 3.7, and 1.5
- **Objective 3:** *Related and supporting:* Actions 1.5 and 3.4
- **Objective 4:** *Primary:* Action 8.6; *Related and supporting:* Actions 2.16 and 8.5
- **Objective 5:** *Primary:* Actions 2.6, 8.5, 2.16, 1.2, 2.1; *Related and supporting:* 11.3 and 10.3
- **Objective 6:** *Primary:* 10.3, 1.2, 2.1, 8.6, 8.5; *Related and supporting:* 6.4 and 11.3

Environmental Justice

Water stress is increasing in many areas of the US, but may be an especially serious challenge for smaller communities with undiversified water supplies, including many small and rural underserved communities across the nation. Water reuse is nearing an imperative for many areas, yet the tools typically used to mitigate the increased risks inherent in reusing contaminated water are not readily adoptable by small and rural systems. For example, adaptation of ozone and UV, two common inputs for water reuse, occurs at much lower rates than larger systems [65]. Also, small drinking water systems in the USA have higher rates of health-based water quality violations [5]. This combination of increasing water stress and inappropriate technology represent an environmental injustice whereby geography and community size are unfortunate predictors of adequate water supplies. This project squarely addresses the disproportionate and adverse human health and environmental impacts by accelerating potential water reuse from small and rural systems, with attention to feasibility, public health implications, and affordability. Survey work (Obj. 4) and interviews and stakeholder workshops (Obj. 5) will actively seek the views, insights, and ideas of community members and community advocacy groups in underserved communities regarding water reuse, willingness to pay for water reuse, opportunities for coordination among disparate interests to enable multi-benefit water reuse, mechanisms for bringing accountability and transparency to water reuse decision making, the role of regulation, and opportunities for regulatory leadership to advance water reuse in underserved communities. A key community research partner, *Leadership Counsel for Justice and Accountability (LCJA),* will work with the academic team on detailed planning and implementation of Obj. 5. Obj. 6 will include case studies in at least two underserved communities. Products from this work including the windows of opportunity roadmap, framework for carrying capacity quantification and list of appropriate and accessible water reuse technology are targeted specifically to small and rural communities: as

many such communities are underserved, our work will help close health and environmental gaps and contribute to national environmental justice priorities.

Innovation and Sustainability

Innovation

The proposed work is driven largely by an interest in acknowledging and addressing the innovation deficit [66] in water management in rural and small systems. The gulf between the current scarce implementation of water reuse in small systems and its potential is wide: advancing water reuse will, by definition, require developing new approaches to technology and management practices. The proposed work itself consists of individual efforts of research innovation, which as a whole will combine to, in turn, enable broader applied innovation through the real-world use of its framework and decision tools. The result will be increased potential for water reuse innovations on the ground, enabling the broader adoption and diffusion of reuse and ultimately its transition to a standard practice. As impediments to the broad legitimization of water reuse are often multidisciplinary barriers, this project contributes to filling knowledge gaps across technical, social, financial, organizational, and regulatory elements, and co-producing community-tailored roadmaps with community leaders. Specifically, this project overcomes the informational (Obj. 1) and technical (Obj. 2) challenges in water reuse implementation, ties with socioeconomic (Obj. 3 and 4) and institutional (Obj. 5) innovations that incentivize water reuse and accelerates community readiness for water reuse via visionary and integrative solutions (Obj. 6). Through the convergence of multidisciplinary innovations, we aim to close the knowledge gaps, address multiple community concerns, and provide generalizable guidance for small systems throughout the US.

Sustainability

This proposed work embodies the three pillars of sustainability: environmental, social, and economic. The central motivation behind the proposed work is the premise that appropriate application of water reuse can help address all three of these pillars at a national scale. By increasing the pace of adoption and diffusion of water reuse approaches, the proposed work will contribute to national sustainability goals for water and environmental systems. Implementation of fit-for-purpose water reuse collectively addresses multiple environmental issues, including but not limited to, reducing exposures to water contamination, alleviating water stress, sustaining ecosystem services, and enhancing resilience against climate change. In particular, advancing water reuse for underserved small, rural, and low-capacity communities may help these communities achieve multiple benefits while simultaneously addressing environmental goals in ways that traditional infrastructure typically does not. Products from this work, which will be co-produced with regulators and community leaders, will address the disproportionate and adverse human health and environmental impacts felt by small communities, and thus promoting the development, planning, and building of sustainable communities. Additionally, this work also empowers communities to learn about sustainability and resilience of water reuse through the proposed community-based case studies. Additionally, this project will connect scientific data with economic analysis that provide quantifiable incentives and considerations of water reuse for resource-stressed communities.

Expected Results, Benefits, Outputs, and Outcomes

The expected outputs and outcomes of this project are summarized in Table 3.

Table 3. Expected results, outputs, benefits and outcomes for each objective.

Objectives / Results	Outputs	Benefits / Outcomes
Obj. 1:	• Inventory of sources for water reuse for Obj. 6 case study communities • Stepwise SOP for developing water inventory • Prototype calculation engine to compute water inventory • Peer-reviewed publications	• Improved access by decision makers to useful, and useable data on water available for reuse • Increased potential for decision makers to consider water reuse from a source water perspective
Obj. 2:	• Searchable, web-based spreadsheet of source/ technology/end-use combinations • A technology scan framework that can be used periodically as new technology developments • Peer-reviewed publications	• Small systems interested in reuse of pre-screened technologies to focus on. • Several new technologies ready for full-scale application due to closed research gaps.
Obj. 3:	• Cost curves for source water/end-use combinations tailored to small communities • Framework for developing cost curves for water reuse • Peer-reviewed publications	• Increased ability for decision makers to consider water reuse in an economic context, and to compare with traditional options. • Increased ability for decision makers to consider intangible economic benefits of water reuse in broader context.
Obj. 4:	• National-scale survey data on public acceptance and WTP for water reuse focused on small community residents • Tailored survey data on water reuse acceptance and WTP for specific source water/technology/end-use combinations for Obj. 6 case study communities • Recommendations for policy approaches and incentives for overcoming social resistance to water reuse. • Peer-reviewed publications	• Increased understanding by decision makers about their constituents' willingness to pay for water reuse in small communities. • Potential policy action targeted towards overcoming small communities' resistance to water reuse.
Obj. 5:	• Workshops • Outreach and engagement (blog posts, fact sheets) • Video products – distillation for lay audiences, motivational • A "virtual road show" through which research results are communicated to broader audiences, and leadership in water reuse is exemplified by the regulators and community decision makers who have succeeded in advancing its implementation • Publications (white papers, issue briefs, journal articles, law review)	• Advancing regulatory leadership in Colorado • Better informed and empowered regulators and community leaders more capable of considering and implementing water reuse in small and rural communities • Methods for advancing environmental justice through water reuse, co-developed and jointly disseminated with a leading EJ organization
Obj. 6:	• Roadmap for water reuse available as guidance to small communities • Peer-reviewed journal articles summarizing convergence of water reuse factors	• Small water systems have tools and resources for accelerating water reuse application • Small systems with more resilience water resources • A decreasing gap between large and small systems with respect to water reuse technology adaptation.

Project Management

Facilities

ISU laboratories: The Environmental Engineering laboratories at ISU are equipped with liquid chromatograph with mass spectrometer (LC-MS), gas chromatograph with mass spectrometer (GC-MS), ion chromatograph, inductively-coupled plasma emission spectroscopy (ICP-ES), combustion oxidation organic carbon analyzer, and routine molecular biology equipment, which will be used in Obj. 2. The research team has access to all ISU core facilities for a nominal fee that offers state-of-the-art equipment for chemical, biological, and physical characterization.

URI laboratories: The Environmental Engineering lab is equipped with routine chemical equipment as well as a UV-vis spectrophotometer, GC for THM analysis, total organic carbon (TOC) analyzer. The laboratory includes a 350 ft^2 area for continuous flow column experiments, including tanks for water storage. Core facilities on campus housing state-of-the-art instrumentation will be leveraged for the analytical methods used in this proposed work.

UCB facilities: The Center for Law, Energy & the Environment at UCB School of Law has extensive facilities for convenings, and a 15 year history of successfully organizing and facilitating workshops, conferences, focus groups, and other meetings. This experience and the related intellectual infrastructure are key resources on which we will draw heavily to complete the proposed work. Our events will most likely to take place off campus, in the regions that are the substantive focus of this work, or virtually as appropriate.

Personnel expertise and experience

Project leadership: PI Ikuma (lead PI) has extensive research experience in environmental microbiology and water quality with a focus on public health protection in water reuse. She has experience leading interdisciplinary, federally-funded research projects with multiple PIs involving human subject research, and has recently completed formal training on effectively leading for large teams. Co-PI Goodwill (URI lead) has fifteen years of experience in academia and consulting working on water physicochemical processes. He specializes in transformation and removal of contaminants in water reuse. Co-PI Kiparsky (UCB lead) has 20 years of experience leading research and engagement efforts at the intersection of water institutions, science, and technology, including extensive work on processes of urban water sector innovation.

Water information expertise: We include a strong team of water resources researchers with expertise in climate change predictions of water availability (Co-PI Liu [ISU]), agricultural flows (Co-PI Arenas [ISU]), and stormwater management (Co-PI Rehmann [ISU]).

Technology innovation and health risk expertise: The project team represents a strong background in innovative active (Co-PIs Goodwill and Ong [ISU]) and passive treatment technologies (Co-PI Charbonnet [ISU]), and public health risk prevention (PI Ikuma, Co-PI Craver [URI]).

Social and organizational innovation expertise: Our team includes researchers with exceptionally strong backgrounds in institutional innovation and regulatory leadership (Co-PI Kiparsky, Senior Research Fellow Green Nylen [UCB]), as well as water and environmental policy (Co-PI Wang [ISU]) and economics (Co-PI Guilfoos [URI]).

Overall project management structure

PI Ikuma will serve as the lead PI and overall project manager. The postdoctoral researcher to be hired at ISU will serve as the QA manager as well as assist in project management in addition to

their research efforts. Most objectives have 2-3 lead co-PIs who will oversee the tasks as shown in Figure 8; these PIs will organize weekly or biweekly progress meetings with associated project personnel. PI Ikuma will organize monthly project-wide meetings with all project personnel to track progress towards achieving the expected results outlined above. These meetings are particularly important to ensure that Obj. 1-5 are not conducted in a vacuum, but that these research efforts are informed by the real small community context through Obj. 6 efforts. All meetings will take place at ISU with URI, UCB, and stakeholders participating via conference video calls. Meeting notes will be shared in a timely manner with all project personnel through an online server and/or email. In addition, PI Ikuma will host a Microsoft Teams channel for real-time communication between project personnel that will be routinely monitored by the postdoc researcher. Other data will be shared using an online server (see QA Statement and Scientific Data Management Plan). PI Ikuma will be responsible for keeping the project, budget, and dissemination of results on track throughout the project period.

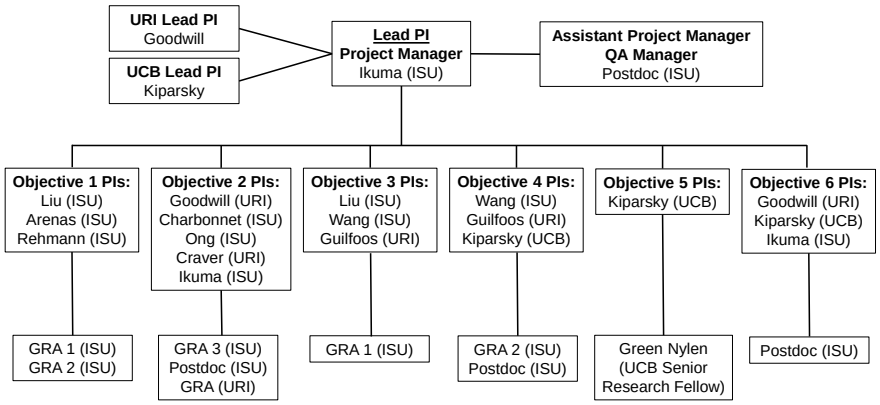


Figure 8. Project management organization.

Project Schedule

The proposed work will span a 4-year period (Table 4). While most tasks will be concurrent, continuous communication with project personnel across tasks will ensure that decisions are made according to the goals and objectives for this project.

Table 4. Project schedules with associated milestones and target dates. Data collection will not start until the QAPP and IRB/HRSSO approval.

		Year 1				Year 2				Year 3				Year 4			
Obj	**Task**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**	**Q1**	**Q2**	**Q3**	**Q4**
--	QAPP to EPA for approval																
--	Obtain IRB and HSRRO approval for human subjects research																
1	Overcome water information barrier	Collect and consolidate available data								Develop prototype calculation engine and SOP							
2	Overcome technology/health barrier	Develop STS framework				Validate technologies and make spreadsheet tool for technology selection											
3	Construct cost curve					Calculate costs				Perform benefit-cost analysis and construct cost curves							
4	Understand public acceptance and WTP	Conduct national survey				Conduct target community surveys											
5	Foster regulatory leadership	CO/CA in-depth case studies on disparate interests, water rights, collective opposition, and building trust												Advance regulatory leadership			
6	Conduct case studies in small communities	Case study community selection				Infrastructure & organizational assessment				Windows of opportunity framework				Landscape analysis			
--	Reporting to EPA				**AR**				**AR**				**AR**				**FR**

QAPP: Quality Assurance Project Plan; **IRB**: Institutional Review Board; **HSRRO**: EPA Human Subjects Research Review Official; **AR**: Annual Report; **FR**: Final Report

QUALITY ASSURANCE STATEMENT

1. Project QA Management Structure

The postdoctoral researcher (ISU; to be hired) will serve as the Quality Assurance (QA) Manager for the entire project and will oversee all QA and quality control (QC) of research activities outlined in the Research Plan. Responsibilities include working with ISU staff on administration of contracts associated with project activities, preparation, review, and approval of the quality assurance project plan (QAPP) and subsequent revisions to ensure data quality, records management, and overall data QA management. Specifically, PI Ikuma (ISU) and the postdoc will coordinate with all other project personnel to maintain adequate QA management of each objective. PI Ikuma has served as QA Manager or in similar roles in two other EPA-funded projects during her postdoc years as well as an assistant professor at ISU, and therefore, can guide the postdoc in how to build an effective QA management structure.

QA management for each objective will be the primary responsibility of the following PIs: Obj. 1 - Co-PI Rehmann (ISU); Obj. 2 - Co-PIs Goodwill (URI) and Charbonnet (ISU); Obj. 3 – Co-PI Liu (ISU); Obj. 4 – Co-PI Wang (ISU); Obj. 5 – Co-PI Kiparsky (UCB); Obj. 6 – PI Ikuma.

2. Project Objectives and Hypotheses

The main goal of this project is to accelerate community readiness for water reuse in small, rural, and underserved communities by overcoming major barriers to water reuse adoption. Our overarching hypothesis for this proposed work is that community readiness for water reuse in small systems can be accelerated by a convergence of technological, informational, social, and institutional innovation. In addition, we hypothesize that severe water scarcity need not be a prerequisite for water reuse implementation, given careful attention to windows of opportunity that integrate multiple community concerns. These main hypotheses will be tested through the following objectives of this project: (1) develop water inventory to overcome the water information barrier; (2) develop validated list of fit-for-purpose technologies to overcome lack of guidance on appropriate technologies; (3) construct projected cost curves that incorporate environmental benefits; (4) identify ways to overcome social barriers to public acceptance; (5) foster institutional innovation to overcome organizational barriers; and (6) conduct case studies to accelerate community readiness for water reuse in five small communities across the US.

3. Data Collection, Analyses, and Use

a. *Collection of new data:* Data collection and analytical methods to be used in each objective will follow the *Research Plan* and best practices in each research area. Though specific analytical methods are not listed herein, we will use rigorously tested and validated methods for all analytical measurements in the laboratory (mostly EPA methods and Standard Methods). In particular for Obj. 2, precision of chemical and biological data will be evaluated by relative percent difference or relative standard deviation on duplicate or split samples (<20% acceptable); accuracy will be evaluated by blind proficiency testing and percent recovery of spikes (<20% acceptable); and completeness will be evaluated (strive for 100% completeness). For quality control purposes, duplicate water samples will

be collected on a minimum of 10% of the batch or pilot-scale experiments performed. Unique sample ID will be generated for each sample to track its progress through the laboratory. Samples are considered complete when all analyses have been performed, and data have been reviewed, verified, and validated. In addition, this project will collect human subjects data. The survey answers will be transferred to an electronic format while hard copies will be destroyed. Semi-structured interview data will include original interview data, including audio recordings and transcriptions of those recordings. Data quality will be assessed through the quality of recordings and transcriptions, and completeness of survey answers.

b. *Use of existing data:* Existing publicly available data will be used in Obj. 1 to generate inventories of water available for reuse and cost curves, which involve volumes and marginal costs of water from different sources. These data will be collected from Oak Ridge National Laboratory Daymet database, CMIP5 hydrology and climate projections, and LOCA hydrologic projections (see *Research Plan* and *Scientific Data Management Plan*). These sources were chosen based on their availability and widespread use, also because all data from these sources go through rigorous QA/QC procedures. Existing, secondary data used in the project will be clearly identified in our data files and in all reports and publications.

c. *Methods development:* No new methods will be developed in this project.

d. *Development of models:* A calculation engine for water availability will be developed in Task 1-2. The calculation engine essentially automates and streamlines the estimation of source water quantity by producing an executable file that performs all calculations based on the methods developed in Task 1-1. Detailed method will be documented and published on peer-reviewed journals, and source code will be shared on public code-sharing platform such as GitHub. Extensive validation and verification of the calculation engine will be performed by comparing calculated results with the data inventory (Task 1-1) for a selective of communities. The calculation engine will be maintained and updated upon additional/new data availability.

e. *Development of environmental technology:* Though no new environmental technology will be developed through this project, we will validate existing, close-to-full-scale water reuse technologies as described in the *Research Plan* (Task 2-3). The technologies will be tested through mesoscale bench or pilot-scale continuous flow experiments in the laboratory. The produced water from these technologies, using different source waters for reuse, will be compared to existing health-based water quality standards as described in Task 2-1 to be deemed acceptable or not. Standard Operating Procedures will be written prior to the testing of each technology. Any design changes will be documented in laboratory notebooks and further clearly stated in reports or other publications.

f. *Conducting surveys:* This project will collect data from human subject interviews and human subject surveys. The survey will be sent to up to 1,000 households in small/rural communities across the US. Detailed treatments and design of surveys including data analysis are provided in the *Research Plan*.

4. Data Management Activities

Scientific data and record files (code, data from simulations, spreadsheets, scans of notebooks, etc.) will be stored on local personal computers. We will maintain backups in the form of hard disk

and cloud-based technologies for digital media. Data will also be backed up using CyBox, a secure, cloud-based storage system sponsored by ISU, which can be made accessible to non-ISU project members. CyBox has the advantage of supporting automatic file-versioning, enabling the tracking and correcting of older versions of a file in case an error is discovered or the current working file is lost. Physical data (e.g., lab notebooks) will be retained in a fire-safe cabinet for a minimum of five years after conclusion of the award or five years after public release (publication), whichever is later. Physical data related to a student's research work will be retained for at least five years after the degree is awarded. Longer periods will apply when questions arise from inquiries or investigations with respect to research. All electronic data collected will be indexed and stored for the remainder of the PIs' careers and will be transferred to new storage media as technology changes over time.

The survey answers will be transferred to an electronic format while hard copies will be destroyed. The researchers will use IRB guidelines to protect the identity of the participants and will keep respondents' names anonymous. Audio recordings from interviews will not be retained after transcription and after applicable policy timelines as they contain personally identifiable information. The survey and interview data will be stored in secure sites (ISU's Cybox) and a locked cabinet for physical copies of surveys and interview recordings. All other data will be maintained with accordance to the IRB protocol at ISU and UCB (see *Human Subject Research Statement*). To ensure replicability of our analysis by others, we will archive all collected data with all personally identifiable information removed.

All data will be shared among project members for discussion and quality assurance throughout the project period. The data will be released to the public at the earliest possible time including an immediate release after publication. Data will be shared with interested parties upon request. Release of the data will adhere to EPA and ISU policies regarding appropriate protection of privacy, confidentiality, security, intellectual property, or other rights or requirements.

EPA HUMAN SUBJECTS RESEARCH STATEMENT

The proposed research includes human subjects research associated with Tasks 3-1 and 3-2 to assess the organizational and social barriers to water reuse adoption in small and rural communities. Prior to beginning any human subjects work, refined plans for the proposed research will be submitted for review to the appropriate Institutional Review Boards (IRBs): for Task 4 the ISU IRB (Federalwide Assurance # FWA00002678; IRB00000473); for Objective 5: The IRB at the University of California, Berkeley (FWA00006252; IRB00000455 and IRB00005610).

1. Risk to Human Subjects

a. Human Subjects Involvement, Characteristics, and Design

Expanding water reuse in small and rural communities will require understanding the unique institutional challenges they face and the different approaches communities and regulators might take to create, or take advantage of, windows of opportunity for appropriate water reuse.

Task 4 and Obj. 5, and will employ mixed methods approaches to understanding organizational and social barriers, including the following human subjects research:

- Surveys to assess public attitudes about water reuse and willingness to pay (WTP);
- Interviews with knowledgeable parties to aid the development of case studies on (a) coordination among and within organizations that is enabling, or could enable, water reuse in small and rural communities; (b) organized resistance to regulation that may affect the prospects for expanding water reuse and regulatory responses to such resistance; and (c) the implications of water rights and effluent-dependent ecosystems for water reuse;
- Interviews on sources of distrust of water reuse in underserved communities and ways to address that distrust;
- Stakeholder convenings (workshops) on (a) the implications of water rights and effluent-dependent ecosystems for water reuse in western states and (b) the potential for more effective regulatory relationships and regulatory leadership around water reuse.

Participants will provide critical insights into institutional challenges associated with water reuse, their social and cultural dimensions and historical origins, and potential means of addressing them that could not be derived in other ways.

Survey data will be collected when participants respond to our online or mail survey. Respondents will receive an invitation letter with the URL link of the online survey, a printed copy of the questionnaire, and a reminder card. They can choose to use the online link to fill out the survey online, or fill out the paper survey and mail back to our address. We will buy name/address information from a service provider (e.g., Dynata) for a representative national sample (2000) of rural population, with a small random sample (500) of urban population for comparison.

Interview and workshop participants will be selected for their involvement in decision making for water reuse, their role as stakeholders who will be affected by reuse projects, or their involvement in community advocacy with underrepresented communities. They will include stakeholders and decision makers associated with water and wastewater utilities (e.g., utility managers and high-level staff), consultants, technical service providers, state and federal water quality regulators, community advocates from underserved communities, NGOs, and other entities that might pursue

water reuse or be affected by it. Many interviews will be focused on case studies in Colorado and California, but participants from other states will also be included, as appropriate. Workshops will include participants from a range of states, with an emphasis on the western U.S. Academic team members will identify potential interviewees and workshop participants in collaboration with community research partners, through publicly available information, and via snowball sampling. Community / non-academic team members will be engaged in specific research projects to assure that the design, implementation, and analysis of the research meets the needs of potential users and beneficiaries. Interview participants will be offered a stipend/honorarium (up to $100) for their participation in this research.

All research participants will be adults (age 18 and older), some of whom will be from economically vulnerable populations. The participation of socioeconomically vulnerable groups will contribute critical perspectives that are too often excluded from water decision making. These perspectives will be crucial for helping us to understand the range in attitudes toward reuse and willingness to pay in small and rural communities, identify untapped opportunities for coordination and collaboration on water reuse in underserved communities, and understand sources of distrust and concern about water reuse in underserved communities as well as potential mechanisms for building accountability and trust around reuse.

b. Sources of Materials

Survey data will be collected from respondents' answers to online or mail survey questions regarding their attitudes about water reuse, willingness to pay, and demographic information. Names/addresses of the sample will be encrypted with a series of randomly-assigned letters and numbers. This encryption will separate personal identifiable information from their survey answers. The personal identifiable information will be stored in the secure university online system – Cybox. Data sharing will also be done via Cybox. The co-PIs and their research assistants who directly participate in survey administration and data entry will have access to personally identifiable information. All personnel who have access to sensitive information will have a certificate of human subject research training.

Interviews will be conducted by phone or Zoom depending on the participant's preference. Workshops will be conducted by Zoom. Collected material from interview and workshop participants will include researchers' notes and audio/video recordings that will be used to aid in data transcription and/or checking notes for accuracy. For Zoom interviews and workshops, we will use the UC Berkeley-licensed version of Zoom and adhere to the UC Berkeley best practices and guidance for Zoom security, including keeping the software up-to-date, using a password-protected meeting code, not allowing others to join before the host, and not allowing others to screen share. We will only do local recordings onto the computer (not Cloud recordings) from Zoom. Participants' personal information (name, organizational affiliation, contact information) will be omitted or anonymized in reporting of results. Data will be secured on a password protected computer and backed up on an external hard drive inside the PIs locked offices. Data will be shared through a secure platform (Box), and accessible to only the researchers on the project team listed on Task 3-2 and approved to conduct Human Subjects Research. All data will be destroyed 5 years after resulting publications.

c. Potential Risks

There is minimal risk in this study in which survey respondents, interviewees, and workshop participants will describe and reflect on their personal and/or professional experiences and views related to water reuse, which is not considered a sensitive topic. It is possible that, due to the specific nature of this project, although individual identities will be kept anonymous, participants might be identifiable to knowledgeable persons of the field.

2. Adequacy of Protection Against Risks

Survey participants will be contacted with an invitation letter. The letter will include an introduction to the study, the URL link to the online survey, informed consent, and a small token ($2 bill) to incentivize participation. Participation in the survey is voluntary. A printed questionnaire will be mailed to those who do not initially respond to provide additional venues of data collection. Individual-level data containing personal identifiable will be encrypted and separated from survey data. The data file containing personal information will be stored using the secure university-approved system – Cybox to ensure safety and reliability. Data and findings will only be reported on the aggregated level. Data-sharing of non-identifiable information will also be conducted through Cybox to prevent any potential risks.

To minimize potential risks to interview and workshop participants, an Information Letter will clearly state, and the interviewer will remind the interviewee at the start of the interview, that confidentiality cannot be guaranteed due to the unique nature of each institution's experience. Participants will be informed about the following elements, at a minimum: a) The identity/affiliation of the researchers; b) A clear description of the study procedures; c) A statement that participation in the research is voluntary; d) Contact information for questions about the research. Participants will also be informed that their name, contact information, and any other identifying information will be kept confidential and that research results will not include a list of interview participants and will not link any identifying information to quotes or any other data, unless they specifically grant permission for it. Audio/video recording will be conducted only if interviewees / workshop participants agree to be audio/video recorded at the beginning of the interview or workshop. Participants will be given the opportunity to review their own quotes and contributions to final publications and will be asked how they should be identified in any publications. They will also be given the opportunity to withdraw their information any time prior to publication of results.

There is a possibility that data privacy could be breached if, e.g., the researcher's computers are hacked, revealing participants survey responses, answers to interview questions, or contributions to workshop discussions. We expect the magnitude of potential harm associated with such a breach would be minimal, since surveys, interviews, and workshops will not be designed to elicit sensitive information and would not put participants at risk of any civil or criminal liability.

3. Potential Benefits of the Proposed Research to Human Subjects and Others

The survey will provide some basic information on water reuse, including how water can be reused from different sources and the potential environmental and health benefits from water reuse. Depending on the participants' prior knowledge, this information may be new to them. A small financial token will be provided to respondents – a $2 bill will be included in the first invitation letter to encourage participation. Respondents who complete the survey will be entered in a lottery to win $20 (up to 30 recipients).

Interview and workshop participants could benefit by developing a better understanding of the institutional challenges associated with implementing water reuse in small and rural communities and ways to address those challenges. Underserved communities in particular could benefit from guidance on improving coordination among and within organizations with different interests to enable water reuse that helps meet multiple community needs, addressing organized resistance to regulation that affects the prospects for water reuse, building accountability and trust around water reuse, and promoting proactive regulatory leadership that helps small and rural communities meet the challenges and responsibilities they face. Workshop participation will provide opportunities for members of underrepresented groups and decision makers at regulatory agencies and water utilities to form networking relationships with each other. These relationships may serve as a point of entry for people from marginalized groups to be meaningfully included in future decision making for water reuse, as well as for decision makers to have access to the valuable perspectives of community members from marginalized groups. Additionally, interview participants will be offered a stipend/honorarium (up to $100) for their participation in this research.

The potential benefits for research participants outweigh the potential risks associated with participation in this study. The risks to participants are reasonable because we expect the risks of a potential breach of confidentiality to be minimal while participants may gain knowledge that could help their communities, or help them in their work.

4. Importance of the Knowledge to be Gained

Small rural communities depend on small systems for water supply, and they often face more constraints and challenges than larger communities. Rural populations differ from urban populations in acceptance, attitudes, and risk perception of water reuse. The survey will provide first-hand data on the specific needs, challenges, and concerns of small rural communities in water reuse. This survey will also be useful in answering some of the questions that haven't been investigated in-depth by previous studies, such as the difference in accepting recycled water from different sources, the specific concerns and risk perceptions of small rural communities, and their willingness to pay for water reuse.

Interviews and workshops will give academic researchers and collaborating partners insights into the institutional challenges associated with implementing water reuse in small and rural communities and how to address those challenges. Resulting publications and other outputs will convey these insights widely, providing critical information to decision makers and stakeholders that can accelerate widespread adoption of water reuse by the nation's many small and rural communities.

The risks to research participants are reasonable because we expect the risks of a potential breach of confidentiality to be minimal while we expect to gain knowledge of great interest and utility to both academics and potential implementers of water reuse projects.

SCIENTIFIC DATA MANAGEMENT PLAN

Types of data and metadata

Objectives 1 and 3 of the proposed project will use publicly available data to generate inventories of water available for reuse and cost curves, which involve volumes and marginal costs of water from different sources). The prototype calculation engine from these objectives will collect and process the data and generate the inventories and cost curves.

Objective 2 of the proposed project will generate two main types of data: (1) numerical rankings from desktop assessments of water treatment technology and (2) bench-scale and pilot-scale treatment processes performance data from resulting from laboratory experiments. Examples of data resulting from laboratory experimentation includes fundamental water quality parameters before and after treatment, such as pH, turbidity, dissolved metals, etc.

Location where data will be publicly accessible

The data used in Objectives 1 and 3 are already accessible from national databases such as SSURGO Database (https://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm), National Elevation Dataset (NED) (https://gdg.sc.egov.usda.gov/Catalog/ProductDescription/NED.html), and Cropland Data Layer (CDL) (https://nassgeodata.gmu.edu/CropScape/). Table 1 presents the sources of meteorological data to be used in Objective 1; runoff will be computed with the curve number method [40]. The particular data used to create the inventories and cost curves for the five case-study communities, as well as the source code, executables, and documentation for the prototype calculation engine, will be made publicly available on GitHub.

Table 1. Sources of meteorological data to be used in Objective 1.

Period	Variable	Sources
Historic	Precipitation	Oak Ridge National Laboratory, Daymet [15]
	Surface runoff	Downscaled CMIP5 hydrology projections [38]
Projected	Precipitation	Downscaled CMIP5 climate projections [67]
	Surface runoff	LOCA hydrologic projections [38]

Data resulting from Objective 2 will be made publicly accessible by posting on The University of Rhode Island Digital Repository (DigitalCommons@URI – digitalcommons.uri.edu). DigitalCommons@URI is open to all URI researchers and offers long-term preservation of 20GB of data, with public access and digital object identifier (DOI) registration. Unique Objective 2 data collected at ISU may be stored on figshare.com to allow open access.

Data standards

The data used, source code, and results produced in the project will be stored as text files, unless otherwise noted. Community-based results produced in Objective 1 and all data from Objective 2 will be stored as spreadsheets (.xlsx). Multiple software programs are capable of viewing and editing .xlsx files.

Access, sharing, and long-term preservation

The PIs have a record of significant peer-reviewed publications, and it is anticipated that the majority of data will be published in peer-reviewed journal publications. When appropriate, manuscripts will be submitted to open access journals. Upon publication, regardless of the journal type, these articles will be made available worldwide by their inclusion in the open-access ISU Digital Repository (http://lib.dr.iastate.edu/), and DigitalCommons@URI. Objective 1 data will also be shared on GitHub, as described above. Archiving these products on these sites will ensure long-term preservation, DOI citations, and free worldwide access.

Validation of published results

Along with the source data, code, and results, we will also store on GitHub documentation that explains how to reproduce figures and tables published in journal articles.

Roles and responsibilities

The three PIs involved in Objectives 1 and 3 (Liu, Arenas, and Rehmann) will share the responsibility of ensuring that the data and code are archived properly on GitHub. PIs Liu and Arenas, who will supervise the graduate research assistants working on Objectives 1 and 3, will guide the students in archiving the results. PIs Ikuma and Goodwill will have final responsibility of ensuring that all data resulting from Objective 2 is properly archived on DigitalCommons@URI or figshare.com.

Resources and capabilities requested

We have not requested any resources for data management. All data management activities involved in Objectives 1 and 3 can be handled within the duties and responsibilities of the PIs and ISU researchers; the ISU Library offers adequate data management support for researchers. Similarly, DigitalCommons@URI is provided to all members of the URI community without costs, and proper archiving within Objective 2 will handled without additional resources required from this proposed project.

COMMUNITY ENGAGEMENT RESEARCH (CEnR) PLAN

This proposed work involves significant levels of community engagement, especially in Objectives 5 and 6, as a critical component of our efforts to accelerate small/rural community readiness for water reuse.

Collaboration and engagement proposed with communities:
Obj. 5 focuses on case studies of small, rural communities in Colorado and California to better understand the unique institutional challenges these communities face in considering and implementing water reuse. We will work with the *Colorado Department of Public Health & Environment* as well as towns such as *Telluride, CO* (see Letters of Intent) for community and stakeholder engagement. The tasks in this objective will leverage existing and new collaboration with experts in environmental justice, including the *Leadership Counsel for Justice and Accountability (LCJA)* and *Felicia Marcus*, who is the William C. Landreth Visiting Fellow at Stanford University's Water in the West Program, a Consultant and Founding Member of the Water Policy Group, and a Fellow of the National Academy of Public Administration (see Letters of Intent). Community engagement with LCJA around Tasks 5-1 to 5-5 will center the environmental justice implications of water reuse in small and rural communities (for example, for Task 5-1: the implications of coordination through consolidation of small water systems in underserved communities with larger drinking water and wastewater systems as a means to generate additional scale benefits for enabling water reuse). LCJA will contribute to the project in several critical ways, including helping to facilitate connections with appropriate interviewees in underserved communities; helping to refine research questions and interview protocols; and reviewing, commenting on, and co-authoring research and policy products. Dr. Marcus will collaborate across the project with a focus on organizational and social aspects of water reuse, participating in research efforts, co-authoring and reviewing drafts, and engaging with external stakeholders.

Obj. 6 integrates all aspects of the proposed work through case studies of five small, rural communities across the US in which the project team will assess ways to accelerate water reuse adoption. Of the five case studies, at least two underserved communities will be selected to further environmental justice and build understanding of how underserved communities needs may differ from better resourced communities' needs. This work will be conducted in close collaboration with the *American Water Works Association (AWWA)* (see Letter of Intent). AWWA has relevant experience developing water engineering and planning for small and rural communities. In particular, AWWA's Community Engineering Corps has deep networks of professional trainers, advisors, and volunteers on which to draw, who regularly assist in contributing technical carrying capacity to small and rural communities to advance water system performance. AWWA staff will consult on selection of small communities for study, technical and institutional assessments, and interviews/meetings with stakeholders, and work closely with a postdoctoral scholar on our team.

Local stakeholders and residents will be engaged throughout the case study period in all five communities. We will engage with the board of each water utility selected for this study through interviews and meetings/conference calls. The boards are comprised of community leaders, and part of their duties include representing community interests. They also have knowledge of utility

realities, thus they are a great place to assess things such as “ick factor”. Board inputs will be included when assessing the technical “carrying capacity” on an individual water system.

In addition, Co-PI Goodwill will engaging with *Rhode Island Department of Health (RIDOH)* and *Tighe & Bond* (see Letters of Intent) to inform the strategic technology scan in Obj. 2 as well as the community case studies in Obj. 6. As a regulatory state agency and local consulting firm, respectively, RIDOH and Tighe & Bond are in unique positions to provide information on utility capabilities and technology best practices for small systems. Co-PI Goodwill will have quarterly meetings with RIDOH and Tighe & Bond to ensure open communication and information exchange about target communities and their current situation. Valuable information that could be gained from RIDOH includes: record of violations (or lack thereof), inventory of existing treatment technologies and inventory of licensed operators, and their respective levels. These data will be used to assess the “carrying capacity” of partner utilities. Ultimately, RIDOH will play a key role in providing utilities to work with in Obj. 2 and 6. Valuable information that could be gained from Tighe & Bond includes: (1) their current practice in assessing carrying capacity of a given community; (2) current market trends in water reuse adaptation; (3) impact of water stress on local communities. These data will inform Obj. 2 and 6.

Enhancing overall impact of the project through community engagement:
Stakeholder workshops conducted as part of Task 5-5 will be geared towards helping us design and implement a program to highlight the potential for regulatory innovation and leadership, with target audiences of regulators, those they regulate, and small and rural community members. The program will include dissemination of policy-focused research results, but will be focused primarily on a “virtual road show,” through which regulators and local utility managers collaborate with academic experts to highlight their stories of successful (and failed) attempts at implementing water reuse projects, and the lessons learned about possibilities for regulatory leadership and institutional innovation.

Engagement with NGOs, AWWA volunteers, and community stakeholders in Obj. 6 will be crucial not only to make the whole project more directly beneficial to those involved, but also to make sure that outputs from Obj. 1-5 are indeed applicable and useable for small and rural communities more generally. Throughout the proposed work, there will be feedback mechanisms, including interviews and meetings with the communities and collaborators in Obj. 6, to inform work across all objectives so that each output/outcome is best tailored towards the needs of small and rural systems, taking into account their unique challenges and issues. In addition, collaboration and engagement with communities will enhance the real-world applicability of the whitepapers, implementation roadmap, and other publications produced through Obj. 6.

Close and cohesive collaboration across the project team:
Frequent communication will be crucial to ensure effective multi-way feedback mechanisms across the objectives and between project researchers. PI Ikuma, Co-PI Goodwill, and Co-PI Kiparsky will ensure that there is sufficient time allocated to feedback and discussion on how each objective informs others during routine, monthly project-wide meetings. In addition, to ensure real-time lines of communication between researchers, PI Ikuma will host a Slack or Microsoft Teams channel that will be routinely monitored by the postdoc researcher. This online platform

will allow project-wide discussions to occur organically and foster better feedback and innovative solutions throughout the project.

Collaboration/engagement plan during project performance:
Letters of intent/support are included from all collaborators identified for this project as described above.

The project team will communicate frequently with community partners outlined above. Co-PI Goodwill will be primarily responsible for coordination with RIDOH and Tighe & Bond. Both RIDOH and Tighe & Bond are based near the URI campus, and quarterly meetings with be in person. Co-PI Kiparsky will be primarily responsible for coordination with LCJA, Dr. Marcus, and CO DPHE through routine meetings. PIs Ikuma, Goodwill, and Kiparksy will be the primary coordinators with AWWA and community stakeholders identified in Obj. 6. All project team members will be encouraged to participate in meetings with these stakeholders and AWWA staff/volunteers to better inform each part of the proposed project. The coordinators for each community collaboration and engagement will be responsible for connecting the whole project team with each collaborator.

Resources allocated for collaboration and engagement:
Both RIDOH and Tighe & Bond have allocated resources internally that will be provided to the project as in-kind contributions, as confirmed in the LOIs. The in-kind contributions from RIDOH and Tighe & Bond include $10,000 and $8,000 per year, respectively. These resources are adequate to ensure meaningful participating from these project partners.

Requested project funds include contractual fees to hire Felicia Marcus, J.D. ($10,000 per year), LCJA consultants to assist in interviewing stakeholders in disadvantaged communities and reviewing drafts of research and policy products ($5,000 per year in years 2-3), and multiple engineering consultants will be hired through AWWA ($50,000 per year) (see Budget Justification for more details). These funds include both personnel costs, travel funds to community sites as necessary, and incentives for community stakeholder interviews administered by LCJA.

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Budget Justification - Iowa State University (ISU)

SENIOR PERSONNEL (Requested: $149,588 Cost share: $331,290)
Partial faculty salaries for ISU PIs are requested for the four-year project period. The PIs are responsible for overseeing the project, supervising the postdoctoral research associate and graduate and undergraduate research assistants, analyzing and interpreting the data, and dissemination of research results. Please see the table below for a breakdown of personnel costs.

OTHER PERSONNEL (Requested: $544,940)
Post-doctoral Scholar (Requested: $210,854)
Funds are requested for four years' support of 1 postdoctoral scholar, who will conduct experiments to fulfill Objective 1, assist in survey efforts in Objective 3, and assist the lead PI in overall project management. The salary for Year 1 is $4,200/month as shown below.

Graduate Research Assistant (Requested: $316,282)
Funds are requested for 3 graduate research assistants (GRA) for 12 months each year during the project period. The graduate students will conduct experiments and analyses to support Objectives 1 and 2. Per University policy, GRA effort cannot exceed 20 hours per week. The graduate stipend for Year 1 is $2,100/month as shown below.

Undergraduate Research Assistant (Requested: $17,804)
Funds are requested for 1 undergraduate research assistant (URA) for 12 months per year for three years. The undergraduate student will assist research efforts in Objective 1. The URA is expected to work on average 40 hours per month at $12/hour rate.

		Costs				
Position/ Title	Base Fringe%	Year 1	Year 2	Year 3	Year 4	Total
PI- Kaoru Ikuma-Requested	26.30%	$1,797	$1,851	$1,906	$1,964	$7,518
PI- Kaoru Ikuma-Costshare	26.30%	$3,980	$4,099	$4,221	$4,349	$16,649
CO-PI- Lu Liu- Requested	26.30%	$1,338	$1,379	$1,420	$1,463	$5,600
CO-PI- Lu Liu- Cost share	26.30%	$2,965	$3,053	$3,145	$3,239	$12,402
CO-PI- Joe Charbonnet- Requested	26.30%	$1,268	$1,306	$1,345	$1,386	$5,305
CO-PI-- Joe Charbonnet- Cost share	26.30%	$2,808	$2,893	$2,980	$3,069	$11,750
CO-PI-- Antonio Arenas- Requested	26.30%	$1,353	$1,393	$1,435	$1,478	$5,659
CO-PI-- Antonio Arenas- Cost share	26.30%	$2,996	$3,086	$3,178	$3,273	$12,533
CO-PI-- Chris Rehmann- Requested	26.30%	$1,177	$1,213	$1,249	$1,287	$4,926
CO-PI- Chris Rehmann- Costshare	26.30%	$2,607	$2,685	$2,766	$2,849	$10,907
CO-PI-- Yu Wang- Requested	26.30%	$1,125	$1,159	$1,193	$1,229	$4,706
CO-PI- Yu Wang- Costshare	26.30%	$2,491	$2,566	$2,643	$2,722	$10,422
CO-PI- Say Kee Ong- Requested	26.30%	$1,345	$1,386	$1,427	$1,470	$5,628
CO-PI- Say Kee Ong- Costshare	26.30%	$2,980	$3,069	$3,161	$3,256	$12,466
Postdoc Reascher- Requested	31.60%	$15,926	$16,404	$16,896	$17,403	$66,629
Graduate Resarch Assistant- Requested	8.50%	$6,426	$6,619	$6,817	$7,022	$26,884
Undergraduate Assistant- Requested	0.60%	$35	$36	$37	$0	$108
Total Fringe Benefits Request		$31,790	$32,746	$33,725	$34,702	$132,963
Total Fringe Benefits Cost-share		$20,827	$21,451	$22,094	$22,757	$87,129
Total Fringe (EPA + Cost Share)		$52,617	$54,197	$55,819	$57,459	$220,092

Iowa State University charges salaries to sponsored projects on a percentage of effort basis as permitted by 2 CFR 200 Subpart E, Cost Principles for Educational Institutions. 2 CFR 200 is incorporated in the FAR in section 31.3. Iowa State University defines year as institutional fiscal year, July 1 – June 30. Labor costs for post docs and graduate students are based on projected monthly salaries paid by the participating academic departments at ISU.. A 3% increase is included in each subsequent fiscal year.

FRINGE BENEFITS (Requested: $132,963 Cost share: $87,129)

At Iowa State University, fringe benefits are specifically identified to each employee and are charged individually as direct costs. These costs are budgeted as a percentage of an individual's salary based on his/her labor category. Current rates for applicable labor categories:

Faculty	26.3%	Post Docs	31.6%
Graduate Assistants	8.5%	Undergrad Assistants	0.6%

		Percentage	Costs				Total
Position/ Title	Annaul Salary	of time	Year 1	Year 2	Year 3	Year 4	
PI- Kaoru Ikuma-Requested		7%	$6,832	$7,037	$7,249	$7,466	$132,626
PI- Kaoru Ikuma-Costshare	$104,042	15%	$15,132	$15,586	$16,053	$16,535	$63,306
CO-PI- Lu Liu- Requested		5%	$5,089	$5,242	$5,400	$5,561	$116,292
CO-PI- Lu Liu- Cost share	$95,000	12%	$11,272	$11,610	$11,958	$12,317	$47,157
CO-PI- Joe Charbonnet- Requested		5%	$4,822	$4,966	$5,115	$5,269	$110,172
CO-PI-- Joe Charbonnet- Cost share	$90,000	12%	$10,678	$10,999	$11,329	$11,668	$44,674
CO-PI-- Antonio Arenas- Requested		5%	$5,143	$5,297	$5,456	$5,620	$117,516
CO-PI-- Antonio Arenas- Cost share	$96,000	12%	$11,390	$11,732	$12,084	$12,446	$47,652
CO-PI-- Chris Rehmann- Requested		3%	$4,477	$4,611	$4,749	$4,892	$148,245
CO-PI- Chris Rehmann- Costshare	$129,516	8%	$9,914	$10,211	$10,518	$10,833	$41,476
CO-PI-- Yu Wang- Requested		5%	$4,277	$4,406	$4,537	$4,674	$97,733
CO-PI- Yu Wang- Costshare	$79,839	12%	$9,473	$9,757	$10,050	$10,351	$39,631
CO-PI- Say Kee Ong- Requested		3%	$5,115	$5,269	$5,427	$5,590	$169,396
CO-PI- Say Kee Ong- Costshare	$147,995	8%	$11,329	$11,668	$12,018	$12,379	$47,394
Postdoc Reascher- Requested	$50,400	100%	$50,400	$51,912	$53,469	$55,073	$261,255
3 Graduate Resarch Assistants- Requested	$25,200	100%	$75,600	$77,868	$80,204	$82,610	$341,483
Undergraduate Assistant- Requested	$480	100%	$5,760	$5,933	$6,111	$0	$18,285
Total Salaries Request			$167,515	$172,541	$177,717	$176,755	$694,528
Total Salaries Cost-share			$79,188	$81,563	$84,010	$86,529	$331,290
Total Salaries (Requested +Cost Share)			$246,703	$254,104	$261,727	$263,284	$1,025,818

TRAVEL (Requested: $23,072)

Funds are requested for travel to annual EPA progress meetings, national conferences (locations to be determined) such as annual meetings of the American Chemical Society, American Water Works Association, etc., sampling trips across Iowa for Objective 1, and travel to selected communities for stakeholder interviews and community engagement efforts for Objective 4 as shown below. No EPA funds will be used for foreign travel without approval from the EPA.

Domestic Travel												
				Lodging			Meals					
Year	Purpose & Destination	# of People	Airfare / Person	# Nights	Rate per Night	*Lodging Total*	# Meal Days	Meal Cost per Day	*Meal Total*	Ground Transportation	Registration Per Person	TOTAL
1	EPA Progress Review, Washington DC	2	$300	2	$188	*$376*	3	$76	*$228*	*$120*	$0	$2,048
1	Sampling trips,	4	$0	0	$0	*$0*	1	$40	*$40*	*$210*	$0	$370
											Year 1 Total	**$2,418**
2	Professional Conference	1	$309	3	$194	*$582*	4	$65	*$260*	*$120*	$400	$1,671
2	EPA Progress Review, Washington DC	2	$309	2	$194	*$388*	3	$76	*$228*	*$120*	$0	$1,970
2	Sampling trips	4	$0	0	$0	*$0*	1	$40	*$40*	*$210*	$0	$370
	Community engagement, TBD	4	$309	3	$194	*$582*	4	$55	*$220*	*$400*	$0	$4,844
											Year 2 Total	**$8,855**
3	Community engagement, TBD	4	$318	4	$200	*$800*	5	$55	*$275*	*$125*	$0	$6,072
3	EPA Progress Review, Washington DC	2	$318	2	$200	*$400*	3	$76	*$228*	*$120*	$0	$2,132
											Year 3 Total	**$8,204**
4	Professional Conference	1	$328	2	$200	*$400*	3	$65	*$195*	*$120*	*$400*	$1,443
4	EPA Progress Review, Washington DC	2	$328	2	$200	*$400*	3	$76	*$228*	*$120*	*$0*	$2,152
											Year 4 Total	**$3,595**
											Total Cost	**$23,072**

OTHER DIRECT COSTS

<u>Participant Support Costs</u> (Requested: $2,600)

Funds are requested as incentives payments in the surveys proposed in Objective 3 ($2/survey for 1000 surveys). 30 gift cards of $20 each will also be purchased as additional incentives to be distributed through a lottery with survey respondents.

Supplies (Requested: $22,694)
Funds are requested for the purchase of research and laboratory supplies that are necessary and essential for completion of tasks as proposed. These include plasticware including reactor components ($6,000), glassware ($2,000), chemicals ($8,000), DNA isolation kits ($5,000), and personal protective equipment ($1,694).

Consultants (Requested: $262,400)
Funds are requested to outsource survey administration and collection in Objective 3 to a specialized firm ($12,400 in year 1). Funds are requested to hire Felicia Marcus, J.D. (Consultant and Founding Member of the Water Policy Group) to collaborate across the teams with a focus on organizational and social aspects of water reuse and engage with external stakeholders. The consultant will be hired at $80/hour for 125 hours per project year ($10,000 per year). Additionally, funds are requested to hire consultants in the Leadership Council for Justice and Accountability (LCJA) to assist in interviewing stakeholders in disadvantaged communities and reviewing drafts of research and policy products. The LCJA consultants will be hired at $75/hour to a total of $2,500 per year. Multiple engineering consultants will be hired through the American Water Works Association at $60/hour rate each year to assist in engineering assessments in Objective 4 ($50,000 per year to cover 5 test communities including travel-associated costs).

User Fees (Requested: $10,800)
Laboratory user fees are requested in years 1-3 for water quality analyses. These fees will be used for pay equipment/facility user fee such as a Seal AQ2 Discrete Analyzer for water chemistry analysis and liquid chromatography for trace organic contaminant measurements at ISU labs.

Subrecipients (Requested: $1,241,906 Cost share: $171,319)
We have 2 subcontractors as shown below.

Subaward#1 University of Rhode Island Requested: $681,965 Cost share: $171,379
Co-PIs Goodwill, Craver, and Guilfoos will conduct analyses for Objectives 1, 3, and 4.

Subaward#2 University of California Berkeley Requested: $559,941 Cost share: $0
Co-PI Kiparsky will lead work on organizational barriers in Objective 3 and support Objective 4.

Tuition (Requested: $220,914)
Per University policy, tuition remission is being requested for three graduate students, commensurate with his or her time on the project. The projected tuition rates are published by the office of the Vice President for Research and Economic Development at http://ospa.iastate.edu/proposal/preparation/tuition/.

INDIRECT COSTS (Requested: $634,122 Cost share: $221,762)
For sponsored research at ISU, indirect rates are applied to Modified Total Direct Costs (MTDC). MTDC consists of all salaries and wages, fringe benefits, materials, supplies, services, travel, and subgrant or subcontracts up to the first $25,000 of each subgrant or subcontract (regardless of the period covered by the sub grant or subcontract). MTDC excludes equipment, capital expenditures, charges for patient care, student tuition remission, rental costs of off-site facilities, scholarships and fellowships, as well as the portion of each subgrant and subcontract in excess of $25,000. Current rates are provided below. These rates were approved by the Department of Health and Human Services (effective 07/01/2020 – 06/30/2024).

On-campus - Organized Research	53.0%

Revised 05/01/2020 **NSF BIOGRAPHICAL SKETCH** **OMB-3145-0058**

NAME:

POSITION TITLE & INSTITUTION:

A. PROFESSIONAL PREPARATION
(see PAPPG Chapter II.C.2.f.(i)(a))

INSTITUTION	LOCATION	MAJOR/AREA OF STUDY	DEGREE (if applicable)	YEAR (YYYY)

B. APPOINTMENTS
(see PAPPG Chapter II.C.2.f.(i)(b))

From - To	Position Title, Organization and Location

C. PRODUCTS
(see PAPPG Chapter II.C.2.f.(i)(c))
Products Most Closely Related to the Proposed Project

Other Significant Products, Whether or Not Related to the Proposed Project

D. SYNERGISTIC ACTIVITIES
(see PAPPG Chapter II.C.2.f.(i)(d))

Revised 05/01/2020 **NSF BIOGRAPHICAL SKETCH** **OMB-3145-0058**

NAME:

POSITION TITLE & INSTITUTION:

A. PROFESSIONAL PREPARATION
(see PAPPG Chapter II.C.2.f.(i)(a))

INSTITUTION	LOCATION	MAJOR/AREA OF STUDY	DEGREE (if applicable)	YEAR (YYYY)

B. APPOINTMENTS
(see PAPPG Chapter II.C.2.f.(i)(b))

From - To	Position Title, Organization and Location

C. PRODUCTS
(see PAPPG Chapter II.C.2.f.(i)(c))
Products Most Closely Related to the Proposed Project

Other Significant Products, Whether or Not Related to the Proposed Project

D. SYNERGISTIC ACTIVITIES
(see PAPPG Chapter II.C.2.f.(i)(d))

Biographical Sketch – Michael Kiparsky

Professional Preparation

Brown University	Biology	A.B.	1995
University of California, Berkeley	Energy and Resources	M.S.	2002
University of California, Berkeley	Energy and Resources	Ph.D.	2010

Appointments

2015-present	Director, Wheeler Water Institute, Center for Law, Energy & the Environment, University of California, Berkeley, School of Law,
2015-present	Co-Director, UC Water Security and Sustainability Research, University of California Initiative (UC Water), *www.ucwater.org*
2012-15	Associate Director, Wheeler Water Institute, Center for Law, Energy & the Environment, UC Berkeley, School of Law
2012-13	Research Scientist, Berkeley Water Center, UC Berkeley
2010-11	Assistant Research Professor, Department of Geography, University of Idaho
2008-10	Visiting Scientist, Department of Geography, University of Idaho
2007-8	Graduate Student Researcher, Department of Civil and Environmental, UC Berkeley
2006	Risk Analysis Intern, CA Public Utilities Commission, San Francisco, CA
2003-2005	Science Policy Analyst and Writer, CALFED Science Program Sacramento, CA
2002-2004	Research Assistant and Research Affiliate, Pacific Institute, Oakland, CA
2002	Research Assistant, Stanford University, Stanford, CA
2000-2002	Consultant and Writer, San Francisco, CA
1999-2000	Software Consultant and Quality Assurance Engineer, San Francisco, CA
1996-1999	Science Teacher, Seoul Foreign H.S, Seoul, S. Korea and Telluride Academy, Telluride, CO
1992-1995	Research Assistant, Brown University, Providence, RI and Darling Marine Center, Walpole, ME

Five Related Publications

1. Alida Cantor, Luke Sherman, Anita Milman, and **Michael Kiparsky**. 2021. "Regulators and utility managers agree about barriers and opportunities for innovation in the municipal wastewater sector." *Environmental Research Communications* 3: 031001, https://doi.org/10.1088/2515-7620/abef5d
2. Luke Sherman, Alida Cantor, Anita Milman, and **Michael Kiparsky**. 2020. "Examining the complex relationship between innovation and regulation through a survey of wastewater utility managers." *Journal of Environmental Management* 260: 110025, https://doi.org/10.1016/j.jenvman.2019.110025
3. Christian Binz, Noosha Bronte Razavian, and **Michael Kiparsky**. 2018. "Of Dreamliners and Drinking Water: Developing Risk Regulation and a Safety Culture for Direct Potable Reuse." *Water Resources Management* 32(2): 511-525, doi: 10.1007/s11269-017-1824-1
4. **Michael Kiparsky**, Anita Milman, Dave Owen, and Andrew T. Fisher. 2017. "The Importance of Institutional Design for Distributed Local Level Governance of Groundwater." *Water*, 9(10):755. doi:10.3390/w9100755

5. **Michael Kiparsky**, Christian Binz, Barton H. Thompson, Jr., Bernhard Truffer, David L. Sedlak and Lars Tummers. 2016. "Barriers to innovation in urban wastewater utilities: Attitudes of managers in California." *Environmental Management*, 57(6): 1204-1216, DOI:10.1007/s00267-016-0685-3

Five Additional Publications

1. Sasha Harris-Lovett, Christian Binz, David L. Sedlak, **Michael Kiparsky** and Bernhard Truffer. 2015. "Beyond User Acceptance: A Legitimacy Framework for Potable Water Reuse in California." *Environmental Science & Technology* 49(13): 7552–7561, DOI: 10.1021/acs.est.5b00504
2. Nell Green Nylen and **Michael Kiparsky**. 2015. Accelerating Cost-Effective Green Stormwater Infrastructure: Learning from Local Implementation. Wheeler Institute for Water Law & Policy, University of California at Berkeley. Berkeley, CA. 47 pp.
3. **Michael Kiparsky**, David L. Sedlak, Barton H. Thompson, Jr., and Bernhard Truffer. 2013. "The innovation deficit in urban water: the need for an integrated perspective on institutions, organizations, and technology." Invited paper, Special Issue of *Environmental Engineering Science*, 30(8): 395-408.
4. **Michael Kiparsky**, Anita Milman, and Sebastian Vicuna. 2012. "Climate and water: knowledge of impacts to action on adaptation." Invited paper for *Annual Review of Environment and Resources*, 37: 163-194.
5. Giorgos Kallis, **Michael Kiparsky**, Anita Milman, and Isha Ray. 2006. "Glossing over the complexity of water." *Science* **314** (5804): 1387c-1388. (Letter).

Synergistic Activities

1. Winner (with Richard Roos-Collins), Imagine H_2O California Water Policy Challenge, For California Water Rights and Use Database. April 2017 ($30,000).
2. Highlighted as one of "Nine Experts to Watch on California Water Policy" by Water Deeply, July 7, 2016.
3. Extensive media engagement, including interviews, quotes, and Op-eds.
4. Over 40 invited presentations from 2010-2021. These include academic conferences, presentations to state and federal regulatory agencies, and an Invited Keynote address to the 2016 International Groundwater and Agriculture Conference.
5. Invited participant, "California's Water Future: An Advanced Communication Workshop." COMPASS, Santa Barbara, May 2016

Revised 05/01/2020 **NSF BIOGRAPHICAL SKETCH** **OMB-3145-0058**

NAME: Lu Liu

POSITION TITLE & INSTITUTION: Assistant Professor, Iowa State University

A. PROFESSIONAL PREPARATION
(see PAPPG Chapter II.C.2.f.(i)(a))

INSTITUTION	LOCATION	MAJOR/AREA OF STUDY	DEGREE (if applicable)	YEAR (YYYY)
University of Maryland	College Park, MD	Civil and Environmental Engineering	Ph.D.	2017
University of Oklahoma	Norman, OK	Environmental Science	M.S.	2012
University of Oklahoma	Norman, OK	Environmental Science	B.S.	2010

B. APPOINTMENTS
(see PAPPG Chapter II.C.2.f.(i)(b))

From - To	Position Title, Organization and Location
2021 - Present	Assistant Professor, Iowa State University, Ames, IA
2020 - 2021	Research Associate, Houston Advanced Research Center, The Woodlands, TX
2018 - 2020	Postdoctoral Research Associate, Rice University, Houston, TX
2014 - 2017	Graduate Research Assistant, University of Maryland, College Park, MD
2012 - 2014	Postmaster Research Associate, Joint Global Change Research Institute, College Park, MD
2010 – 2012	Graduate Research Assistant, University of Oklahoma, Norman, OK

C. PRODUCTS

(see PAPPG Chapter II.C.2.f.(i)(c))

Products Most Closely Related to the Proposed Project

1. Liu L., E. Lopez, L. Dueñas-Osorio, L. Stadler, Y. Xie, P. Alvarez, and Q. Li (2020), The importance of system configuration for distributed direct potable water reuse, Nature Sustainability. DOI: 10.1038/s41893-020-0518-5.
2. Liu L., M. Hejazi, G. Iyer, and B. Forman (2019), Implications of water constraints on electricity capacity expansion in the United States, Nature Sustainability. DOI: 10.1038/s41893-019-0235-0.
3. Liu L., M. Hejazi, H. Li, B. Forman, and X. Zhang (2017), Vulnerability of US thermoelectric power generation to climate change when incorporating state-level environmental regulations, 2, 17109, Nature Energy. DOI: 10.1038/nenergy.2017.109.
4. Liu L., Hejazi M., Patel P., Kyle P., Davies E., Zhou Y., Clarke L., Edmonds J. (2015), Water demands for electricity generation in the U.S.: Modeling different scenarios for the water energy nexus. Technological Forecasting and Social Change, 94, 318-334, DOI:10.1016/j.techfore.2014.11.004.
5. Liu L., Y. Hong, J. E. Hocker, M. A. Shafer, C. N. Bednarczyk (2012), Hydro-climatological Drought Analyses and Projection using Meteorological and Hydrological Drought Indices: A Case Study in Blue River Basin, Oklahoma, 26 (10), 2761–2779, Water Resources Management. DOI: 10.1007/S11269-012-0044-y.

Other Significant Products, Whether or Not Related to the Proposed Project

1. Liu L., S. Parkinson, M. Gidden, E. Byers, Y. Satoh, K. Riahi, and B. Forman (2018), Quantifying the potential for reservoirs to secure future surface water yields in the world's largest river basins, Environmental Research Letters. DOI: 10.1088/1748-9326/aab2b5.
2. Voisin N., M. I. Hejazi, L. R. Leung, L. Liu, M. Huang, H. Li, and T. Tesfa (2017), Effects of sectoral water withdrawals, allocation and consumptive use on the redistribution of water resources in an integrated water model, Water Resources Research. DOI: 10.1002/2016WR019767.
3. Kim S., M. Hejazi, L. Liu, K. Calvin, L. Clarke, J. Edmonds, P. Kyle, P. Patel, M. Wise, E. Davies (2015), Balancing global water availability and use at basin scale in an integrated assessment model. Climatic Change. DOI: 10.1007/s10584-016-1604-6.

D. SYNERGISTIC ACTIVITIES

(see PAPPG Chapter II.C.2.f.(i)(d))

- Organized 2019 Chinese Environmental Scholars Forum (2019)
- Mentored two M.S. students on Master's theses, Tsinghua University (2018 – 2021)
- Contributed to STEM education in K-12 as LEAD E-Mentor for Elizabeth Seton High School, Maryland (2018)
- Served as peer reviewer for multiple journals including Nature Sustainability, Nature Energy, Nature Communications, Journal of Applied Remote Sensing, International Journal of Remote Sensing, Environmental Research Letters, Environmental Science & Technology, and Climatic Change (2014 – present)
- Designed and hosted science and engineering education workshops for Oklahoma K-12 teachers (2011)

NAME:

POSITION TITLE & INSTITUTION:

A. PROFESSIONAL PREPARATION
(see PAPPG Chapter II.C.2.f.(i)(a))

INSTITUTION	LOCATION	MAJOR/AREA OF STUDY	DEGREE (if applicable)	YEAR (YYYY)

B. APPOINTMENTS
(see PAPPG Chapter II.C.2.f.(i)(b))

From - To	Position Title, Organization and Location

C. PRODUCTS
(see PAPPG Chapter II.C.2.f.(i)(c))
Products Most Closely Related to the Proposed Project

Other Significant Products, Whether or Not Related to the Proposed Project

D. SYNERGISTIC ACTIVITIES
(see PAPPG Chapter II.C.2.f.(i)(d))

Chris R. Rehmann

Professional preparation

Massachusetts Institute of Technology (Cambridge, MA)	Civil Engineering	B.S., 1989
Stanford University (Stanford, CA)	Civil Engineering	M.S., 1990
Stanford University (Stanford, CA)	Civil Engineering	Ph.D., 1995
Stanford University (Stanford, CA)	Postdoc. researcher	1995-1996
Woods Hole Oceanographic Institution (Woods Hole, MA)	Postdoc. scholar	1996-1998

Appointments

2021-present	Joel A. and Judy Cerwick Professor
2012-present	Associate Chair for Undergraduate Affairs, Dept. of Civil, Construction, and Environmental Eng., Iowa State University
2010-2012	Assistant Chair for Undergraduate Affairs, Dept. of Civil, Construction, and Environmental Eng., Iowa State University
2008-present	Associate Professor, Iowa State University
2004-2008	Assistant Professor, Iowa State University
1998-2004	Assistant Professor, University of Illinois at Urbana-Champaign
1995-1996	Lecturer, Stanford University

Selected publications

Dickey, L.C., McEachran, A.R., Rutherford, C.J., Rehmann, C.R., Perez, M.A., Groh, T.A., and Isenhart, T.M. 2021 Slope stability of streambanks at saturated riparian buffer sites. *Journal of Environmental Quality*, doi:10.1002/jeq2.20281.

Rehmann, C.R., Jackson, P.R., and Puglis, H.J. 2021 Predicting the spatiotemporal exposure of aquatic species to intrusions of fire retardant in streams with limited data. *Science of the Total Environment*, 782, 146879, doi:10.1016/j.scitotenv.2021.146879.

McEachran, A.R., Dickey, L.C., Rehmann, C.R., Groh, T.A., Isenhart, T.M., Perez, M.A., and Rutherford, C.J. 2020 Improving the effectiveness of saturated riparian buffers for removing nitrate from subsurface drainage. *Journal of Environmental Quality*, doi:10.1002/jeq2.20160.

Ikuma, K. and Rehmann, C.R. 2020 Importance of extracellular DNA in the fate and transport of antibiotic resistance genes downstream of a wastewater treatment plant. *Environmental Engineering Science*, doi:10.1089/ees.2019.0319.

Alfawzan, F., Alleman, J.E., and Rehmann, C.R. 2019 Wind energy assessment for NEOM city, Saudi Arabia. *Energy Science and Engineering*. 8(2), doi:10.1002/ese3.548.

Xie, S., Hill, A.L., Rehmann, C.R., and Levy, M.Z. 2018 Dynamics of bed bug infestations and control under disclosure policies. *Proc. Natl. Acad. Sci.*, 116(13), 6473-6481.

Maroney, C.L. and Rehmann C.R. 2017 Stream depletion rate for a radial collector well in an unconfined aquifer near a fully penetrating river, *Journal of Hydrology*, 547, 732-741. doi: 10.1016/j.jhydrol.2017.02.010.

Tesfatsion, L., Rehmann, C.R., Cardoso, D.S., Jie, Y., and Gutowski, W.J. 2017 WACCShed: an agent-based watershed platform, *Environmental Modelling and Software*, 89, 40-60, doi: 10.1016/j.envsoft.2016.11.021.

Pandey, P.K., Soupir, M.L., Ikenberry, C., and Rehmann C.R. 2016 Predicting streambed sediment and water column *Escherichia coli* levels at watershed scale, *Journal of the American Water Resources Association*, 52, 184-197, doi: 10.1111/1752-1688.12373.

Schmalle, G.F. and Rehmann, C.R. 2014 Analytical solution of a model of contaminant transport in the advective zone of a river, *Journal of Hydraulic Engineering*, 140, 04014029, doi: 10.1061/(ASCE)HY.1943-7900.0000885.

Wain, D.J., Kohn, M.S., Scanlon, J.A., and Rehmann, C.R. 2013 Internal wave driven transport of fluid away from the boundary of a lake, *Limnology and Oceanography*, 58, 429-442.

Pandey, P.K., Soupir, M.L., and Rehmann, C.R. 2012 A model for predicting resuspension of *Escherichia coli* from streambed sediments, *Water Research*, 46, 115-126.

Rehmann, C.R. and Soupir, M.L. 2009 Importance of interactions between the water column and the sediment for microbial concentrations in streams, *Water Research*, 43, 4579–4589.

Selected research grants

U.S. Environmental Protection Agency: Ikuma, K. (PI), Rehmann, C.R. (co-PI), Poleacovschi, C., Weems, C.F., and Garcia Zambrana, I., "Building resilience in elderly vulnerable communities facing repeated flooding and increased exposure risks to untreated wastewater in Puerto Rico", 2020-2023.

Iowa Department of Transportation: Rehmann, C.R. (PI), Perez, M.A., "Groundwater systems impacts on the U.S. 63 railroad underpass at Waterloo, Iowa: Phase IV", 2014-2019.

Iowa Department of Agriculture and Land Stewardship and City of Johnston: Rehmann, C.R. (PI), Perez, M.A., Ikuma, K., "In-situ performance evaluation of bioretention intake systems", 2019-2020.

City of Clive: Rehmann, C.R. (PI), Perez, M.A., Ikuma, K., "Field evaluation of the unified sizing criteria for post-construction stormwater management practices", 2019-2020.

Minnesota Department of Transportation: Rehmann, C.R. (PI), Ikuma, K., Perez, M.A., Cetin, B., "Environmental field evaluation of potassium acetate", 2019-2021.

National Resources Conservation Service: Rutherford, C.J. (PI), Perez, M.A., Rehmann, C.R. (co-PI), Isenhart, T.M., and Jaynes, T., "Evaluation and enhancement of saturated buffers as a conservation drainage practice for agricultural subsurface drainage treatment", 2018-2020.

U.S. Army Corps of Engineers: Wilkinson, G. (PI), Crumpton, W., Rehmann, C.R. (co-PI), "Water quality monitoring for Saylorville, Red Rock, and Coralville Reservoirs", 2017-2022.

U.S. Environmental Protection Agency Region 7: Soupir, M.L (PI) and Rehmann, C.R., "Improving SWAT for TMDLs for Bacteria", 2009-2010.

Selected service

Associate Editor, *Journal of Hydraulic Engineering*, 2005-2012.

Associate Editor, *Limnology and Oceanography*, 2005-2012

Technical Committee on Hydraulic Measurements and Experimentation, Environmental and Water Resources Institute (EWRI) of the American Society of Civil Engineers (ASCE), secretary 2002-2003, vice chair 2005-2006, chair 2006-2008.

BIOGRAPHICAL SKETCH

NAME: Joseph A. Charbonnet
POSITION TITLE & INSTITUTION: Assistant Professor, Iowa State University

A. PROFESSIONAL PREPARATION

INSTITUTION	LOCATION	MAJOR/AREA OF STUDY	DEGREE (if applicable)	YEAR
Georgia Institute of Technology	Atlanta, GA	Environmental Engineering	BS	2012
University of California, Berkeley	Berkeley, CA	Civil & Environmental Engineering	MS	2013
University of California, Berkeley	Berkeley, CA	Civil & Environmental Engineering	PhD	2018
Colorado School of Mines	Golden, CO	Environmental Engineering	Postdoctoral Fellowship	2020-2021

B. APPOINTMENTS

From - To	Position Title, Organization and Location
2022- Present	Assistant professor; Iowa State University; Ames, IA
2019-2020	Instructor; Mt. Tamalpais College; San Quentin, CA
2019	Lecturer; University of California, Berkeley; Berkeley, CA
2018-2020	Staff Scientist; Green Science Policy Institute; Berkeley, CA
2016	Researcher; Lawrence Berkeley National Laboratory; Kolkata, India

C. PRODUCTS

Charbonnet, J.A.*, Rodowa, A.E.*, Guelfo, J.L., Field, J., Higgins, C., Helbling, D.E. & Houtz, E.F. Environmental Source Tracking of Per- and Polyfluoroalkyl Substances within a Forensic Context: Current and Future Techniques. *Environ. Sci. and Technol.* (2021). DOI: 10.1021/acs.est.0c08506

Charbonnet, J. A., Duan Y., Van Genuchten, C. & Sedlak, D. L. Regenerated manganese-oxide coated sands: The role of mineral phase in organic contaminant reactivity. *Environ. Sci. and Technol.* **55,** 5282-5290 (2021). DOI: 10.1021/acs.est.0c05745

Charbonnet, J.A., Weber, R. & Blum, A. Flammability Standards for Furniture, Building Insulation and Electronics: Benefit and Risk. *Emerg. Contam.* **6,** 432-441 (2020). DOI: 10.1016/j.emcon.2020.05.002

Charbonnet, J. A., Duan Y. & Sedlak, D. L. The use of manganese oxide-coated sand for the removal of trace metal ions from stormwater. *Environ. Sci.: Water Res. & Tech.* (2019) DOI: 10.1039/C9EW00781D

Charbonnet, J. A., Duan Y., Van Genuchten, C. & Sedlak, D. L. Chemical regeneration of manganese oxide coated sand for oxidation of organic stormwater contaminants. *Environ. Sci. and Technol.* **53,** 10728-10736 (2018). DOI: 10.1021/acs.est.8b03304

Grebel, J. E.*, **Charbonnet, J. A.*** & Sedlak, D. L. Oxidation of organic contaminants by manganese oxide geomedia for passive urban stormwater treatment systems. *Water Res.* **88,** 481–491 (2016). DOI: 10.1016/j.watres.2015.10.019

Teixido, M., **Charbonnet, J. A.**, LeFevre, G.H., Luthy, R. & Sedlak, D.L. Geomedia-amended infiltration system to enhance metal and trace organic compound removal in urban stormwater runoff. *In preparation*

**equal contributions*

D. SYNERGISTIC ACTIVITIES

Per- and Polyfluoroalkyl Substances Suspect List (2021): In collaboration with National Institute of Standards and Technology, compiled most comprehensive publically available data of PFAS structures for high-resolution mass spsctrometry suspect screening (https://github.com/usnistgov/NISTPFAS).

Water You Talking About Podcast (2016-Present): Founder and producer of podcast featuring environmental engineering academics communicating water issues and innovations to a lay audience (https://soundcloud.com/water-podcast). Over 30 episodes have been produced with over 15,000 total listens.

Colorado School of Mines Society of Hispanic Professional Engineers (2020-2021): Chapter co-advisor, mentor to senior student leadership, and seminar presenter ("School So Nice You Do It Twice: Everything to Know About Graduate School." November 6, 2020).

King Middle School, Berkeley, CA (2013-2018): Volunteer science tutor and mentor. Including supervising the development, execution, and reporting of results for 10 science experimentation projects. In collaboration with museum educators at the Lawrence Hall of Science, developed and led urban stormwater modeling activity.

Re-Inventing the Nation's Urban Water Infrastructure (ReNUWIt) ERC: Student Leadership Council President and Campus Representative. Organized weekly seminars and student activities and presentations at annual meetings.

Say Kee Ong, P.E.
Professor
Civil, Construction, and Environmental Engineering, 422 Town Engineering Building,
Iowa State University, Ames, Iowa 50011
Tel. Phone: 515 294 3927, E-mail: skong@iastate.edu

Education

Ph.D.	Environmental Engineering, Cornell University, NY
M.S.	Environmental Engineering, Vanderbilt University, TN
B.E.	Mechanical Engineering, University of Malaya, Malaysia

Experience

May '06 – present	Professor, Dept. of Civil, Construction and Environmental Engineering, Iowa State University, Ames, IA
Jan. '06 – May '19	Visiting Professor, International Faculty Member, National Center of Excellence for Environmental and Hazardous Waste Management (NCE-EHWM), Chulalongkorn University, Bangkok, Thailand
May '00 – May '06	Associate Professor, Dept. of Civil, Construction and Environmental Engineering, Iowa State University, Ames, IA
Jan. '94 – May '00	Assistant Professor, Dept. of Civil, Construction and Environmental Engineering, Iowa State University, Ames, IA
Sept. '92 - Dec. '93	Assistant Professor, Dept. of Civil and Environmental Engineering, Polytechnic University, Brooklyn, NY (now NYU)
Jan. '90 - Aug. '92	Principal Research Engineer, Environmental Tech. Dept., Battelle, Columbus, OH
Apr. '80 - Apr. '84	Project Engineer, Water and Wastewater Group, Paterson Candy Co., Malaysia

Honors (Selected)

2020	Joseph C. and Elizabeth A. Anderlik Faculty Award for Excellence in Undergraduate Teaching
2020	Visiting Faculty, Swiss Federal Institute of Aquatic Science and Technology (Eawag), Switzerland
2018	Iowa State University Board of Regents Award for Faculty Excellence
2011	Erskine Fellow, University of Canterbury, New Zealand
2008	WEF McKee Groundwater Protection, Restoration or Sustainable Use Medal
2005	Assoc. of Environmental Engineering and Science Professors (AEESP) Outstanding Teacher Award
2005	Montgomery-Watson-Harza / AEESP Master Thesis Award, First Place (with Angela Kolz)

Publications

i. Five related

1. Shi, G., S.K. Ong, 2021. Oxidation of 2,4-Dichlorophenoxyacetic acid (2,4 D) by persulfate or peroxymonosulfate with iron(II) as an activator, ASCE J. of Hazardous, Toxic and Radioactive Waste Management. DOI: 10.1061/(ASCE)HZ.2153-5515.0000645
2. Moharramzadeh, S., S.K. Ong, J. Alleman, K. Cetin, 2021, Parametric study of the progressive freeze concentration for desalination, Desalination, 510. 115077. doi:https://doi.org/10.1016/j.desal.2021.115077
3. Law, J.Y., M.L. Soupir, D.R. Raman, T.B. Moorman, S.K. Ong, 2018, Electrical stimulation for enhanced denitrification in woodchip bioreactors: Opportunities and challenges, J. Ecological Engineering, 110:38-47.
4. Tian, Q., L. Zhuang, S.K. Ong, Q. Wang, K. Wang, X. Xie, Y. Zhu, F. Li, 2017. Phosphorus (P) recovery coupled with increasing influent ammonium facilitated intracellular carbon source storage and simultaneous aerobic phosphorus & nitrogen removal, Water Research, 119: 267 – 275 (http://dx.doi.org/10.1016/j.watres.2017.02.050)

5. Tian, Q., S. K. Ong, K. W. Wang, X. Xie , F. Li, B. Yang, Y. Zhu, 2016, Enhanced phosphorus recovery and biofilm microbial community changes in an alternating anaerobic/aerobic biofilter, Chemosphere 144:1797-1806.

ii. Five other

1. Waleeittikul, A., S. Chotpantarat, S.K. Ong, 2019, Impacts of salinity level and flood irrigation on Cd mobility through a Cd-contaminated soil, Thailand: experimental and modeling techniques, J. Soils and Sediments. 19:2357-2373
2. Sharma, B., B. Steward, S.K. Ong, and F.E. Miguez, 2017. Evaluation of teaching approach and students' learning in an interdisciplinary sustainable engineering course, J. Cleaner Production, 142(4):4032-4040.
3. Sikkemma, J. K., S. K. Ong, J. E. Alleman, 2015, Photocatalytic concrete pavements: Laboratory investigation of NO oxidation rate under varied environmental conditions, Construction and Building Materials, 100:305-314
4. Wikiniyadhanee, R., S. Chotpantarat, S.K. Ong, 2015, Effects of kaolinite colloid on Cd2+ transport through saturated sand under varying ionic strength conditions: Column experiments and modeling approaches, J. of Contaminant Hydrology, 182:146-156 (doi:10.1016/j.jconhyd.2015.08.008)
5. Mao, F., S.K. Ong, J. Gaunt, 2015. Modelling benzene permeation through drinking water high density polyethylene (HDPE) pipes, Journal of Water and Health, 13(3):758-772. (doi:10.2166/wh.2015.183)

Synergistic Activities

Dr. Ong's teaching experience and research interests are in fate and transport of pollutants in engineered and natural systems, development of sustainable urban water infrastructure, and development of sustainable compact water and wastewater treatment processes. Dr. Ong's research is focused on the interactions of physical, chemical and biological processes on the behavior of nutrients, micro-pollutants and hazardous compounds in water and wastewater. Since joining ISU, Dr. Ong has graduated 18 Ph.D. students and 53 M.S. students. He has received five teaching awards including ISU Foundation Award for Outstanding Achievement in Teaching, ISU top teaching award. Courses he taught include Environmental Engineering Chemistry, Wastewater and Water Treatment Design, and Sustainable Engineering and International Development. Dr. Ong served as a visiting International Faculty member at the National Center of Excellence for Environmental and Hazardous Waste Management, Chulalongkorn University, Bangkok, Thailand from 2006 - 2020.

Collaborators and other Affiliations

Dr. Rao Surampalli, US EPA, Kansas City, MO; Dr. Tom Moorman, USDA-ARS, Ames, IA; Dr. Robert Hinchee, Battelle, Columbus, OH; Dr. B. Wickramnayake, Battelle, OH; Dr. James Alleman, Iowa State University; Dr. Andrea Leeson, SERDP, Washington, DC; Dr. Ni-Bin Chang, Univ. of Central Florida, FL; Dr. Shihwu Sung, University of Hawaii, Hilo.

Graduate students and Post-docs advised

Jeong Hyub Ha, Pohang University of Science and technology,, Korea; Chu-Lin Cheng, U. of Texas, Pan American, TX; Shane Rogers, Ph.D., Clarkson University, NY; Washington Braida, Ph.D., Stevens Institute of Technology, Hoboken, NJ (also worked as a post-doc); Ben Pak-Hing Lee, Ph.D., Fooyin University, Kaoshiung, Taiwan; Chulsung Kim, Ph.D., Georgia Gwinnet University, GA; Keh Ping Chao, Ph.D., Environmental Health Department, China Medical College, Taichung, Taiwan; Yong Woo Lee, Ph.D., Hyundai Research Center, Seoul, Korea; Cagatayhan Ersu, PhD, Cukurova University, Turkey.

Thesis Advisors

Master's thesis advisor - Dr. Alan Bowers, Dept. of Civil and Environmental Engineering, Vanderbilt University, Nashville, TN

Ph.D. dissertation advisor - Dr. Leonard Lion, Dept. of Civil and Environmental Engineering, Cornell University, Ithaca, NY

Biographic Sketch

Yu Wang
Department of Political Science
Iowa State University
545 Ross Hall, Ames, IA 50010
Phone: (515)294-3934

(a) Professional Preparation

Georgia Institute of Technology, Atlanta, GA, Public Policy, Ph.D, 2014
Shanghai Jiao Tong University, Shanghai, China, Environmental Engineering, M.S, 2008
Shanghai Jiao Tong University, Shanghai, China, Natural Resources & Environment, B.S, 2005

(b) Academic Appointments

Associate Professor, Department of Political Science, Iowa State University, 2021 - present
Assistant Professor, Department of Political Science, Iowa State University, 2014 - 2021

(c) Products

(i) Five Closely Related Products

(1) Robert Urbatsch, Yu Wang. (2021) Religiosity and energy-policy preferences. Accepted at Energy Research & Social Science
(2) Yang, C., Wang, Y.*, Dong, Z. (2020) Evaluating the impact of denitrification tariff on energy-related NOX generation in China: policy effects and regional disparities. Energy Policy. 142. 111520, ISSN 0301-4215.
(3) Wang, Y.*, and Cheng, M. Greenhouse Gas Emissions Embedded in US-China Fuel Ethanol Trade: A Comparative Well-to-Wheel Estimate. Journal of Cleaner Production. 2018 (183): 653-661
(4) Yu Wang*, Ming-Hsun Cheng, and Mark Mba-Wright. Life-cycle energy consumption and greenhouse gas emissions from corncob ethanol in China. Biofuels Bioproducts & Biorefining. 2018; 12: 1037-1046.
(5) Brown, M., Wang, Y. Energy-Efficiency Skeptics and Advocates: The Debate Heats Up as the Stakes Rise. Energy Efficiency, 2017; 10(5): 1155-1173

(ii) Other Significant Products

(1) Alvina Aui, Yu Wang*. Mark Mba-Wright. (2021) Meta-analysis of economic feasibility of cellulosic ethanol technologies. Renewable & Sustainable Energy Review. 145: 111098
(2) Chen, C.-F., Wang, Y., Adua, L., & Bai, H. (2020). Reducing Household Fossil Fuel Consumption by Enabling Technology and Behavior. Energy Research and Social Science, 60:101402.
(3) Chien-fei Chen, Tianzhen Hong, Gerardo Zarazua de Rubens, Selin Yilmaz, Karol Bandurski, Zsófia Deme Bélafi, Marilena De Simone, Mateus Vinícius Bavaresco, Yu Wang, Pei-ling Liu, Verena M. Barthelmes, Jacqueline Adams, Simona D'Oca, Łukasz Przybylski, Culture, conformity, and carbon? A multi-country analysis of heating and cooling practices in office buildings, Energy Research & Social Science, Volume 61, 2020, 101344, ISSN 2214-6296

(4) Yu Wang*. Overview of State Policies for Energy Efficiency in Buildings. Current Sustainable and Renewable Energy Reports. 2018: 5(1): 101-108
(5) Ming-Hsun Cheng, Minliang Yang, and Yu Wang*. 2016. American's Energy Future: An Analysis of the Proposed Energy Policy Plans in Presidential Election. *Energies*. 9, 1000

(d) Synergistic Activities

(1) Serving as the co-PI on multiple research projects to study energy use by buildings, including a research project (funded by A. Sloan Foundation) examining the social acceptance of demand response technologies, and a research project modeling building level energy use in an urban center (funded by the Iowa Energy Center)
(2) Serving on the policy council and review panel for the Association of Public Policy Analysis & Management since 2019; Review manuscripts; Organize and chair multiple panels; Serving as discussant for multiple panels; Funding member of the Chinese Policy Scholar Group since 2020
(3) Setting up the ISU-NMES (National Energy Modeling System) model to establish modeling capacity of the national energy market, and facilitate interdisciplinary collaboration on energy research;
(4) Serving as reviewer for multiple journals in the field of energy policy research, including Journal of Policy Analysis and Management, Journal of Cleaner Production, Global Environmental Change, Applied Energy, etc; Written a book on energy efficiency policies to introduce the policies and markets for energy efficiency and offer analysis of state, national, and global energy efficiency markets
(5) Panel reviewer: NSF-GRFP 2017; APPAM Fall Research Conference multiple panels

NSF BIOGRAPHICAL SKETCH

NAME: Oyanedel-Craver, Vinka

ORCID: 0000-0002-7851-2108

POSITION TITLE & INSTITUTION: Interim Associate Dean of Research, College of Engineering, University of Rhode Island

(a) PROFESSIONAL PREPARATION -(see PAPPG Chapter II.C.2.f.(a))

INSTITUTION	LOCATION	MAJOR / AREA OF STUDY	DEGREE (if applicable)	YEAR YYYY
P. Catholic U. of Valparaiso	Valpo., Valpo.	Biochemical Engineering	BS	1997
P.Catholic U. of Valparaiso	Valparaiso, Valpo.	Biochemical Engineering	MS	2001
U. of Santiago de Compostela	Compostela, Galicia	Chem. and Environ. Engineering	PHD	2002
U. of Virginia	Charlottesville, Virginia	Civil and Enviro. Engineering	Postdoctoral Fellow	2003 - 2007

(b) APPOINTMENTS -(see PAPPG Chapter II.C.2.f.(b))

2021 - present Interim Associate Dean of Research, College of Engineering, University of Rhode Island, Kingston, RI

2021 - present Academic Advisor, New England Transportation Consortium

2019 - present Professor, University of Rhode Island, Department of Civil and Environmental Engineering, Kingston, RI

2019 - present Board Member, Ixtatan Foundation (non profit organization)

2020 - 2020 Visiting Scholar, Department of Sanitary and Environmental Engineering, Universidade Federal de Santa Maria

2019 - 2021 President, Sustainable Nanotechnology Organization

2015 - 2015 Visiting Scholar (sabbatical), Harvard T.H. Chan School of Public Health

2015 - 2015 Visiting Scholar, Biochemical Engineering School, Pontificia Universidad Catolica, Valparaiso

2014 - 2019 Associate Professor, University of Rhode Island, Department of Civil and Environmental Engineering, Kingston, RI

2008 - 2014 Assistant Professor, University of Rhode Island, Department of Civil and Environmental Engineering, Kingston, RI

2006 - 2007 Adjunct Professor, University of Virgia, Department of Civil and Environmental Engineering, Charlottesville, VA

(c) PRODUCTS -(see PAPPG Chapter II.C.2.f.(c))

Products Most Closely Related to the Proposed Project

1. Faghihzadeh F, Anaya N, Hadjeres H, Boving T, Oyanedel-Craver V. Pulse UV light effect on microbial biomolecules and organic pollutants degradation in aqueous solutions. Chemosphere. 2019 February; 216:677-683. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0045653518320472 DOI:

10.1016/j.chemosphere.2018.10.176

2. Guilfoos T, Hayden S, Uchida E, Oyanedel-Craver V. WTP for water filters and water quality testing services in Guatemala. Water Resources and Economics. 2020 July; 31:100139-. Available from: https://linkinghub.elsevier.com/retrieve/pii/S2212428417301615 DOI: 10.1016/j.wre.2019.01.005
3. Singh D, Schifman L, Watson-Wright C, Sotiriou G, Oyanedel-Craver V, Wohlleben W, Demokritou P. Nanofiller Presence Enhances Polycyclic Aromatic Hydrocarbon (PAH) Profile on Nanoparticles Released during Thermal Decomposition of Nano-enabled Thermoplastics: Potential Environmental Health Implications. Environmental Science & Technology. 2017 April 20; 51(9):5222-5232. Available from: https://pubs.acs.org/doi/10.1021/acs.est.6b06448 DOI: 10.1021/acs.est.6b06448
4. Kallman E, Oyanedel-Craver V, Smith J. Ceramic Filters Impregnated with Silver Nanoparticles for Point-of-Use Water Treatment in Rural Guatemala. Journal of Environmental Engineering. 2011 June; 137(6):407-415. Available from: http://ascelibrary.org/doi/10.1061/%28ASCE%29EE.1943-7870.0000330 DOI: 10.1061/(ASCE)EE.1943-7870.0000330
5. Mellor J, Kallman E, Oyanedel-Craver V, Smith J. Comparison of Three Household Water Treatment Technologies in San Mateo Ixtatán, Guatemala. Journal of Environmental Engineering. 2015 May; 141(5):04014085-. Available from: http://ascelibrary.org/doi/10.1061/%28ASCE%29EE.1943-7870.0000914 DOI: 10.1061/(ASCE)EE.1943-7870.0000914

Other Significant Products, Whether or Not Related to the Proposed Project

1. Schifman LA, Kasaraneni VK, Sullivan RK, Oyanedel-Craver V, Boving TB. New Antimicrobially Amended Media for Improved Nonpoint Source Bacterial Pollution Treatment. Environ Sci Technol. 2015 Dec 15;49(24):14383-91. PubMed PMID: 26562065.
2. Gambilongo L, Greco L, Oyanedel-Craver V. Life Cycle Assessment approach: comparative analysis of CLT panels and concrete system for a complex building envelope.. [Print]. Calabria, Italy: Università della Calabria; 2020 July.
3. Chede S, Anaya N, Oyanedel-Craver V, Gorgannejad S, Harris T, Al-Mallahi J, Abu-Dalo M, Qdais H, Escobar I. Desalination using low biofouling nanocomposite membranes: From batch-scale to continuous-scale membrane fabrication. Desalination. 2019 February; 451:81-91. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0011916417309463 DOI: 10.1016/j.desal.2017.05.007
4. Sullivan R, Erickson M, Oyanedel-Craver V. Understanding the microbiological, organic and inorganic contaminant removal capacity of ceramic water filters doped with different silver nanoparticles. Environmental Science: Nano. 2017; 4(12):2348-2355. Available from: http://xlink.rsc.org/?DOI=C7EN00443E DOI: 10.1039/C7EN00443E
5. Shepard Z, Lux E, Oyanedel-Craver V. Performance of silver nanoparticle-impregnated ovoid ceramic water filters. Environmental Science: Nano. 2020; 7(6):1772-1780. Available from: http://xlink.rsc.org/?DOI=D0EN00115E DOI: 10.1039/D0EN00115E

(d) SYNERGISTIC ACTIVITIES -(see PAPPG Chapter II.C.2.f.(d))

1. Professional: Chair of the diversity committee for the College of Engineering. Participate in the organization of multiple activities, especially those engaging young professionals and women.
2. Outreach: Collaboration with Guiding Education in Math and Science Network (GEMS-Net) to support developing hands-on activities for K-12 science classrooms .
3. Innovation in education: NSF funded undergraduate course NanoTools. Results for this effort were recently published in the book " Exposure to Engineered Nanomaterials in the Environment"
4. Scientific Community: President of the Sustainable Nanotechnology Organization.
5. International: Co-Chair of two Pan American Nanotechnologies conferences (2017 and 2020) A total of 120 participants were from the USA and over 400 Latin American.

OMB No. 0925-0001 and 0925-0002 (Rev. 12/2020 Approved Through 02/28/2023)

BIOGRAPHICAL SKETCH

Provide the following information for the Senior/key personnel and other significant contributors.
Follow this format for each person. **DO NOT EXCEED FIVE PAGES.**

NAME: Todd Guilfoos

eRA COMMONS USER NAME (credential, e.g., agency login):

POSITION TITLE:Associate Professor

EDUCATION/TRAINING *(Begin with baccalaureate or other initial professional education, such as nursing, include postdoctoral training and residency training if applicable. Add/delete rows as necessary.)*

INSTITUTION AND LOCATION	DEGREE *(if applicable)*	Completion Date MM/YYYY	FIELD OF STUDY
The Ohio State University	BSBA	05/2001	Finance
Binghamton University	PhD	05/2013	Economics

A. Personal Statement

I am a water economist, and my main interests are in water economics, cooperation and behavioral economics, environmental markets, and non-market valuation. I'm a member of the Water Cluster at URI which is a leading group of interdisciplinary scientists interested in water who work across disciplines. A component of my research has been in groundwater economics and thinking about the connections between hydrology and optimal groundwater management. Recent advances in the field have explored how spatial and physical constraints affect groundwater use and management. Additionally, I have done work to understand water quality from a valuation and policy perspective. I've worked on valuation work in Guatemala on water filtration systems and measured economic impacts of the chemical spill in the Elk River in West Virginia in 2013. I'm currently working on a project investigating causes of lead exposure in schools through drinking water.

B. Positions, Scientific Appointments, and Honors

Associate Professor, University of Rhode Island, 2019-current
Assistant Professor, University of Rhode Island, 2013-2019

Associate Editor – Water & Resource Economics, 2020-current
Guest co-Editor – Agricultural and Resource Economics Review, 2016 Special Issue on Water Quality Economics

Program Committee, International Conference on Complex Systems 2018
Program Committee, Northeast Regional Conference on Complex Systems 2018, 2019
NAREA Board Member, 2017-2020
Chair, Agricultural Experiment Station W3190 2016-2017
Vice Chair, Agricultural Experiment Station W3190 2015-2016
Secretary, Agricultural Experiment Station W3190 2014-2015

C. Contributions to Science

Guilfoos, T., Pape, A. D. (2020). Estimating Case-Based Learning. Games, 11(3), 38.

Edwards, E., Guilfoos, T. (2020). The Economics of Groundwater Governance Institutions Across the Globe. *Applied Economic Perspectives and Policy*. (Forthcoming)

Zia, A., Ding, S., Messer, K. D., Miao, H., Suter, J. F., Fooks, J. R., ... & Merrill, S. (2020). Characterizing Heterogeneous Behavior of Non-Point-Source Polluters in a Spatial Game under Alternate Sensing and Incentive Designs. *Journal of Water Resources Planning and Management*, *146*(8), 04020054.

Weir, M. J., Ashcraft, C. M., Leuchanka Diessner, N., McGreavy, B., Vogler, E., & Guilfoos, T. (2020). Language effects on bargaining. *Plos one*, *15*(3), e0229501.

Guilfoos, T., Hayden, S., Uchida, E., & Oyanedel Craver, V. (2019). WTP for Water Filters and Water Quality Testing Services in Guatemala. *Water Resource and Economics*: 100139.

Guilfoos, T., Miao, H., Trandafir, S., & Uchida, E. (2019). Social Learning and Communication with Threshold Uncertainty. *Resource and Energy Economics*. *55*, 81-101.

Boslett, A., Guilfoos, T., & Lang, C. (2019). Valuation of the External Costs of Unconventional Oil and Gas Development: The Critical Importance of Mineral Rights Ownership. *Journal of the Association of Environmental and Resource Economists.* 6(3), 531-561.

Brozyna, C., Guilfoos, T., & Atlas, S. (2018). Slow and deliberate cooperation in the commons. *Nature Sustainability*, *1*(4), 184.

Guilfoos, T., Kell, D., Boslett, A., & Hill, E. L. (2018). The Economic and Health Effects of the 2014 Chemical Spill in the Elk River, West Virginia. *American Journal of Agricultural Economics*.

Merrill, N. H., & Guilfoos, T. (2018). Optimal groundwater extraction under uncertainty and a spatial stock externality. *American journal of agricultural economics*, *100*(1), 220-238.

Guilfoos, T., Khanna, N., & Peterson, J. M. (2016). Efficiency of Viable Groundwater Management Policies. *Land Economics*, 92(4), 618-640.

Miao, H., Fooks, J. R., Guilfoos, T., Messer, K. D., Pradhanang, S. M., Suter, J. F., ... & Uchida, E. (2016). The impact of information on behavior under an ambient-based policy for regulating nonpoint source pollution. *Water Resources Research*.

Booth, P. L., Guilfoos, T., & Uchida, E. (2016). Endowment Effects and Drinking Water Quality. *Agricultural and Resource Economics Review*,*45*(02), 338-366.

Kim, C. S., & Guilfoos, T. (2016). The Effect of Cost-share Programs on Ground Water Exploitation and Nonpoint-source Pollution under Endogenous Technical Change. *Agricultural and Resource Economics Review*, *45*(02), 394-417.

Boslett, A., Guilfoos, T., & Lang, C. (2016). Valuation of expectations: a hedonic study of shale gas development and New York's Moratorium. *Journal of Environmental Economics and Management*, *77*, 14-30.

Guilfoos, T., & Pape, A. D. (2016). Predicting human cooperation in the Prisoner's Dilemma using case-based decision theory. *Theory and Decision*,*80*(1), 1-32.

Guilfoos, T., Pape, A. D., Khanna, N., & Salvage, K. (2013). Groundwater management: The effect of water flows on welfare gains. *Ecological Economics*, *95*, 31-40.

Biographical Sketch — Nell Green Nylen

University of California, Berkeley, School of Law • 393 Simon Hall, Berkeley, CA 94720
ngreennylen@berkeley.edu

Education

Stanford University	Geological and Environmental Sciences	B.S.	1996
Stanford University	Geological and Environmental Sciences	Ph.D.	2005
University of California, Berkeley	Law	J.D.	2012

Experience

2016-present	Senior Research Fellow, Wheeler Water Institute, Center for Law, Energy & the Environment, University of California, Berkeley, School of Law, Berkeley, CA
2013–2016	Research Fellow, Wheeler Water Institute, Center for Law, Energy & the Environment, University of California, Berkeley, School of Law, Berkeley, CA
2012–2013	Law Clerk to Justice Gregory J. Hobbs, Jr., Colorado Supreme Court, Denver, CO
2011	Teaching Assistant (Part-time), University of California, Berkeley, School of Law, Berkeley, CA
2011	Legal Intern, California Attorney General's Office, Oakland, CA
2010	Legal Intern, Center for Biological Diversity, San Francisco, CA
2009	Research and Curatorial Assistant, California Academy of Sciences, San Francisco, CA
2006–2008	Museum Assistant and GIS Specialist (Part-time), Yale Peabody Museum of Natural History, New Haven, CT
2006–2008	Assistant to Professor Michael Donoghue (Part-time), Yale University, New Haven, CT
1998–2002	Teaching Assistant (Part-time), Stanford University, Stanford, CA
1997–1998	GIS, CAD, and Graphics Specialist, Stanford University, Stanford, CA
1997	GIS and Graphics Intern, Stanford University, Stanford, CA
1996–1997	Geologist, United States Geological Survey, Menlo Park, CA
1995–1996	Teaching Assistant, Stanford University, Stanford, CA

Selected Publications

Nell Green Nylen, Michael Kiparsky, and Anita Milman. "Cultivating Effective Utility-Regulator Relationships Around Innovation: Lessons from Four Case Studies in the U.S. Municipal Wastewater Sector." (In preparation)

Lidia Cano Pecharroman, Christopher Williams, **Nell Green Nylen**, and Michael Kiparsky. "How Can We Govern Large-Scale Green Infrastructure for Multiple Water Security Benefits?" *Blue Green Systems*. (In press)

Nell Green Nylen. 2021. "Surface Water Quality Regulation as a Driver for Groundwater Recharge: The Case of Virginia's Sustainable Water Initiative for Tomorrow." *Case Studies in the Environment* 5(1): 1124592, https://doi.org/10.1525/cse.2020.1124592.

Nell Green Nylen, Michael Kiparsky, Dave Owen, Holly Doremus, and Michael Hanemann. 2018. Addressing Institutional Vulnerabilities in California's Drought Water Allocation, Part 1: Water Rights Administration and Oversight During Major Statewide Droughts, 1976–2016, California's Fourth Climate Change Assessment, California Natural Resources Agency, Publication number: CCCA4-CNRA-2018-009, https://www.energy.ca.gov/sites/default/files/2019-12/Water_CCCA4-CNRA-2018-009_ada.pdf.

Nell Green Nylen, Camille Pannu, and Michael Kiparsky. 2018. Learning from California's Experience with Small Water System Consolidations: A Workshop Synthesis. Center for Law, Energy & the Environment, University of California, Berkeley. Berkeley, CA. 28 pp, *available at* https://www.law.berkeley.edu/research/clee/research/wheeler/learning-from-consolidations/.

Nell Green Nylen, Luke Sherman, Michael Kiparsky, and Holly Doremus. 2016. Citizen Enforcement and Sanitary Sewer Overflows in California. Center for Law, Energy & the Environment, University of California, Berkeley. Berkeley, CA. 200 pp, *available at* https://www.law.berkeley.edu/research/clee/research/wheeler/sso-citizen-enforcement/.

Nell Green Nylen and Michael Kiparsky. 2015. Accelerating Cost-Effective Green Stormwater Infrastructure: Learning from Local Implementation. Center for Law, Energy & the Environment, University of California, Berkeley. Berkeley, CA. 47 pp, *available at* https://www.law.berkeley.edu/research/clee/research/wheeler/accelerating-cost-effective-green-stormwater-infrastructure-learning-from-local-implementation/

Synergistic Activities and Associations

Executive Committee Member, Environmental Law Section of the California Lawyers Association, 2020–present

Board Member, California Water Law Symposium, 2019–present

Member, County Drought Advisory Group, convened by California Department of Water Resources to aid AB 1668 implementation, 2018–present

Over 20 invited presentations from 2015–2021

Member, Judging Committee, 2017 California Water Law Writing Prize

Bar Admission

California (inactive)

United States
ENVIRONMENTAL PROTECTION AGENCY
Washington, DC 20460

OMB Control No. 2030-0020
Approval expires 06/30/2024

Current and Pending Support

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: Kaoru Ikuma

Other agencies (including NSF) to which this proposal has been/will be submitted.

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Building resilience in vulnerable older adult communities facing increased exposure risks to wastewater contamination from flooding in Puerto Rico

Source of Support: U.S. Environmental Protection Agency
Total Award Amount: 800,000.00 Total Award Period Covered: 08/16/2020 to 08/15/2023
Location of Project: Iowa State University
Person-Months Per Year Committed to the Project. Cal: 0.65 Acad: 0.00 Sumr: 0.00

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Environmental Field Evaluation of Potassium Acetate

Source of Support: Minnesota Department of Transportation
Total Award Amount: 212,877.00 Total Award Period Covered: 08/15/2019 to 07/15/2022
Location of Project: Iowa State University
Person-Months Per Year Committed to the Project. Cal: 0.00 Acad: 0.00 Sumr: 0.25

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: A systems approach for understanding, predicting, and managing harmful algal blooms in Midwestern lakes

Source of Support: U.S. Environmental Protection Agency
Total Award Amount: 760,000.00 Total Award Period Covered: 01/01/2018 to 12/31/2021
Location of Project: Iowa State University
Person-Months Per Year Committed to the Project. Cal: 0.00 Acad: 0.00 Sumr: 0.25

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Evaluation of per- and polyfluoroalkyl substances in Iowa wastewater treatment facilities, treated effluent, and biosolids

Source of Support: Iowa Water Environment Association
Total Award Amount: 10,000.00 Total Award Period Covered: 08/01/2021 to 06/30/2022
Location of Project: Iowa State University
Person-Months Per Year Committed to the Project. Cal: 0.00 Acad: 0.00 Sumr: 0.10

Support: ☐ Current ☑ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Biodegradable polymeric nanoparticles: transport, fate and release of agrochemicals in soil environments

Source of Support: U.S. Dept. of Agriculture National Institute of Food and Agriculture
Total Award Amount: 650,000.00 Total Award Period Covered: 01/01/2022 to 12/31/2025
Location of Project: Iowa State University
Person-Months Per Year Committed to the Project. Cal: 0.00 Acad: 0.00 Sumr: 0.60

*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

United States
ENVIRONMENTAL PROTECTION AGENCY
Washington, DC 20460

OMB Control No. 2030-0020
Approval expires 06/30/2024

Current and Pending Support

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: Kaoru Ikuma	Other agencies (including NSF) to which this proposal has been/will be submitted.

Support: ☐ Current ☑ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: CAREER: Understanding the development of bacterial resistance to disinfectants during water reuse

Source of Support: National Science Foundation
Total Award Amount: 519,488.00 Total Award Period Covered: 05/01/2022 to 04/30/2027
Location of Project: Iowa State University
Person-Months Per Year Committed to the Project. Cal: 0.50 Acad: 0.00 Sumr: 0.00

Support: ☐ Current ☑ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Pathways to exposure to pathogens during floods

Source of Support: National Institutes of Water Resources
Total Award Amount: 250,000.00 Total Award Period Covered: 10/15/2021 to 10/01/2024
Location of Project: Iowa State University
Person-Months Per Year Committed to the Project. Cal: 1.70 Acad: 0.00 Sumr: 0.00

Support: ☐ Current ☑ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Accelerating technical and community readiness for water reuse in small systems

Source of Support: U.S. Environmental Protection Agency
Total Award Amount: 3,246,000.00 Total Award Period Covered: 05/01/2022 to 04/30/2026
Location of Project: Iowa State University
Person-Months Per Year Committed to the Project. Cal: 0.00 Acad: 0.00 Sumr: 1.50

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal:

Source of Support:
Total Award Amount: Total Award Period Covered: to
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal:

Source of Support:
Total Award Amount: Total Award Period Covered: to
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

United States
ENVIRONMENTAL PROTECTION AGENCY
Washington, DC 20460

OMB Control No. 2030-0020
Approval expires 06/30/2024

Current and Pending Support

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: Joseph E. Goodwill

Other agencies (including NSF) to which this proposal has been/will be submitted.
None

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: CAREER: Closing the Rural Water and Eduction Gaps with a Simple Advanced Oxidation Process

Source of Support: NSF
Total Award Amount: 507,240.00 Total Award Period Covered: 04/01/2021 to 04/01/2026
Location of Project: Univ. or Rhode Island, Kingston, RI
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr: 0.75

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Co-treatment of Acid Mine Drainage in Municipal Waster Plants for Sustainable Design in Reclamation

Source of Support: US Dept. of Interior
Total Award Amount: 199,630.00 Total Award Period Covered: 09/01/2021 to 05/01/2023
Location of Project: Univ. of Rhode Island, Kingston, RI
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr: 0.25

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Nonstructural approaches to reduce sediment and pollutant runoff from infrastructure in urban areas

Source of Support: Transportation Infrastructure Durability Center, UMaine
Total Award Amount: 400,576.00 Total Award Period Covered: 08/01/2021 to 07/31/2022
Location of Project: Univ. of Rhode Island, Kingston, RI
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr: 0.25

Support: ☐ Current ☑ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: RII Track-1: Blue Economies Require Health Coastal Ecosystems: Building Capacity at the Nexus of Climate Change, Marine Plastics, and Emerging Pollutants in the Ocean State

Source of Support: NSF-EPSCOR
Total Award Amount: 20,000,000.00 Total Award Period Covered: 07/01/2022 to 07/01/2027
Location of Project: Univ. of Rhode Island, Kingston, RI
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr: 0.50

Support: ☐ Current ☑ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Accelerating technical and community readiness for beneficial water reuse in small systems (this proposal)

Source of Support: USEPA
Total Award Amount: 821,919.00 Total Award Period Covered: 09/01/2022 to 08/31/2026
Location of Project: Univ. of Rhode Island, Kingston, RI
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr: 1.00

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Current and Pending Support

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: Michael Kiparsky

Other agencies (including NSF) to which this proposal has been/will be submitted.

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Water Resource Innovation Partnership with Valley Water

Source of Support: Santa Clara Valley Water District
Total Award Amount: 79.994 Total Award Period Covered: 01/01/2021 to 12/21/2022
Location of Project: UC Berkeley
Person-Months Per Year Committed to the Project. Cal: 1 Acad: Sumr:

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Guidance for Achieving Voluntary Agreements in California Water

Source of Support: Water Foundation
Total Award Amount: 26,000 Total Award Period Covered: 08/19/2021 to 12/31/2021
Location of Project: UC Berkeley
Person-Months Per Year Committed to the Project. Cal: 1 Acad: Sumr:

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Recharge Net Metering to Secure Water Resources, Enhance Aquatic Systems, sustain landscapes and empower local institutions

Source of Support: Gordon and Betty Moore Foundation
Total Award Amount: 157,968 Total Award Period Covered: 11/02/2020 to 11/01/2023
Location of Project: UC Berkeley
Person-Months Per Year Committed to the Project. Cal: 2 Acad: Sumr:

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Improving Water Rights Administration and Oversight for Future Droughts

Source of Support: State Water Resources Control Board
Total Award Amount: 296,188 Total Award Period Covered: 06/25/2020 to 01/31/2022
Location of Project: UC Berkeley
Person-Months Per Year Committed to the Project. Cal: 2 Acad: Sumr:

Support: ☐ Current ☑ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Reinventing teh Nation's Urban Water Reuse Systems (ReNUWeRs)

Source of Support: EPA
Total Award Amount: 3,245,670 Total Award Period Covered: 08/01/2022 to 07/31/2026
Location of Project: UC Berkeley
Person-Months Per Year Committed to the Project. Cal: 1 Acad: Sumr:

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Current and Pending Support

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: Michael Kiparsky

Other agencies (including NSF) to which this proposal has been/will be submitted.

Support: ☐ Current ☑ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Accelerating Technical and community readiness for benefical water reuse in small systems

Source of Support: EPA
Total Award Amount: 3,245,670 Total Award Period Covered: 08/01/20222 to 07/31/2026
Location of Project: UC Berkeley
Person-Months Per Year Committed to the Project. Cal: 2 Acad: Sumr:

Support: ☐ Current ☑ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Data enabled water trading to sustain agrosystems in the semi-arid west

Source of Support: USDA
Total Award Amount: 924,646 Total Award Period Covered: 10/01/21 to 09/30/25
Location of Project: UC Berkeley
Person-Months Per Year Committed to the Project. Cal: 1.5 Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal:

Source of Support:
Total Award Amount: Total Award Period Covered: to
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal:

Source of Support:
Total Award Amount: Total Award Period Covered: to
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal:

Source of Support:
Total Award Amount: Total Award Period Covered: to
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

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Investigator: Lu Liu	Other agencies (including NSF) to which this proposal has been/will be submitted.

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: GOALI: Collaborative Research: Advancing wastewater treatment resiliency and sustainability

Source of Support: NSF
Total Award Amount: 35,331.00 Total Award Period Covered: 08/16/2019 to 08/14/2022
Location of Project: Iowa State University, Ames, IA
Person-Months Per Year Committed to the Project. Cal: 0.20 Acad: 0.00 Sumr: 0.00

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Analytical tool for assessing climate risks for ERCOT

Source of Support: Alfred P. Sloan Foundation
Total Award Amount: 40,000.00 Total Award Period Covered: 05/01/2021 to 04/30/2023
Location of Project: Iowa State University, Ames, IA
Person-Months Per Year Committed to the Project. Cal: 0.00 Acad: 0.00 Sumr: 0.00

Support: ☐ Current ☑ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: The impact of climate change, agriculture management, and water use on nitrate levels in the primary sources of drinking water supply for Des Moines, IA

Source of Support: USGS - G21AS00518
Total Award Amount: 201,931.00 Total Award Period Covered: 10/01/2021 to 10/01/2024
Location of Project: Iowa State University, Ames, IA
Person-Months Per Year Committed to the Project. Cal: 2.00 Acad: Sumr:

Support: ☐ Current ☑ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Accelerating technical and community readiness for water reuse in small systems

Source of Support: EPA
Total Award Amount: 3,254,999.00 Total Award Period Covered: 05/01/2022 to 04/30/2026
Location of Project: Iowa State University, Ames, IA
Person-Months Per Year Committed to the Project. Cal: 1.55 Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal:

Source of Support:
Total Award Amount: Total Award Period Covered: to
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

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Investigator: Antonio Arenas

Other agencies (including NSF) to which this proposal has been/will be submitted.

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Developing Design Criteria to Test a New Saturated Waterway Consevation Practice

Source of Support: Iowa Nutrient Research Center
Total Award Amount: 27,157.00 Total Award Period Covered: 10/01/2021 to 09/30/2021
Location of Project: Iowa State University
Person-Months Per Year Committed to the Project. Cal: Acad: 2.00 Sumr:

Support: ☐ Current ☑ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: ASSESSING THE FLOOD REDUCTION BENEFITS OF ON-ROAD STRUCTURES

Source of Support: Iowa Department of Transportation / The University of Iowa
Total Award Amount: 194,087.00 Total Award Period Covered: 10/01/2021 to 02/28/2024
Location of Project: Iowa State University
Person-Months Per Year Committed to the Project. Cal: Acad: 3.00 Sumr:

Support: ☐ Current ☑ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Accelerating technical and community readiness for beneficial water reuse in small systems

Source of Support: U.S. Environmental Protection Agency
Total Award Amount: 3,245,999.00 Total Award Period Covered: 05/01/2022 to 04/30/2026
Location of Project: Iowa State University
Person-Months Per Year Committed to the Project. Cal: Acad: 1.55 Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal:

Source of Support:
Total Award Amount: Total Award Period Covered: to
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal:

Source of Support:
Total Award Amount: Total Award Period Covered: to
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

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Investigator: Chris Rehmann

Other agencies (including NSF) to which this proposal has been/will be submitted.

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Building resilience in elderly vulnerable communities facing repeated flooding and increased exposure risks to untreated wastewater in Puerto Rico

Source of Support: U.S. Environmental Protection Agency
Total Award Amount: 800,000.00 Total Award Period Covered: 09/01/2020 to 08/31/2023
Location of Project: Iowa State University
Person-Months Per Year Committed to the Project. Cal: 0.00 Acad: 0.00 Sumr: 1.00

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Environmental Field Evaluation of Potassium Acetate

Source of Support: Minnesota Department of Transportation
Total Award Amount: 212,877.00 Total Award Period Covered: 08/01/2019 to 07/31/2022
Location of Project: Iowa State University
Person-Months Per Year Committed to the Project. Cal: 0.00 Acad: 0.00 Sumr: 0.25

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Evaluation and Enhancement of Saturated Buffers as a Conservation Drainage Practice for Agricultural Subsurface Drainage Treatment

Source of Support: U.S. Department of Agriculture--Natural Resource Conservation Service
Total Award Amount: 150,000.00 Total Award Period Covered: 09/01/2018 to 08/31/2022
Location of Project: Iowa State University
Person-Months Per Year Committed to the Project. Cal: 0.00 Acad: 0.00 Sumr: 0.00

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Groundwater Systems Impacts on the US 63 Railroad Underpass at Waterloo, Iowa: Phase IV

Source of Support: Iowa Department of Transportation
Total Award Amount: 139,999.00 Total Award Period Covered: 01/01/2020 to 12/31/2021
Location of Project: Iowa State University
Person-Months Per Year Committed to the Project. Cal: 0.00 Acad: 0.00 Sumr: 0.50

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: IRecognizeU: Finding the pathway to increasing women civil engineering students' feeling of recognition to develop an engineering identity

Source of Support: National Science Foundation
Total Award Amount: 199,965.00 Total Award Period Covered: 09/01/2020 to 08/31/2023
Location of Project: Iowa State University
Person-Months Per Year Committed to the Project. Cal: 0.00 Acad: 0.00 Sumr: 0.25

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Investigator: Chris Rehmann

Other agencies (including NSF) to which this proposal has been/will be submitted.

Support: ☐ Current ☑ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Pathways to exposure to pathogens during floods

Source of Support: National Institutes for Water Resources
Total Award Amount: 250,000.00 Total Award Period Covered: 10/15/2021 to 10/14/2024
Location of Project: Iowa State University
Person-Months Per Year Committed to the Project. Cal: 0.00 Acad: 0.00 Sumr: 1.70

Support: ☐ Current ☑ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Accelerating technical and community readiness for water reuse in small systems

Source of Support: U.S. Environmental Protection Agency
Total Award Amount: 3,246,000.00 Total Award Period Covered: 05/01/2022 to 04/30/2026
Location of Project: Iowa State University
Person-Months Per Year Committed to the Project. Cal: 0.00 Acad: 0.00 Sumr: 1.00

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal:

Source of Support:
Total Award Amount: Total Award Period Covered: to
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal:

Source of Support:
Total Award Amount: Total Award Period Covered: to
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal:

Source of Support:
Total Award Amount: Total Award Period Covered: to
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

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EPA

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Current and Pending Support

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Investigator: Joseph A. Charbonnet

Other agencies (including NSF) to which this proposal has been/will be submitted.
N/A

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Evaluation of per- and polyfluoroalkyl substances in Iowa wastewater treatment facilities, treated effluent, and biosolids

Source of Support: Iowa Water Environment Association
Total Award Amount: 10,0000 Total Award Period Covered: 8/1/2021 to 5/31/22
Location of Project: Ames, IA
Person-Months Per Year Committed to the Project. Cal: 0 Acad: 0 Sumr: 0

Support: ☐ Current ☑ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: National Priorities: Water Innovation, Science, and Engagement to Advance Water Reuse

Source of Support: US EPA
Total Award Amount: 4,057,500 Total Award Period Covered: 5/1/2022 to 4/30/2026
Location of Project: Ames, IA
Person-Months Per Year Committed to the Project. Cal: 1.55 Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal:

Source of Support:
Total Award Amount: Total Award Period Covered: to
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal:

Source of Support:
Total Award Amount: Total Award Period Covered: to
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal:

Source of Support:
Total Award Amount: Total Award Period Covered: to
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

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Investigator: Say Kee Ong

Other agencies (including NSF) to which this proposal has been/will be submitted.

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal:
Evaluation of per- and polyfluoroalkyl substances in Iowa wastewater treatment facilities, treated effluent, and biosolids

Source of Support: Iowa Water Environment Association
Total Award Amount: 10,000.00 Total Award Period Covered: 09/01/2021 to 09/01/2022
Location of Project: Iowa
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr: 0.00

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal:
Evaluation of wastewater disinfection using peracetic acid

Source of Support: Iowa Water Environment Association
Total Award Amount: 9,000.00 Total Award Period Covered: 09/01/2020 to 09/01/2021
Location of Project: Des Moines, Iowa
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr: 0.00

Support: ☐ Current ☑ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal:
Clean Watersheds Needs Survey

Source of Support: Iowa Dept. of Natural Resources
Total Award Amount: 105,000.00 Total Award Period Covered: 11/01/2021 to 05/15/2023
Location of Project: Iowa
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr: 1.00

Support: ☐ Current ☑ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal:
Accelerating technical and community readiness for water reuse in small systems

Source of Support: US EPA
Total Award Amount: 3,246,000.00 Total Award Period Covered: 05/01/2022 to 04/30/2026
Location of Project: Iowa, New Hampshire
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr: 1.00

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal:

Source of Support:
Total Award Amount: Total Award Period Covered: to
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

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Investigator: Yu Wang

Other agencies (including NSF) to which this proposal has been/will be submitted.

Support: ☐ Current ☑ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal:
This proposal

Source of Support: EPA
Total Award Amount: $4,057,500 Total Award Period Covered: to
Location of Project: Iowa State University
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr: 0.5

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal:
A Model-based Assessment of Socioeconomic, Policy, and Environmental Implications for Sustainable

Source of Support: USDA
Total Award Amount: $499,622 Total Award Period Covered: 03/15/2017 to 03/14/2022
Location of Project: Iowa State Univeristy
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr: 0.35

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal:
Future growth of diverse demand response resources and their impact on transmission and distribution

Source of Support: Alfred Sloan Foundation
Total Award Amount: $263,764 Total Award Period Covered: 08/15/2019 to 12/3/2021
Location of Project: Iowa State University
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr: 0.5

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal:
CNH2-L: Sustainable field-to-market supply chains enabled by blockchain networks (this proposal)

Source of Support: NSF
Total Award Amount: $381,795 Total Award Period Covered: 01/01/2020 to 12/31/2021
Location of Project: Iowa State University
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr: 0.5

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal:

Source of Support:
Total Award Amount: Total Award Period Covered: to
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

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Current and Pending Support

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Investigator: Vinka Oyanedel-Craver

Other agencies (including NSF) to which this proposal has been/will be submitted.

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Nonstructural approaches to reduce sediment and pollutant runoff from transportation infrastructure in urbanized areas

Source of Support: TIDC-FHWA
Total Award Amount: 185,879.00 Total Award Period Covered: 09/01/2021 to 12/27/2021
Location of Project: URI
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr: 0.30

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: RI Water Resources Center 104b 2021

Source of Support: USGS
Total Award Amount: 125,000.00 Total Award Period Covered: 09/01/2021 to 08/30/2022
Location of Project: URI
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr: 1.00

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Response of anti-reflection material to a biofouling challenge

Source of Support: HIGHRI OPTICS, INC.
Total Award Amount: 62,000.00 Total Award Period Covered: 07/01/2021 to 06/30/2024
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr: 0.30

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: RI Water Resource Center 104b 2020

Source of Support: USGS
Total Award Amount: 125,000.00 Total Award Period Covered: 03/01/2020 to 12/30/2021
Location of Project: URI
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr: 0.30

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: MRI: Acquistion of a Scanning/Transmission Electron Microscope for Materials Research and Education

Source of Support: NSF
Total Award Amount: 1,600,000.00 Total Award Period Covered: 08/01/2019 to 07/30/2022
Location of Project: URI
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr: 0.30

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Investigator: Vinka Oyanedel-Craver	Other agencies (including NSF) to which this proposal has been/will be submitted.

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: MRI: Acquisition of a Confocal High Content Screening System to Enhance Bioengineering and Biomedical Research

Source of Support: NSF
Total Award Amount: 863,345.00 Total Award Period Covered: 09/01/2018 to 11/27/2021
Location of Project: URI
Person-Months Per Year Committed to the Project. Cal: Acad: 1.00 Sumr:

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Are microplastics a vector for organic pollutants and disease in marine food webs?

Source of Support: Seagrant
Total Award Amount: 292,830.00 Total Award Period Covered: 09/01/2021 to 08/30/2022
Location of Project: URI
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr: 0.20

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Rhode Island – Enhancing the Coastal Environment to Enable Growth in a Blue Economy

Source of Support: NSF
Total Award Amount: 20,000,000.00 Total Award Period Covered: 07/01/2017 to 06/30/2022
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr: 0.20

Support: ☐ Current ☑ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Blue Economies Require Healthy Coastal Ecosystems: Building Capacity at the Nexus of Climate Change, Marine Plastics, and Emerging Pollutants in the Ocean State

Source of Support: NSF
Total Award Amount: 20,000,000.00 Total Award Period Covered: 03/01/2022 to 12/30/2027
Location of Project: URI
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr: 0.50

Support: ☐ Current ☑ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Towards a mechanistic understanding of the structure and reactivity biogenic of MnOx nanoparticles

Source of Support: NSF
Total Award Amount: 432,707.00 Total Award Period Covered: 08/01/2022 to 07/30/2025
Location of Project: URI
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr: 0.50

*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

United States
ENVIRONMENTAL PROTECTION AGENCY
Washington, DC 20460

OMB Control No. 2030-0020
Approval expires 06/30/2024

Current and Pending Support

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: Todd Guilfoos

Other agencies (including NSF) to which this proposal has been/will be submitted.

Support: ☐ Current ☑ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Accelerating technical and community readiness for beneficial water reuse in small systems

Source of Support: EPA
Total Award Amount: 821,919.00 Total Award Period Covered: 09/01/2022 to 08/31/2026
Location of Project: Rhode Island
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr: 0.75

Support: ☐ Current ☑ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Communication, Rules, and Cooperation in Social Dilemmas: Large-scale Experiments Using Games

Source of Support: NSF
Total Award Amount: 1,386,234.00 Total Award Period Covered: 07/01/2022 to 07/01/2026
Location of Project: University of Rhode Island
Person-Months Per Year Committed to the Project. Cal: Acad: 1.00 Sumr: 1.00

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Does Mental Stress Affect Preferences For Groundwater Management

Source of Support: USDA
Total Award Amount: 200,000.00 Total Award Period Covered: 06/01/2019 to 05/31/2022
Location of Project: University of Rhode Island
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr: 1.00

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal:

Source of Support:
Total Award Amount: Total Award Period Covered: to
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal:

Source of Support:
Total Award Amount: Total Award Period Covered: to
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

United States
ENVIRONMENTAL PROTECTION AGENCY
Washington, DC 20460

OMB Control No. 2030-0020
Approval expires 06/30/2024

Current and Pending Support

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: Nell Green Nylen

Other agencies (including NSF) to which this proposal has been/will be submitted.

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Water Resource Innovation Partnership with Valley Water

Source of Support: Santa Clara Valley Water District
Total Award Amount: 79.994 Total Award Period Covered: 01/01/2021 to 12/21/2022
Location of Project: UC Berkeley
Person-Months Per Year Committed to the Project. Cal: 1 Acad: Sumr:

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Guidance for Achieving Voluntary Agreements in California Water

Source of Support: Water Foundation
Total Award Amount: 26,000 Total Award Period Covered: 08/19/2021 to 12/31/2021
Location of Project: UC Berkeley
Person-Months Per Year Committed to the Project. Cal: .5 Acad: Sumr:

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Recharge Net Metering to Secure Water Resources, Enhance Aquatic Systems, sustain landscapes and empower local institutions

Source of Support: Gordon and Betty Moore Foundation
Total Award Amount: 157,968 Total Award Period Covered: 11/02/2020 to 11/01/2023
Location of Project: UC Berkeley
Person-Months Per Year Committed to the Project. Cal: 1 Acad: Sumr:

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Improving Water Rights Administration and Oversight for Future Droughts

Source of Support: State Water Resources Control Board
Total Award Amount: 296,188 Total Award Period Covered: 06/25/2020 to 01/31/2022
Location of Project: UC Berkeley
Person-Months Per Year Committed to the Project. Cal: 3 Acad: Sumr:

Support: ☐ Current ☑ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Reinventing teh Nation's Urban Water Reuse Systems (ReNUWeRs)

Source of Support: EPA
Total Award Amount: 3,245,670 Total Award Period Covered: 08/01/2022 to 07/31/2026
Location of Project: UC Berkeley
Person-Months Per Year Committed to the Project. Cal: 2 Acad: Sumr:

*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

United States
ENVIRONMENTAL PROTECTION AGENCY
Washington, DC 20460

OMB Control No. 2030-0020
Approval expires 06/30/2024

Current and Pending Support

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: Nell Green Nylen

Other agencies (including NSF) to which this proposal has been/will be submitted.

Support: ☐ Current ☑ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Accelerating Technical and community readiness for benefical water reuse in small systems

Source of Support: EPA
Total Award Amount: 3,245,670
Total Award Period Covered: 08/01/20222 to 07/31/2026
Location of Project: UC Berkeley
Person-Months Per Year Committed to the Project. Cal: 3 Acad: Sumr:

Support: ☐ Current ☑ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Data enabled water trading to sustain agrosystems in the semi-arid west

Source of Support: USDA
Total Award Amount: 924,646
Total Award Period Covered: 10/01/21 to 09/30/25
Location of Project: UC Berkeley
Person-Months Per Year Committed to the Project. Cal: 3 Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal:

Source of Support:
Total Award Amount:
Total Award Period Covered: to
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal:

Source of Support:
Total Award Amount:
Total Award Period Covered: to
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal:

Source of Support:
Total Award Amount:
Total Award Period Covered: to
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

American Water Works Association
Dedicated to the World's Most Important Resource®

6666 West Quincy Avenue
Denver, CO 80235-3098
T 303.794.7711
F 303.794.7310
800.926.7337
www.awwa.org

September 20, 2021

Dr. Kaoru Ikuma
Assistant Professor
Iowa State University
328 Town Engr
813 Bissell Rd.
Ames, IA 50011

RE: Letter of Support

Dr. Ikuma and Members of the Bidding Consortium,

With regards to the solicitation **Environmental Protection Agency; National Priorities: Water Innovation, Science and Engagement to Advance Water Reuse, EPA-G2021-ORD-E1**, American Water Works Association (AWWA) stands in support of broadening the water supply portfolio of utilities in the context of small and rural systems throughout the United States. If the consortium, led by Iowa State University, is successful in their bid to conduct this research program, AWWA will seek to mobilize resources to assist in this effort in a fee-for-service model. Examples of potential activities may include engineering and infrastructure feasibility studies conducted through the Community Engineering Corps program (www.communityengineeringcorps.org), and utilization of volunteers and technical experts to assess the potential for water reuse in small, disadvantaged, and rural communities. All activities dependent on employing AWWA resources will be negotiated after award.

Sincerely,

Barbara Martin
Director of Engineering & Technical Services
American Water Works Association

Department of Health

Three Capitol Hill
Providence, RI 02908-5097

TTY: 711
www.health.ri.gov

September 21, 2021

Sarah Ludwig-Monty
United State Environmental Protection Agency
Office of Research
1200 Pennsylvania Ave NW
Washington, DC 20004

RE: Letter of Intent, EPA-G2021-ORD-E1

Dear Ms. Ludwig-Monty:

If the proposal submitted by the University of Rhode Island (Prime: Iowa State University) is selected for funding by the United States Environmental Protection Agency, I am pleased to participate and collaborate as detailed in the proposal. Briefly, this will include connecting the principal investigators to target small utilities in the region for execution of pilot studies, the sharing of water quality and treatment data and operator licensing information *via* quarterly meetings with Dr. Goodwill. It is estimated that the value of this data and staff time represents an in-kind contribution equivalent to $10,000 per year.

Sincerely,

Zhengkai Li, Sc.D., P.E.
Environmental Engineer IV
Center for Drinking Water Quality
Rhode Island Department of Health

Tighe&Bond

September 21, 2021

Sarah Ludwig-Monty
United State Environmental Protection Agency
Office of Research
1200 Pennsylvania Ave NW
Washington, DC 20004

Re: **Letter of Intent, EPA-G2021-ORD-E1**

Dear Ms. Ludwig-Monty:

If the proposal submitted by the University of Rhode Island (Prime: Iowa State University) is selected for funding by the United States Environmental Protection Agency, it is my intent to collaborate as detailed in the proposal. Briefly, this will include connecting the principal investigators to target small utilities in the region for execution of physical and desktop pilot studies, the sharing of relevant project experience in the Northeast including market trends and our approach to determining appropriate designs for small communities, and quarterly meetings with Dr. Goodwill. It is estimated that the value of this data and staff time represents an in-kind contribution equal to $8,000 per year.

Very truly yours,
TIGHE & BOND, INC.

Benjamin Levesque, PE
Vice President

COLORADO
Department of Public Health & Environment

Michael Kiparsky
Director, Wheeler Water Institute
Center for Law, Energy & the Environment
UC Berkeley School of Law
Via email

RE: Letter of Intent to participate in EPA-G2021-ORD-E1

September 20, 2021

Dear Dr. Kiparsky:

The Colorado Water Quality Control Division, Permits Section is pleased to participate in the research proposal entitled, "National Priorities: Water Innovation, Science, and Engagement to Advance Water Reuse" (RFA EPA-G2021-ORD-E1). Advancing water reuse is important for our organization, and we believe this research could contribute to successful implementation of our reuse program. We recognize the need to understand the complex institutional environment for reuse and to coordinate the disparate interests that could benefit from it. We are pleased to collaborate with the Iowa State University research team by helping to refine research questions, provide information through documents and interviews, and review drafts of written products, as appropriate and as availability permits.

We look forward to participating with you in this important project. However, please note that this letter does not necessarily constitute an endorsement of any future findings or conclusions stemming from this research.

Sincerely,

Meg Parish
Colorado Department of Public Health and Environment
Water Quality Control Division
Permits Section Manager
Phone: 303-692-3419
Meg.parish@state.co.us

TOWN OF TELLURIDE

Public Works Department
P.O. Box 397
Telluride, CO 81435

970-728-2177 Phone
970-728-0548 Fax

January 7, 2019

Michael Kiparsky
Director, Wheeler Water Institute
Center for Law, Energy & the Environment
UC Berkeley School of Law
Via email

RE: Letter of Intent to participate in EPA-G2021-ORD-E1

Dear Dr. Kiparsky:

The Town of Telluride is pleased to participate in the research proposal entitled, "National Priorities: Water Innovation, Science, and Engagement to Advance Water Reuse" (RFA EPA-G2021-ORD-E1). We recognize the need to understand the complex institutional environment for reuse and to coordinate the disparate interests that could benefit from it. We are pleased to collaborate with the Iowa State University research team by helping to refine research questions, provide information through documents and interviews, and review drafts of written products, as appropriate.

We look forward to participating with you in this project.

Respectfully,

Joyce Huang
Town Engineer
Public Works Department

Michael Kiparsky
Director, Wheeler Water Institute
Center for Law, Energy & the Environment
UC Berkeley School of Law
Via email

RE: Letter of Intent to participate in EPA-G2021-ORD-E1

September 20, 2021

Dear Dr. Kiparsky:

Leadership Counsel for Justice and Accountability is pleased to participate in the research proposal entitled, “National Priorities: Water Innovation, Science, and Engagement to Advance Water Reuse” (RFA EPA-G2021-ORD-E1). Examining the potential for water reuse to address environmental justice concerns is of great interest to our organization. We recognize the need to understand the complex institutional environment for reuse and to coordinate the disparate interests that could benefit from it. We are pleased to collaborate with the Iowa State University research team by helping to facilitate connections with appropriate interviewees in disadvantaged communities; reviewing and commenting on research questions and interview protocols; and reviewing, commenting on, and co-authoring research and policy products, to the extent time permits. We look forward to participating with you in this project.

Sincerely,

Phoebe Seaton, Co-Executive Director
Leadership Counsel for Justice and Accountability

FELICIA MARCUS
FELICIAAMARCUS@GMAIL.COM

Michael Kiparsky
Director, Wheeler Water Institute
Center for Law, Energy & the Environment
UC Berkeley School of Law
Via email

RE: Letter of Intent to participate in EPA-G2021-ORD-E1

September 28, 2021

Dear Dr. Kiparsky:

I am pleased to participate in the research proposal entitled, "National Priorities: Water Innovation, Science, and Engagement to Advance Water Reuse" (RFA EPA-G2021-ORD-E1). Examining the potential for water reuse in small and rural communities is of great interest to me and builds directly on my unique experience as an implementer and regulator of water and wastewater systems. I am pleased to collaborate with the Iowa State University research team on all aspects of the proposed research, and look forward to the opportunity to advance water reuse through research and engagement.

Sincerely,

Felicia Marcus

Founding Member, Water Policy Group
Fellow, National Academy of Public Administration
William C. Landreth Visiting Fellow, Stanford University, Water in the West Program

BUDGET INFORMATION - Non-Construction Programs

SECTION A - BUDGET SUMMARY						
Grant Program Function or Activity (a)	Catalog of Federal Domestic Assistance Number (b)	Estimated Unobligated Funds		New or Revised Budget		
		Federal (c)	Non-Federal (d)	Federal (e)	Non-Federal (f)	Total (g)
1. Year 1	66.511			$827,005.00	$185,016.00	$1,012,021.00
2. Year 2	66.511			$815,724.00	$202,616.00	$1,018,340.00
3. Year 3	66.511			$801,548.00	$208,753.00	$1,010,301.00
4. Year 4	66.511			$801,723.00	$215,115.00	$1,016,838.00
5. Totals				$3,246,000.00	$811,500.00	$4,057,500.00

SECTION B - BUDGET CATEGORIES					
6. Object Class Categories	GRANT PROGRAM, FUNCTION OR ACTIVITY				Total (5)
	(1) Year 1	(2) Year 2	(3) Year 3	(4) Year 4	
a. Personnel	$167,515.00	$172,541.00	$177,717.00	$176,755.00	$694,528.00
b. Fringe Benefits	$31,790.00	$32,746.00	$33,725.00	$34,702.00	$132,963.00
c. Travel	$2,418.00	$8,855.00	$8,204.00	$3,595.00	$23,072.00
d. Equipment	$0.00	$0.00	$0.00	$0.00	$0.00
e. Supplies	$7,695.00	$7,500.00	$7,500.00		$22,695.00
f. Contractual	$77,400.00	$65,000.00	$60,000.00	$60,000.00	$262,400.00
g. Construction	$0.00	$0.00	$0.00	$0.00	$0.00
h. Other	$359,766.00	$375,254.00	$360,307.00	$380,893.00	$1,476,220.00
i. Total Direct Charges (*sum of 6a-6h*)	$646,584.00	$661,896.00	$647,453.00	$655,945.00	$2,611,878.00
j. Indirect Charges	$180,421.00	$153,828.00	$154,095.00	$145,778.00	$634,122.00
k. TOTALS (*sum of 6i and 6j*)	$827,005.00	$815,724.00	$801,548.00	$801,723.00	$3,246,000.00
7. Program Income	$0.00	$0.00	$0.00	$0.00	$0.00

Prescribed by OMB Circular A-102

SECTION C - NON-FEDERAL RESOURCES					
(a) Grant Program		(b) Applicant	(c) State	(d) Other Sources	(e) TOTALS
12. TOTAL (sum of lines 8-11)					
SECTION D - FORECASTED CASH NEEDS					
13. Federal	**Total for 1st Year**	**1st Quarter**	**2nd Quarter**	**3rd Quarter**	**4th Quarter**
14. Non-Federal					
15. TOTAL (*sum of lines 13 and 14*)					
SECTION E - BUDGET ESTIMATES OF FEDERAL FUNDS NEEDED FOR BALANCE OF THE PROJECT					
(a) Grant Program		FUTURE FUNDING PERIODS (Years)			
		(b) First	(c) Second	(d) Third	(e) Fourth
20. TOTAL (*sum of lines 16-19*)					
SECTION F - OTHER BUDGET INFORMATION					
21. Direct Charges: 2611878			22. Indirect Charges: 634122		
23. Remarks:					

EXHIBIT J

U.S. ENVIRONMENTAL PROTECTION AGENCY

Grant Agreement

GRANT NUMBER (FAIN): 84046101 **MODIFICATION NUMBER:** 0 **PROGRAM CODE:** CR	**DATE OF AWARD** 08/03/2022
TYPE OF ACTION New	**MAILING DATE** 08/08/2022
PAYMENT METHOD: ASAP	**ACH#** 77915

RECIPIENT TYPE:
State Institution of Higher Learning

Send Payment Request to:
Contact EPA RTPFC at: rtpfc-grants@epa.gov

RECIPIENT:
Iowa State University
1138 Pearson Hall
Ames, IA 50011-2207
EIN: 42-6004224

PAYEE:
Fiscal and Operational Officer
Iowa State University
2521 University Blvd, Suite 124
Ames, IA 50010-8629

PROJECT MANAGER	EPA PROJECT OFFICER	EPA GRANT SPECIALIST
Kaoru Ikuma 394 Town 813 Bissell Rd Ames, IA 50011-2207 **Email:** kikuma@iastate.edu **Phone:** 515-294-2140	Sarah Ludwig-Monty 1300 Pennsylvania Ave NW, 3204R Washington, DC 20460-0001 **Email:** Ludwig-Monty.Sarah@epa.gov **Phone:** 202-566-1072	Alison Hanlon OGD-GIAMD, 3903R 1200 Pennsylvania Ave NW Washington, DC 20460-0001 **Email:** Hanlon.Alison@epa.gov **Phone:** 202-564-0244

PROJECT TITLE AND DESCRIPTION

Accelerating Technical and Community Readiness for Beneficial Water Reuse in Small Systems

See Attachment 1 for project description.

BUDGET PERIOD	PROJECT PERIOD	TOTAL BUDGET PERIOD COST	TOTAL PROJECT PERIOD COST
09/01/2022 - 08/31/2026	09/01/2022 - 08/31/2026	$4,057,500.00	$4,057,500.00

NOTICE OF AWARD

Based on your Application dated 09/29/2021 including all modifications and amendments, the United States acting by and through the US Environmental Protection Agency (EPA) hereby awards $3,246,000.00. EPA agrees to cost-share 80.00% of all approved budget period costs incurred, up to and not exceeding total federal funding of $3,246,000.00. Recipient's signature is not required on this agreement. The recipient demonstrates its commitment to carry out this award by either: 1) drawing down funds within 21 days after the EPA award or amendment mailing date; or 2) not filing a notice of disagreement with the award terms and conditions within 21 days after the EPA award or amendment mailing date. If the recipient disagrees with the terms and conditions specified in this award, the authorized representative of the recipient must furnish a notice of disagreement to the EPA Award Official within 21 days after the EPA award or amendment mailing date. In case of disagreement, and until the disagreement is resolved, the recipient should not draw down on the funds provided by this award/amendment, and any costs incurred by the recipient are at its own risk. This agreement is subject to applicable EPA regulatory and statutory provisions, all terms and conditions of this agreement and any attachments.

ISSUING OFFICE (GRANTS MANAGEMENT OFFICE)	AWARD APPROVAL OFFICE
ORGANIZATION / ADDRESS	**ORGANIZATION / ADDRESS**
Environmental Protection Agency , Grants and Interagency Agreement 1200 Pennsylvania Ave, NW Mail code 3903R Washington, DC 20460	Environmental Protection Agency, OSAPE ORD - Office of Research and Development 1200 Pennsylvania Ave, NW Washington, DC 20460

THE UNITED STATES OF AMERICA BY THE U.S. ENVIRONMENTAL PROTECTION AGENCY

Digitally signed by EPA Award Official Digitally signed by EPA Award Official	Jill Young - Chief - Grants Management Branch LaShaun Phillips - Associate Award Official
DATE 08/03/2022	

EPA Funding Information

FUNDS	FORMER AWARD	THIS ACTION	AMENDED TOTAL
EPA Amount This Action	$0	$3,246,000	$3,246,000
EPA In-Kind Amount	$0	$0	$0
Unexpended Prior Year Balance	$0	$0	$0
Other Federal Funds	$0	$0	$0
Recipient Contribution	$0	$811,500	$811,500
State Contribution	$0	$0	$0
Local Contribution	$0	$0	$0
Other Contribution	$0	$0	$0
Allowable Project Cost	$0	$4,057,500	$4,057,500

Assistance Program (CFDA)	Statutory Authority	Regulatory Authority
66.511 - Office of Research and Development Consolidated Research/Training/Fellowships	SafeDrinkingWaterAct:Sec.1442 CleanWaterAct:Sec.104 2021ConsolidatedAppropriationsAct(PL116-260)	2 CFR 200, 2 CFR 1500, 40 CFR 33 and 40 CFR 40

Fiscal									
Site Name	Req No	FY	Approp. Code	Budget Oganization	PRC	Object Class	Site/Project	Cost Organization	Obligation / Deobligation
-	222631M040	2122	C	2631000	000FL2	4141	-	26A6A	$3,246,000
									$3,246,000

Budget Summary Page

Table A - Object Class Category (Non-Construction)	Total Approved Allowable Budget Period Cost
1. Personnel	$1,029,903
2. Fringe Benefits	$220,919
3. Travel	$23,192
4. Equipment	$0
5. Supplies	$16,343
6. Contractual	$262,400
7. Construction	$0
8. Other	$1,649,558
9. Total Direct Charges	$3,202,315
10. Indirect Costs: 53.00 % Base MTDC	$855,185
11. Total (Share: Recipient 20.00 % Federal 80.00 %)	$4,057,500
12. Total Approved Assistance Amount	$3,246,000
13. Program Income	$0
14. Total EPA Amount Awarded This Action	$3,246,000
15. Total EPA Amount Awarded To Date	$3,246,000

Attachment 1 - Project Description

The objective of this project is to accelerate water reuse adoption in rural communities by increasing technical and community readiness. The general hypothesis is that community readiness for water reuse in small systems can be accelerated by a convergence of technical, informational, social, and institutional innovation. The research project aims for an integrated research and engagement program that will: (1) address knowledge gaps and generate frameworks for overcoming these barriers, and (2) use research outputs to evaluate and accelerate community readiness for reuse in five case studies. Both general activities will be executed in parallel such that knowledge can be co-produced with decision-makers. Specific methods to address knowledge gaps include, community surveys, the use of a prototype calculation engine, and desktop, bench-scale and pilot-scale evaluations of treatment technologies. Specific methods to accelerate community readiness include legal and policy analyses and case-study evaluations of five small water systems. This project's outputs include annual and final reports, as well as modular, decision support tools such as water inventories, technology databases, cost and demand curves for water reuse. These outputs will be integrated into institutional and state and local regulatory decision-making processes in small, rural, and underserved communities. Intended beneficiaries include stakeholders in small communities such as utilities and local resource managers, state and tribal decision makers, as well as customers of small water systems. The subaward to the University of Rhode Island (Requested $681,965 Cost share: $171,319) is for analyses for Objectives 2 (Develop validated list of fit-for-purpose technologies), 4 (Identify ways to overcome social barriers to public acceptance), and 6 (Conduct case studies). The subaward to the University of California Berkeley (Requested: $559,941) is for work on organizational barriers in Objective 5 (Foster institutional innovation to overcome organizational barriers) and support for Objective 6 (Conduct case studies).

Administrative Conditions

A. General Terms and Conditions

The recipient agrees to comply with the current EPA general terms and conditions available at: https://www.epa.gov/grants/epa-general-terms-and-conditions-effective-october-1-2021-or-later. These terms and conditions are in addition to the assurances and certifications made as a part of the award and the terms, conditions, or restrictions cited throughout the award.

The EPA repository for the general terms and conditions by year can be found at: https://www.epa.gov/grants/grant-terms-and-conditions#general.

B. Correspondence Condition

The terms and conditions of this agreement require the submittal of reports, specific requests for approval, or notifications to EPA. Unless otherwise noted, all such correspondence should be sent to the following email addresses:

- Federal Financial Reports (SF-425): rtpfc-grants@epa.gov and *Alison Hanlon, EPA Grants Specialist, Hanlon.Alison@epa.gov*
- MBE/WBE reports (EPA Form 5700-52A): **Suzanne Hersh, DBE Coordinator; mbe.wbe@epa.gov**
- All other forms/certifications/assurances, Indirect Cost Rate Agreements, Requests for Extensions of the Budget and Project Period, Amendment Requests, Requests for other Prior Approvals, updates to recipient information (including email addresses, changes in contact information or changes in authorized representatives) and other notifications: Sarah Monty-Ludwig, EPA Project Officer, Ludwig-Monty.Sarah@epa.gov
- Payment requests (if applicable): rtpfc-grants@epa.gov
- Quality Assurance documents, workplan revisions, equipment lists, programmatic reports and deliverables: Sarah Monty-Ludwig, EPA Project Officer, Ludwig-Monty.Sarah@epa.gov

C. Prompt Payment

In accordance with Section 2(d) of the Prompt Payment Act (P.L. 97-177), Federal funds may not be used by the recipient for the payment of interest penalties to contractors when bills are paid late nor may interest penalties be used to satisfy cost sharing requirements. Obligations to pay such interest penalties will not be obligations of the United States.

D. No Fed

The recipient understands that none of the funds for this project (including funds contributed by the recipient as cost sharing) may be used to pay for the travel of Federal employees or for other costs associated with Federal participation in this project. Except however, if a Federal agency is selected through the recipient's procurement process to carry out some of the work as a contractor to the recipient, funds may be used to allow necessary Federal travel and other costs associated with Federal participation in this project.

E. Payment to Consultants

EPA participation in the salary rate (excluding overhead) paid to individual consultants retained by recipients or by a recipient's contractors or subcontractors shall be limited to the maximum daily rate for a Level IV of the Executive Schedule (formerly GS-18), to be adjusted annually. This limit applies to consultation services of designated individuals with specialized skills who are paid at a daily or hourly rate. As of January 1, 2022, the limit is $675.80 per day and $84.47 per hour. This rate does not include transportation and subsistence costs for travel performed (the recipient will pay these in accordance with their normal travel reimbursement practices). Subagreements with firms for services which are awarded using the procurement requirements in Subpart D of 2 CFR 200, are not affected by this limitation unless the terms of the contract provide the recipient with responsibility for the selection, direction and control of the individuals who will be providing services under the contract at an hourly or daily rate of compensation. See 2 CFR 1500.9.

Programmatic Conditions

This award is subject to EPA's set of standard terms and conditions for research awards located at https://www.epa.gov/grants/grant-terms-and-conditions#office.

A. Authority: Quality Assurance applies to all assistance agreements involving environmental information as defined in 2 C.F.R. § 1500.12 Quality Assurance.

The recipient shall ensure that subawards involving environmental information issued under this agreement include appropriate quality requirements for the work. The recipient shall ensure sub-award recipients develop and implement the Quality Assurance (QA) planning documents in accordance with this term and condition; and/or ensure sub-award recipients implement all applicable approved QA planning documents.

1. **Quality Management Plan (QMP)**
    a. Prior to beginning environmental information operations, the recipient must:
        i. Develop a QMP,
        ii. Prepare the QMP in accordance with the most current version of EPA QA/R-2: EPA Requirements for Quality Management Plans,
        iii. Submit the document to the EPA PO for EPA QA review, and
        iv. Obtain EPA Director of Quality Assurance (DQA) approval prior to work start.
    b. The recipient must submit the QMP within 60 days after grant award.
    c. The recipient must review their approved QMP at least annually. The results of the QMP review and any revisions must be submitted to the PO and the DQA in the annual report and may also be submitted when changes occur.
2. **Quality Assurance Project Plan (QAPP)**
    a. Prior to beginning environmental information operations, the recipient must:
        i. Develop a QAPP,
        ii. Prepare QAPP in accordance with the most current version of EPA QA/R-5: EPA Requirements for Quality Assurance Project Plans,
        iii. Submit the document for EPA review, and
3. Obtain EPA DQA approval prior to work start.

b. The recipient must submit the QAPP 90 days after grant award.
c. The recipient shall notify the PO and DQA when substantive changes are needed to the QAPP. EPA may require the QAPP be updated and re-submitted for approval.
d. The recipient must review their approved QAPP at least annually. The results of the QAPP review and any revisions must be submitted to the PO and the DQA in the annual report and may also be submitted when changes occur.

For Reference:

- EPA QA/R-2: *EPA Requirements for Quality Management Plans* and EPA QA/R-5: *EPA Requirements for Quality Assurance Project Plans*; contain quality specifications for EPA and non-EPA organizations and definitions applicable to these terms and conditions.
- EPA QA/G-5: *Guidance for Quality Assurance Project Plans*, Appendix C provides a QAPP Checklist.
- Quality Specifications for non-EPA Organizations to do business with EPA.
- The Office of Grants and Debarment Quality Assurance Requirements.

The EPA Project Officer will provide the recipient with the EPA QA contact's information upon request for pre-submittal questions. The recipient will copy the PO on any communication with the EPA QA contact.

B. All geospatial data created must be consistent with Federal Geographic Data Committee (FGDC) endorsed standards. Information on these standards may be found at www.fgdc.gov.

C. Cybersecurity Grant Condition for Other Recipients, Including Intertribal Consortia (a) The recipient agrees that when collecting and managing environmental data under this assistance agreement, it will protect the data by following all applicable State or Tribal law cybersecurity requirements. (b) (1) EPA must ensure that any connections between the recipient's network or information system and EPA networks used by the recipient to transfer data under this agreement, are secure. For purposes of this Section, a connection is defined as a dedicated persistent interface between an Agency IT system and an external IT system for the purpose of transferring information. Transitory, user-controlled connections such as website browsing are excluded from this definition. If the recipient's connections as defined above do not go through the Environmental Information Exchange Network or EPA's Central Data Exchange, the recipient agrees to contact the EPA Project Officer (PO) no later than 90 days after the date of this award and work with the designated Regional/Headquarters Information Security Officer to ensure that the connections meet EPA security requirements, including entering into Interconnection Service Agreements as appropriate. This condition does not apply to manual entry of data by the recipient into systems operated and used by EPA's regulatory programs for the submission of reporting and/or compliance data. (2) The recipient agrees that any subawards it makes under this agreement will require the subrecipient to comply with the requirements in (b)(1) if the subrecipient's network or information system is connected to EPA networks to transfer data to the Agency using systems other than the Environmental Information Exchange Network or EPA's Central Data Exchange. The recipient will be in compliance with this condition: by including this requirement in subaward agreements; and during subrecipient monitoring deemed necessary by the recipient under 2 CFR 200.331(d), by inquiring whether the subrecipient has contacted the EPA Project Officer. Nothing in this condition requires the recipient to contact the EPA Project Officer on behalf of a subrecipient or to be involved in the negotiation of an Interconnection Service Agreement between the subrecipient and EPA.

D. Subaward Reporting Requirement

The recipient must report on its subaward monitoring activities under 2 CFR 200.332(d). Examples of items that must be reported if the pass-through entity has the information available are: 1. Summaries of results of reviews of financial and programmatic reports. 2. Summaries of findings from site visits and/or desk reviews to ensure effective subrecipient performance. 3. Environmental results the subrecipient achieved. 4. Summaries of audit findings and related pass-through entity management decisions. 5. Actions the pass-through entity has taken to correct deficiencies such as those specified at 2 CFR 200.332(e), 2 CFR 200.208 and 2 CFR 200.339.

E. Minimum Matching Share Requirement

This award and the resulting federal funding share of 80% as shown under "Notice of Award" above is based on estimated costs requested in the recipient’s application dated 09/29/21. While actual total costs may differ from those estimates, the recipient is required to provide no less than 20% of the final total allowable program/project costs (outlays). EPA's participation shall not exceed the total amount of federal funds awarded or the statutory limitation of 80%.

EXHIBIT K

National Priorities: Water Innovation, Science and Engagement to Advance Water Reuse Grants

EPA awarded two institutions over $6 million in total research funding to address multiple water reuse sources and applications to support national efforts to reduce technological and institutional barriers for expanded water reuse.

Water reuse (also commonly known as water recycling or water reclamation) represents a major opportunity to enhance the sustainability and efficient use of water resources to ensure the quality and quantity of existing water supplies. It is a well-established practice in some areas of the U.S. and internationally, yet substantial barriers exist to expand its consideration and application for different purposes and benefits.

Water reuse reclaims water from a variety of sources then treats and reuses it for beneficial purposes such as agriculture and irrigation, potable water supplies, groundwater replenishment, industrial processes and environmental restoration. There are additional opportunities to reuse water from other sources, such as stormwater, agricultural flows and industrial waters and for other use applications. Communities, agriculture and businesses are looking to diversify their water supply portfolios to meet

current and future needs.

This research will help improve the national understanding of the water available for reuse and the critical impediments to advancing water reuse across the U.S., including public acceptance.

Iowa State University, Ames, Iowa

Award Amount: $3,246,000

Project Title: Accelerating Technical and Community Readiness for Water Reuse in Small Systems

Principal investigator (PI): Kaoru Ikuma

Study Locations: Iowa, Rhode Island, California, Colorado

The objective of this project is to accelerate water reuse adoption in rural communities by increasing technical and community readiness. The general hypothesis is that community readiness for water reuse in small systems can be accelerated by a convergence of technical, informational, social and institutional innovation. The proposed work will be an integrated research and engagement program in which to: (1) address knowledge gaps and generate frameworks for overcoming these barriers and (2) use research outputs to evaluate and accelerate community readiness for reuse in five case studies. The key results include modular, decision support tools such as water inventories, technology databases, cost and demand curves for reuse. These outputs will be integrated into institutional and regulatory decision-making processes in small, rural, underserved communities with results made available to communities through workshops, outreach events, and publications.

View the research abstract for this project <https://cfpub.epa.gov/ncer_abstracts/index.cfm/fuseaction/display.abstractdetail/abstract_id/11306/report/0>.

The Water Research Foundation, Denver, Colorado

Award Amount: $3,245,999

Project Title: Unlocking the Nationwide Potential of Water Reuse

Principal investigator (PI): Lyndsey Bloxom

Study Locations: Across the United States (U.S.)

The proposed research will use wastewater-based epidemiology (WBE) and surveillance to understand pathogen loading and enable rapid identification and response in reuse systems, develop quantitative microbial risk assessment tools for application to underappreciated reuse applications, and identify opportunities for chemical health risk reduction. This research project will (1) develop a comprehensive model for reuse treatment processes that includes predictive algorithms, integrated to evaluate treatment train performance for microbial and chemical water quality goals, incorporating pilot demonstration and techno-economic analysis to support real-time monitoring and risk mitigation, (2) quantify water reuse potential across the nation and identify barriers, drivers and pathways to successful reuse through a rigorous case study evaluation process and partner with community leaders to synthesize and address organizational and social barriers to advancing reuse across diverse contexts and for traditional marginalized communities, and (3) evaluate planned and potential reuse projects through a quantitative sustainable design process to identify strategies for water reuse capacity building efforts expanding reuse across a diversity of contexts. The expected results of this work will provide interested groups of diverse backgrounds with user friendly tools and materials to advance water reuse in their community.

View the research abstract for this project.
<https://cfpub.epa.gov/ncer_abstracts/index.cfm/fuseaction/display.abstractdetail/abstract_id/11305/report/0>

Last updated on September 12, 2024

EXHIBIT L

U.S. ENVIRONMENTAL PROTECTION AGENCY

Assistance Amendment

GRANT NUMBER (FAIN): 84046101 **MODIFICATION NUMBER:** 1 **PROGRAM CODE:** CR	**DATE OF AWARD** 05/12/2025
TYPE OF ACTION No Cost Amendment	**MAILING DATE** 05/12/2025
PAYMENT METHOD: ASAP	**ACH#** 77915

RECIPIENT TYPE:
State Institution of Higher Learning

Send Payment Request to:
Contact EPA RTPFC at: rtpfc-grants@epa.gov

RECIPIENT:
IOWA STATE UNIVERSITY OF SCIENCE AND TECHNOLOGY
515 Morrill Rd
1350 Beardshear Hall
Ames, IA 50011-2103
EIN: 42-6004224

PAYEE:
IOWA STATE UNIVERSITY OF SCIENCE AND TECHNOLOGY
2521 University Blvd, Suite 124
Ames, IA 50010-8629

PROJECT MANAGER	EPA PROJECT OFFICER	EPA GRANT SPECIALIST
Kaoru Ikuma 394 Town 813 Bissell Rd Ames, IA 50011-2207 **Email:** kikuma@iastate.edu **Phone:** 515-294-2140	Sarah Ludwig-Monty 1200 Pennsylvania Ave NW, 3204R Washington, DC 20460 **Email:** ludwig-monty.sarah@epa.gov **Phone:** 202-566-1072	Zachary Lane OGD - GMBOD, 3903R 1200 Pennsylvania Ave, NW Washington, DC 20460-0001 **Email:** Lane.Zachary@epa.gov **Phone:** 202-564-3397

PROJECT TITLE AND EXPLANATION OF CHANGES

Accelerating Technical and Community Readiness for Beneficial Water Reuse in Small Systems

This amendment is to stop work; terminate the agreement; reduce performance period duration; curtail scope of work; and waive certain reporting requirements. Administrative terms and conditions are added.

Per 2 CFR 200.340 and the Termination General Terms and Conditions of this agreement, EPA is terminating this award. Your organization shall immediately stop work and take all reasonable steps to minimize the incurrence of costs otherwise allocable to the assistance agreement. See terms and conditions.

BUDGET PERIOD	PROJECT PERIOD	TOTAL BUDGET PERIOD COST	TOTAL PROJECT PERIOD COST
09/01/2022 - 05/12/2025	09/01/2022 - 05/12/2025	$ 4,057,500.00	$ 4,057,500.00

NOTICE OF AWARD

Based on your Application dated 09/29/2021 including all modifications and amendments, the United States acting by and through the US Environmental Protection Agency (EPA) hereby awards $ 0.00. EPA agrees to cost-share 80.00% of all approved budget period costs incurred, up to and not exceeding total federal funding of $ 3,246,000.00. Recipient's signature is not required on this agreement. The recipient demonstrates its commitment to carry out this award by either: 1) drawing down funds within 21 days after the EPA award or amendment mailing date; or 2) not filing a notice of disagreement with the award terms and conditions within 21 days after the EPA award or amendment mailing date. If the recipient disagrees with the terms and conditions specified in this award, the authorized representative of the recipient must furnish a notice of disagreement to the EPA Award Official within 21 days after the EPA award or amendment mailing date. In case of disagreement, and until the disagreement is resolved, the recipient should not draw down on the funds provided by this award/amendment, and any costs incurred by the recipient are at its own risk. This agreement is subject to applicable EPA regulatory and statutory provisions, all terms and conditions of this agreement and any attachments.

ISSUING OFFICE (GRANTS MANAGEMENT OFFICE)	AWARD APPROVAL OFFICE
ORGANIZATION / ADDRESS	**ORGANIZATION / ADDRESS**
Environmental Protection Agency, Grants Management & Business Operations Division 1200 Pennsylvania Ave, NW Mail code 3903R Washington, DC 20460	Environmental Protection Agency, OSAPE ORD - Office of Research and Development 1200 Pennsylvania Ave, NW Washington, DC 20460

THE UNITED STATES OF AMERICA BY THE U.S. ENVIRONMENTAL PROTECTION AGENCY

Digital signature applied by EPA Award Official for Devon Brown - Branch Chief, GMB **by** Phillip Schindel - Award Official Delegate	**DATE** 05/12/2025

EPA Funding Information

FUNDS	FORMER AWARD	THIS ACTION	AMENDED TOTAL
EPA Amount This Action	$ 3,246,000	$ 0	$ 3,246,000
EPA In-Kind Amount	$ 0	$ 0	$ 0
Unexpended Prior Year Balance	$ 0	$ 0	$ 0
Other Federal Funds	$ 0	$ 0	$ 0
Recipient Contribution	$ 811,500	$ 0	$ 811,500
State Contribution	$ 0	$ 0	$ 0
Local Contribution	$ 0	$ 0	$ 0
Other Contribution	$ 0	$ 0	$ 0
Allowable Project Cost	$ 4,057,500	$ 0	$ 4,057,500

Assistance Program	Statutory Authority	Regulatory Authority
66.511 - Office of Research and Development Consolidated Research/Training/Fellowships	SafeDrinkingWaterAct:Sec.1442 CleanWaterAct:Sec.104 2021ConsolidatedAppropriationsAct(PL116-260)	2 CFR 200, 2 CFR 1500, 40 CFR 33 and 40 CFR 40

Budget Summary Page

Table A - Object Class Category (Non-Construction)	Total Approved Allowable Budget Period Cost
1. Personnel	$ 1,029,903
2. Fringe Benefits	$ 220,919
3. Travel	$ 23,192
4. Equipment	$ 0
5. Supplies	$ 16,343
6. Contractual	$ 262,400
7. Construction	$ 0
8. Other	$ 1,649,558
9. Total Direct Charges	$ 3,202,315
10. Indirect Costs: 53.00 % Base MTDC	$ 855,185
11. Total (Share: Recipient 20.00 % Federal 80.00 %)	$ 4,057,500
12. Total Approved Assistance Amount	$ 3,246,000
13. Program Income	$ 0
14. Total EPA Amount Awarded This Action	$ 0
15. Total EPA Amount Awarded To Date	$ 3,246,000

Administrative Conditions

UNILATERAL TERMINATION

1. The Agency is asserting its right under 2 CFR 200.340 and the Termination General Term and Condition of this agreement to unilaterally terminate this award. This amendment serves as required notice under 2 CFR 200.341.

2. Consistent with 2 CFR 200.343 Effect of suspension and termination, costs to the recipient or subrecipient resulting from financial obligations incurred by the recipient or subrecipient after the termination of a Federal award are not allowable. Costs after termination are allowable if:

a. The costs result from financial obligations which were properly incurred by the recipient or subrecipient before the effective date of suspension or termination, and not in anticipation of it; and

b. The costs would be allowable if the Federal award was not suspended or expired normally at the end of the period of performance in which the termination takes effect.

c. The costs are reasonable and necessary termination costs consistent with 2 CFR 200.472.

3. Federal Financial Reporting (FFR) General Terms and Conditions is still in full force and effect. EPA recipients must submit the SF-425 no later than 120 calendar days after the end date of the period of performance of the award.

4. Programmatic Terms and Conditions. Performance reporting is still in full force and effect. The recipient must submit the final report no later than 120 calendar days after the period of performance.

In accordance with 2 CFR 200.329, the recipient agrees to submit performance reports that include information on each of the following areas:

a. A comparison of accomplishments to the outputs/outcomes established in the assistance agreement work plan for the reporting period;

b. Explanations on why established outputs/outcomes were not met; and

c. Additional information, analysis, and explanation of cost overruns or high-than-expected-unit costs.

5. Waiver of Reports

The following reports are waived:

a. Utilization of Disadvantaged Business Enterprises General Terms and Conditions, EPA Form 5700-52A.

b. Tangible Personal Property Report, SF-428, General Terms and Conditions.

6. Record Retention

Access to Records, 2 CFR 200.337, is still in full force and effect. The termination of this award does not affect the right of EPA to disallow costs and recover funds on the basis of a later audit or other reviews. Information regarding record retention, property disposition in accordance with EPA regulations, and other frequently asked questions can be accessed at https://www.epa.gov/grants/frequent-questions-about-closeouts.

Programmatic Conditions

All programmatic conditions remain the same.

EXHIBIT M

OFFICE OF MISSION SUPPORT

WASHINGTON, D.C. 20460

May 12, 2025

MEMORANDUM

SUBJECT: Termination of EPA Assistance Agreement CR-84046101 under 2 CFR 200.340

FROM: EPA Award Official

TO: Sara Fonseca Ricke, Pre-Award Administrator
Iowa State University of Science and Technology

The purpose of this communication is to notify you that the U.S. Environmental Protection Agency (EPA) is hereby terminating Assistance Agreement No. CR-84046101 awarded to Iowa State University of Science and Technology. This EPA Assistance Agreement is terminated in its entirety effective immediately on the grounds that the award no longer effectuates the program goals or agency priorities. The objectives of the award are no longer consistent with EPA funding priorities.

The EPA Administrator has determined that, per the Agency's obligations to the constitutional and statutory law of the United States, this priority includes ensuring that the Agency's grants do not conflict with the Agency's policy of prioritizing merit, fairness, and excellence in performing our statutory functions. In addition to complying with the law, it is vital that the Agency assess whether all grant payments are free from fraud, abuse, waste, and duplication, as well as to assess whether current grants are in the best interests of the United States.

The grant specified above provides funding for programs that promote initiatives that conflict with the Agency's policy of prioritizing merit, fairness, and excellence in performing our statutory functions; that are not free from fraud, abuse, waste, or duplication; or that otherwise fail to serve the best interests of the United States. The grant is inconsistent with, and no longer effectuates, Agency priorities.

The process for closeout is generally outlined in 2 CFR 200.344. EPA is clarifying what reports are required and what reports are waived below. Other requirements are still in effect if applicable to your grant.

EPA is requiring the following closeout reports due within 120 days of closeout (2 CFR 200.344a:)

- Final Federal Financial Report, SF-425
- Final Technical Report
- Other programmatic reports identified in your terms and conditions

As part of this termination, EPA is waiving the following closeout reports:

- Property Report, SF-428
- Final Minority Business Enterprise/Woman Business Enterprise Utilization Under Federal Grants and Cooperative Agreements, EPA Form 5700-52A

The recipient may request payment from the Automated Standard Application Payments (ASAP) system for allowable costs incurred up to the date of this memo provided that such costs were contained in the approved workplan. Costs incurred by you after this termination are allowable only if (a) those costs were properly incurred by you before the effective date of this termination, and not in anticipation of it; and (b) those costs would be allowable if your federal award was not suspended or expired normally at the end of the period of performance in which the termination takes effect. *See* 2 C.F.R. § 200.343. You are encouraged to carefully review and discharge your closeout responsibilities set forth in 2 C.F.R. § 200.344-45 and your award agreement. Those responsibilities include, but are not limited to, your obligation to "promptly refund any unobligated funds" that have been paid out but "are not authorized to be retained." *See* 2 C.F.R. § 200.344(g).

Also, per 2 CFR 200.472, a recipient may use grant funds to properly closeout their grant including reasonable and necessary costs that might occur after the date of this memo. If the recipient drew down funds from ASAP for costs beyond the termination date or for costs that exceed the amount necessary to properly closeout their grant, the recipient must contact RTPFC at rtpfc-grants@epa.gov for instructions on how to return the excess funds.

The EPA Grants Management Office has issued an amendment to the agreement to document the termination.

If you wish to dispute this termination decision, the Disputes Decision Official (DDO) is Mr. Michael Molina, Principal Deputy Assistant Administrator, Office of Mission Support. Mr. Molina must receive the Dispute no later than 30 calendar days from the date this termination notice is electronically sent to you. Disputes must be sent electronically by email to the DDO, at Molina.Michael@epa.gov with a copy to the EPA Award Official, Mr. Devon Brown, Brown.Devon@epa.gov, within the 30-day period stated above. The Dispute submitted to the DDO must include: (1) A copy of the disputed Agency Decision; (2) A detailed statement of the specific legal and factual grounds for the Dispute, including copies of any supporting documents; (3) The specific remedy or relief you seek under the Dispute; and (4) The name and contact information, including email address, of your designated point of contact for the Dispute. *See* 2 CFR 1500.15

The requirements on post-closeout adjustments and continuing responsibilities, including audit and record retention requirements, at 2 CFR 200.345 remain in effect.

ATTACHMENT
Amendment Document

Cc: Zachary Lane, EPA Grant Specialist
Sarah Ludwig-Monty, EPA Project Officer
Kaoru Ikuma, Grantee Program Manager

EXHIBIT N

EPA Announces $49 Million in Technical Assistance to Help Rural, Small, and Tribal Communities Address Wastewater Challenges

April 29, 2025

Contact Information
EPA Press Office (press@epa.gov)

WASHINGTON – The U.S. Environmental Protection Agency (EPA) announced $49 million in funding to technical assistance providers to help communities address wastewater challenges through the Rural, Small and Tribal Clean Water Technical Assistance Grant Program.

This funding will be for projects helping hundreds of communities with wastewater infrastructure and Clean Water Act compliance projects advancing the agency's Powering the Great American Comeback initiative by ensuring that all Americans can rely on clean air, land and water.

"Small and rural communities are the backbone of this great country, and EPA is committed to partnering with them to provide clean and safe water that supports healthy people, agricultural production, economic opportunity, and vibrant ecosystems," **said EPA Senior Advisor Jessica Kramer**. "With $49 million, more communities will receive assistance for planning, designing and funding essential wastewater infrastructure upgrades."

EPA anticipates awarding federal grants to these recipients after legal and administrative requirements are satisfied:

- National Rural Water Association <https://nrwa.org/>
- Rural Community Assistance Partnership <https://www.rcap.org/>
- Southwest Environmental Finance Center-New Mexico <https://swefc.unm.edu/home/>
- Alaska Municipal League <https://www.akml.org/>
- NEIWPCC <https://neiwpcc.org/> (formerly known as New England Interstate Water Pollution Control Commission)
- Pacific International Center for High Technology Research <https://pichtr.org/>

“NRWA is grateful that EPA has continued making these vital technical assistance awards. Funding for hands-on assistance programs is essential for addressing the significant water and wastewater challenges faced by the small and rural communities across our nation,” **said Matt Holmes, CEO of the National Rural Water Association**. “We are honored by the EPA's confidence in our ability to deliver effective training and technical assistance, assist in navigating complex funding landscapes, and support the implementation of reliable infrastructure solutions where they are needed most.”

“We are very excited to work with EPA to further the capacity building efforts of rural and tribal utilities across the nation,” **said Olga Morales Pate, CEO, Rural Community Assistance Partnership Incorporated**. “As a national leader in technical assistance, RCAP is positioned to continue to provide customized assistance to small utilities, particularly those who need it most. We appreciate and support EPA's commitment to improve the quality of life of those who call rural America home.”

Background

Many rural, small, and tribal systems face unique financial and operational challenges, including aging infrastructure, workforce shortages, increasing costs, and declining rate bases. The technical assistance providers receiving EPA’s grant funding will help address the most pressing water challenges in communities, provide training on water infrastructure and management best practices, and help communities navigate the application process for federal and state water infrastructure financing and strategically invest in reliable infrastructure solutions.

Learn more about EPA's Water Technical Assistance efforts and request assistance for a community <https://epa.gov/water-infrastructure/water-technical-assistance-waterta>.

Discover training and technical assistance resources for small, rural, Tribal wastewater systems <https://epa.gov/small-and-rural-wastewater-systems/training-and-technical-assistance-ta-program-rural-small-and>.

Last updated on April 29, 2025

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Attorneys for Plaintiffs and the Proposed Class
[Additional counsel listed on signature page]

UNITED STATES DISTRICT COURT

NORTHERN DISTRICT OF CALIFORNIA

NEETA THAKUR, KEN ALEX, NELL GREEN NYLEN, ROBERT HIRST, CHRISTINE PHILLIOU, and JEDDA FOREMAN, on behalf of themselves and all others similarly situated,

Plaintiffs,

v.

DONALD J. TRUMP, in his official capacity as President of the United States; DEPARTMENT OF GOVERNMENT EFFICIENCY ("DOGE"); AMY GLEASON, in her official capacity as Acting Administrator of the Department of Government Efficiency; NATIONAL SCIENCE FOUNDATION;

[*caption cont'd next page*]

Case No. 3:25-cv-04737-RL

DECLARATION OF JEDDA FOREMAN

The Honorable Rita F. Lin

BRIAN STONE, in his official capacity as Acting Director of the National Science Foundation;
NATIONAL ENDOWMENT FOR THE HUMANITIES;
MICHAEL MCDONALD, in his official capacity as Acting Chairman of the National Endowment for the Humanities;
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY;
LEE ZELDIN, in his official capacity as Administrator of the U.S. Environmental Protection Agency;
UNITED STATES DEPARTMENT OF AGRICULTURE;
BROOKE ROLLINS, in her official capacity as Secretary of the U.S. Department of Agriculture;
AMERICORPS (a.k.a. the CORPORATION FOR NATIONAL AND COMMUNITY SERVICE);
JENNIFER BASTRESS TAHMASEBI, in her official capacity as Interim Agency Head of AmeriCorps;
UNITED STATES DEPARTMENT OF DEFENSE;
PETE HEGSETH, in his official capacity as Secretary of the U.S. Department of Defense;
UNITED STATES DEPARTMENT OF EDUCATION;
LINDA MCMAHON, in her official capacity as Secretary of the U.S. Department of Education;
UNITED STATES DEPARTMENT OF ENERGY;
CHRIS WRIGHT, in his official capacity as Secretary of Energy;
UNITED STATES DEPARTMENT OF HEALTH AND HUMAN SERVICES;
ROBERT F. KENNEDY, JR., in his official capacity as Secretary of the U.S. Department of Health and Human Services;
UNITED STATES CENTERS FOR DISEASE CONTROL;
MATTHEW BUZZELLI, in his official capacity as Acting Director of the Centers for Disease Control;
UNITED STATES FOOD AND DRUG ADMINISTRATION;
MARTIN A. MAKARY, in his official capacity as Commissioner of the Food and Drug Administration;
UNITED STATES NATIONAL INSTITUTES OF HEALTH;
JAYANTA BHATTACHARYA, in his official capacity as Director of the National Institutes of

Health;
INSTITUTE OF MUSEUM AND LIBRARY SERVICES;
KEITH SONDERLING, in his official capacity as Acting Director of the Institute of Museum and Library Services;
UNITED STATES DEPARTMENT OF THE INTERIOR;
DOUG BURGUM, in his official capacity as Secretary of the Interior;
UNITED STATES DEPARTMENT OF STATE;
MARCO RUBIO, in his official capacity as Secretary of the U.S. Department of State;
DEPARTMENT OF TRANSPORTATION;
SEAN DUFFY, in his official capacity as Secretary for the U.S. Department of Transportation,

Defendants.

DECLARATION OF JEDDA FOREMAN

I, Jedda Foreman declare as follows:

1. I have personal knowledge of the facts contained in this declaration and, if called as a witness, could and would testify competently to those facts.

2. I am the Director, Center for Environmental Learning at the Lawrence Hall of Science at the University of California, Berkeley.

3. I am a graduate of Carleton College and hold an M.B.A. in Design Strategy from the California College of the Arts and a Graduate Certificate in Field Science and Place-Based Education from Teton Science Schools.

4. I have over fourteen years of experience in environmental education, curriculum and professional learning development, and project management.

5. I have served as a Principal Investigator or co-Principal Investigator on several National Science Foundation ("NSF") funded projects.

The Lawrence Hall of Science

6. The Lawrence Hall of Science is UC Berkeley's public science center. Opened to the public in 1968, The Lawrence Hall of Science's mission is to inspire and engage through science discovery and learning in ways that advance equity and opportunity. We activate hundreds of thousands of Northern CA youth, families, educators and communities through fun and rigorous, hands-on science learning at our Berkeley-based science center and with extensive outreach programs. Nationwide, The Lawrence reaches over 20% of US K–12 students through its science curricula (including Amplify Science, FOSS, SEPUP). We also impact millions of people worldwide via our effective STEM learning programs, educator professional learning, and STEM learning research and design.

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7. The Lawrence Hall of Science has a history of leading the way in designing, studying, and scaling issues-oriented and practice-rich science learning materials and programs in ways that inspire, engage and prepare learners of all ages. We do so by broadening and deepening efforts to engage youth--early and often--in phenomena-based, issues-oriented STEM learning experiences both in and out of school. We address the critical need to prepare youth and communities to tackle the problems and possibilities of today and to inspire them to improve tomorrow. We seek to inspire people with cutting-edge research, exciting discoveries, and transformative innovations; engage people in learning, scientific thinking, pursuits, and dialogue; and catalyze them to take actions in service of the greater good.

First Application for Grant Funding (2314075)

8. On January 11, 2023, together with my collaborators at the Lawrence Hall of Science Melissa Collins and Valeria Fike Romero, and through the Regents of the University of California, I submitted to the NSF proposal number 2314075 entitled "Understanding the Impact of Outdoor Science and Environmental Learning Experiences Through Community-Driven Outcomes." A true and correct copy of the Grant Application is attached hereto as **Exhibit A**.

9. Our Grant Application was submitted to National Science Foundation Program NSF 22-626, Advancing Informal STEM Learning (AISL). The AISL program is an NSF program that exclusively invests in research and practice on how people learn STEM outside of formal education. The AISL program funds a range of informal STEM learning experiences and environments. The AISL program seeks proposals that further the well-being of individuals and communities who have historically been and continue to be excluded, under-served, or underrepresented.

10. Our proposal was for a four-year Integrating Research and Practice project program that would produce a set of science and environmental literacy measures for underrepresented communities. Scientific and environmental literacy are valuable outcomes linked to academic learning, STEM career pathways, and broader engagement in science and environmental causes and advocacy.

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11. Our project was structured to have three phases. In Phase 1, we would form a Community Research Network composed of youth, educators, leadership and community members of partnership outdoor science and environmental learning organizations. Our Community Research Network would collect data and develop outcome measures.

12. In Phase 2, we would validate these measures through quantitative study to understand how underrepresented youth are impacted by outdoor science and environmental learning experiences. We would pursue a focal student case study approach.

13. In Phase 3, we would collaborate with our Community Research Network to share findings with the field, including through a conceptual framework that articulates the outcomes that allow youth to thrive.

14. Our project aimed to build upon scholarship on how science and environmental literacy can be improved to better position youth for STEM pathways and to cultivate the next generation of STEM and environmental leaders.

15. Our project also aimed to produce a suite of psychometrically tested tools that would improve the ability of scholars and practitioners to measure science and environmental literacy.

First Award of Grant Funding (2314075)

16. On August 22, 2023, The NSF accepted our proposal and awarded us a grant (Award Number 2314075). A true and correct copy of this Award Notice is attached hereto as **Exhibit B**.

17. The Award Notice stated that the NSF was obligated by an amount of $1,583,195, and that the total intended award amount was $2,149,437.

18. The Award Notice did not require any cost share or matching amounts.

19. The Award Notice provided, “Contingent on the availability of funds and scientific progress of the project, NSF expects to continue support at approximately the following level: Fiscal Year: 2026, Increment Amount: $566,242.”

20. The Award Notice provided that the period of performance was from January 1, 2024 through December 31, 2027.

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21. The Award Notice contained the following General Terms and Conditions: "This is awarded pursuant to the authority of the National Science Foundation Act of 1950, as amended (42 U.S.C. 1861-75) and is subject to Research Terms and Conditions (RTCs) dated 11/12/2020, and NSF Agency Specific Requirements, dated 01/30/2023, available at https://www.nsf.gov/awards/managing/rtc.jsp. This institution is a signatory to the Federal Demonstration Partnership (FDP) Phase VI Agreement which requires active institutional participation in new or ongoing FDP demonstrations and pilots. This award is made in accordance with the provisions of NSF Solicitation: NSF 22-626 Advancing Informal STEM Learning."

22. The Award Notice provided for Total Direct Costs of $986,406 and Total Indirect Costs of $596,789, with an Indirect Cost Rate of 60.5%. The Award Notice provided, "These rates are at the time of award and are based upon the budget submitted to the NSF. It does not include any out-year adjustments. The NSF will not modify awards simply to correct indirect cost rates cited in the award notice. See the Proposal & Award Policies & Procedures Guide (PAPPG) Chapter X.A.3.a. for guidance on re-budgeting authority."

23. The award covered salaries and wages for three senior personnel: principal investigator Melissa Collins, Ph.D., co-principal investigator Valeria Romero, M.A., and myself. The award also covered salaries and wages for several other professional researchers and project coordinators at the Lawrence Hall of Science. The award also provided for support from an undergraduate research assistant.

Second Application for Grant Funding (2315277)

24. On January 17, 2023, together with my collaborators Valeria Romero and Craig Strang at the Lawrence Hall of Science, through the Regents of the University of California, I submitted to the NSF proposal number 2315277 entitled "Working Toward Racial Equity: Building Capacity to Institutionalize Equity in Outdoor and Environmental Science Education." A true and correct copy of the Grant Application is attached hereto as **Exhibit C**.

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25. Our Grant Application was submitted to National Science Foundation Program NSF 22-634, Racial Equity in STEM Education (RESTEM). The RESTEM program is an NSF program which aims to support bold, groundbreaking, and potentially transformative projects that contribute to advancing racial equity in STEM education and workforce development through practice and/or fundamental or applied research. The RESTEM program builds from the NSF Strategic Plan, seeking "to achieve excellence in U.S. science, technology, engineering and mathematics (STEM) education at all levels and in all settings (both formal and informal) in order to support the development of a diverse and well-prepared workforce of scientists, technicians, engineers, mathematicians and educators and a well-informed citizenry that have access to the ideas and tools of science and engineering. The purpose of these activities is to enhance the quality of life of all citizens and the health, prosperity, welfare and security of the nation."

26. Our project aimed to support a team of leaders from five organizations to facilitate and guide organization-wide discussions related to racial equity. Our project aimed to develop a Tool Kit with three components: 1) a Facilitator's Reflection Guide, 2) a Foundations of Racial Equity Guide, and 3) Organization Systems Change Tools.

27. Our project aimed to produce a replicable model for broadening participation. Associated research and evaluation findings would benefit the entire field of outdoor and environmental science education by giving organizations the appropriate capacity-building scaffolds and approaches.

28. The project would also advance scholarship about the approaches, tools, and programmatic elements that can position organizational leaders and staff of science education institutions to facilitate conversations about racial equity.

Second Award of Grant Funding (2315277)

29. On September 13, 2023, The NSF accepted our proposal and awarded us a grant (Award Number 2315277). A true and correct copy of this Award Notice is attached hereto as **Exhibit D**.

30. The Award Notice stated that the NSF was obligated by an amount of $1,701,416 , and that the total intended award amount was $4,723,028.

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31. The Award Notice did not require any cost share or matching amounts.

32. The Award Notice provided, "Contingent on the availability of funds and scientific progress of the project, NSF expects to continue support at approximately the following level: Fiscal Year: 2025, Increment Amount: $947,005, Fiscal Year: 2026, Increment Amount: $1,133,391, Fiscal Year: 2027, Increment Amount: $941,216."

33. The Award Notice provided that the period of performance was from January 1, 2024 through December 31, 2028.

34. The Award Notice contained the following General Terms and Conditions: "This is awarded pursuant to the authority of the National Science Foundation Act of 1950, as amended (42 U.S.C. 1861-75) and is subject to Research Terms and Conditions (RTCs) dated 11/12/2020, and NSF Agency Specific Requirements, dated 01/30/2023, available at https://www.nsf.gov/awards/managing/rtc.jsp. This institution is a signatory to the Federal Demonstration Partnership (FDP) Phase VI Agreement which requires active institutional participation in new or ongoing FDP demonstrations and pilots. This award is made in accordance with the provisions of NSF Solicitation: NSF 22-634 Racial Equity in STEM Education."

35. The indirect rate for this award was 40%. Over the total 5-years of intended award, the indirect costs would come out at $1,110,094. For the 2 year period that the funds were obligated, the indirect totaled $410,587 and the direct totaled $1,290,829.

Third Application for Grant Funding (2241805)

36. On August 12, 2022, with my collaborators Ari Krakowski, Kimiko Ryokai, Sarah Olsen, and Vincent Medina, through the Regents of the University of California, I submitted to the NSF proposal number 2241805 entitled "Supporting Rightful Presence in Museum Spaces: Youth as Participatory Designers of Indigenous Mixed Reality Science Exhibits." A true and correct copy of the Grant Application is attached hereto as **Exhibit E**.

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37. Our Grant Application was submitted to National Science Foundation Program NSF 22-585, Innovative Technology Experiences for Students and Teachers (ITEST). Through the ITEST program, NSF is responding to the challenge and opportunity to provide all students with equitable access to a STEM education related to the technical and scientific workforce. ITEST is an applied research and development program with goals to advance the equitable and inclusive integration of technology in the learning and teaching of science, technology, engineering, or mathematics from pre-kindergarten through high school. The program's objective is to support all students' acquisition of the foundational preparation in STEM disciplines.

38. Our project aimed to address the ongoing marginalization of Indigenous communities in informal science learning spaces by developing and studying a model that strengthens Indigenous youths' disposition towards, and capacity for STEM pathways.

39. The project built on a partnership between the Lawrence Hall of Science and mak-'amham, an Indigenous Ohlone cultural organization.

40. The project aimed to engage Ohlone youth in iterative cycles of participatory design and prototyping to create immersive Indigenous science exhibit experiences using mixed reality technologies.

41. In collaboration with an Ohlone Research Advisory Committee, the project team planned to analyze the following data: interviews with youth; artifact-elicited focus groups; ethnographic observations of design workshops and reflective conversations; and design artifacts gathered from youth design teams. The project would engage Indigenous youth directly and investigate the impact of the participatory design model on their Stem learning, science identity, and interest in STEM careers. The project findings would be disseminated in informal science and technology learning communities to support the youth participatory design model in informal science education contexts.

Third Award of Grant Funding (2241805)

42. On February 19, 2023, the NSF accepted our proposal and awarded us a grant (Award Number 2241805). A true and correct copy of this Award Notice is attached hereto as **Exhibit F**.

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43. The Award Notice stated that the NSF was obligated by an amount of $1,292,298.

44. The Award Notice did not require any cost share or matching amounts.

45. The Award Notice provided that the period of performance was from June 1, 2023 through May 31, 2026.

46. The Award Notice contained the following General Terms and Conditions: "This is awarded pursuant to the authority of the National Science Foundation Act of 1950, as amended (42 U.S.C. 1861-75) and is subject to Research Terms and Conditions (RTCs) dated 11/12/2020, and NSF Agency Specific Requirements, dated 01/30/2023, available at https://www.nsf.gov/awards/managing/rtc.jsp. This institution is a signatory to the Federal Demonstration Partnership (FDP) Phase VI Agreement which requires active institutional participation in new or ongoing FDP demonstrations and pilots. This award is made in accordance with the provisions of NSF Solicitation: NSF 22-585, Innovative Technology Experiences for Students and Teachers."

47. The Award Notice provided for Total Direct Costs of $995,805 and Total Indirect Costs of $296,493, with an Indirect Cost Rate of 40%. The Award Notice provided, "These rates are at the time of award and are based upon the budget submitted to the NSF. It does not include any out-year adjustments. The NSF will not modify awards simply to correct indirect cost rates cited in the award notice. See the Proposal & Award Policies & Procedures Guide (PAPPG) Chapter X.A.3.a. for guidance on re-budgeting authority."

48. The award covered salaries and wages for five senior personnel: Principal Investigator Ari Krakowski, Ph.D., co-Principal Investigator Kimiko Ryokai, Ph.D., co-Principal Investigator Sarah Olsen, Ph.D., co-Principal Investigator Vincent Medina, and myself. The award also covered salaries and wages for several other professional researchers and project coordinators at the Lawrence Hall of Science. The award also provided $162,712 to support the work of graduate students.

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Supplemental Award for Third Grant (2241805)

49. Together with my collaborators Ari Krakowski, Kimiko Ryokai, Sarah Olsen, and Vincent Medina, through the Regents of the University of California, I submitted to the NSF a proposal for a supplement to award number 2241805 to celebrate NSF's 75th anniversary on May 10, 2025.

50. On January 15, 2025, the NSF accepted our proposal and awarded us a grant supplement (Award Number 2241805). A true and correct copy of this Supplemental Award Notice is attached hereto as **Exhibit G**.

51. The Supplemental Award Notice stated that the NSF was obligated by an additional amount of $98,981, bringing the total funds awarded to $1,391,279.

52. The Supplemental Award Notice also extended the end of the award period from May 31, 2026 to November 30, 2026.

Termination of Grant Funding (2315277, 2314075 and 2241805)

53. On April 18, 2025, the University of California, Berkeley received an email (the "April 18 Termination Email") from the address "grants005@nsf.gov," purporting to be Jamie H. French, Division Director, Office of Budget Finance and Award Management, Division of Grants and Agreements. A true and correct copy of this email is attached hereto as **Exhibit H**.

54. The April 18 Termination Email reads in relevant part: "The U.S. National Science Foundation (NSF) has undertaken a review of its award portfolio. Each award was carefully and individually reviewed, and the agency has determined that termination of certain awards is necessary because they are not in alignment with current NSF priorities. Effective immediately, the following are terminated:

NSF Award Id

2243822

2315277

2314075

2314435

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NSF is issuing this termination to protect the interests of the government pursuant to NSF Grant General Conditions (GC-1) term and condition entitled 'Termination and Enforcement,' on the basis that they no longer effectuate the program goals or agency priorities. This is the final agency decision and not subject to appeal. Costs incurred as a result of this termination may be reimbursed, provided such costs would otherwise be allowable under the terms of the award and the governing cost principles. In accordance with your award terms and conditions, you have 30 days from the termination date to furnish a summary of progress under the award and an itemized accounting of allowable costs incurred prior to the termination date." See Exh. H.

55. The April 18 Termination Email was forwarded to me by Angela Ford, the Executive Director of the Sponsored Projects Office at the University of California, Berkeley. This is how I learned that two NSF awards for which I was principal investigator and co-principal investigator (2315277 and 2314075) were terminated.

56. On April 25, 2025, the University of California, Berkeley received an email (the "April 25 Termination Email") from the address "grants005@nsf.gov," purporting to be Jamie H. French, Division Director, Office of Budget Finance and Award Management, Division of Grants and Agreements. A true and correct copy of this email is attached hereto as **Exhibit I**.

57. The April 25 Termination Email reads in relevant part:

> The U.S. National Science Foundation (NSF) has undertaken a review of its award portfolio. Each award was carefully and individually reviewed, and the agency has determined that termination of certain awards is necessary because they are not in alignment with current NSF priorities. Effective immediately, the following are terminated:
>
> NSF Award Id
> 2420364
> 2413236
> 2115614
> 2427457
> 2227705
> 2241576
> 2241805
>
> NSF is issuing this termination to protect the interests of the government pursuant to NSF Grant General Conditions (GC-1) term and condition entitled 'Termination and Enforcement,' on the basis that they no longer effectuate the program goals or agency priorities. This is the final agency decision and not subject to appeal. Costs incurred as a result of this termination may be reimbursed, provided such costs would otherwise be allowable under the terms of the award and the governing cost

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> principles. In accordance with your award terms and conditions, you have 30 days from the termination date to furnish a summary of progress under the award and an itemized accounting of allowable costs incurred prior to the termination date.

See Exh. I.

58. On the morning of April 25 2025, Ari Krakowski, the lead Principal Investigator for award 2241805, received an unofficial communication from an NSF contact that the award had been terminated. Ms. Krakowski called me to tell me the news. Leilah Lyons, the program officer for award 2241805, followed up with an email to Ms. Krakowski that same day (the "Lyons Email"), which Ms. Krakowski forwarded to me. A true and correct copy of this email is attached hereto as **Exhibit J**.

59. The Lyons Email states in relevant part:

> I am given to understand you and/or your SRO received the news this morning that the following award has been terminated:
>
> Award ID: 2241805
> Award Title: Supporting Rightful Presence in Museum Spaces: Youth as Participatory Designers of Indigenous Mixed Reality Science Exhibits
>
> I understand that this is distressing news. These types of grant actions are not common, and I have not yet been trained on how to manage them, so in interim I will point you towards current policy guides.
>
> Our existing proposal and awards policies and procedures guide (PAPPG) has this to say about terminations: https://www.nsf.gov/policies/pappg/24-1/ch-12-disputes-misconduct#a-suspension-and-termination-procedures-ca9
>
> I am given to understand the letter you were sent said that there was no appeals process, in contradiction to the PAPPG, which outlines an appeal process (https://www.nsf.gov/policies/pappg/24-1/ch-12-disputes-misconduct#ch12A4), and states that any appeal must be received by NSF within 30 days of the termination notice. As I was not trained on this, I cannot give any advice about following the PAPPG process to submit an appeal of the cancellation within 30 days – you now have as much information as I do. I am not a lawyer, and have no authority to attempt to interpret these conflicting sources of guidance.
>
> With regards to shutting down award activity, this is covered in the PAPPG and in standard statutes (https://www.ecfr.gov/current/title-2/subtitle-A/chapter-II/part-200/subpart-E/subject-group-ECFRed1f39f9b3d4e72/section-200.472).

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60. This is how I learned that the third NSF award for which I was a co-principal investigator (2241805) was terminated.

61. I decided not to appeal these terminations, since both the April 18 and April 25 Termination Emails stated that these terminations were not subject to appeal. In addition, the NSF included two FAQs on its website reiterating its position that no appeals would be reviewed or considered. *See* https://www.nsf.gov/updates-on-priorities#appeals.

Harm Suffered from Terminations of Grant Funding (2315277, 2314075 and 2241805)

62. The Lawrence Hall of Science has historically successfully obtained and benefited from significant (20-25% of our budget) federal funding to support the research, development, innovation and scaling work that we do to inspire tomorrow by engaging young people, families, communities, and educators in STEM discovery and learning in ways that advance equity. Federal funding (mostly from NSF and IMLS, but also from NASA, NOAA, and NIH) provides a critical innovation and resource engine for all of our work and impact. Our federally funded work has helped us to inform, improve and build upon the understanding gained as we create new instructional materials, programs and methods. The effectiveness that is demonstrated through our research ensures that we are a trusted source for educators. We share our findings, including our data, methods, tools and instructional materials with the widest possible audience of individuals and organizations across the formal (schools) and informal (afterschool, community-based, science centers) STEM learning organizations. In essence, the impacts of these terminations have compromised our ability to carry out our public service mission to the fullest degree possible and will deprive us of a source of research and development funding that both fuels our STEM innovations and provides a significant benefit to the American public.

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63. As to "Supporting Rightful Presence in Museum Spaces: Youth as Participatory Designers of Indigenous Mixed Reality Science Exhibits" (Award 2241805), $490,834.22 or 35% of the award remained unpaid at the time of termination. In addition, when this award was terminated, the supplemental funding for a celebration of the NSF's 75th anniversary on May 10, 2025 was terminated as well. Because we had already made promises to community members, we still went forward with the event, incurring the remaining costs to the Lawrence Hall of Science.

64. As to "Working Toward Racial Equity: Building Capacity to Institutionalize Equity in Outdoor and Environmental Science Education," (Award 2315277), approximately $3,769,075.24or 80% of the award remained unpaid at the time of termination.

65. As to " Understanding the Impact of Outdoor Science and Environmental Learning Experiences Through Community-Driven Outcomes" (Award 2314075), approximately $1,500,251.79 or 75% of the award remained unpaid at the time of termination.

66. The financial implications of these terminations accounts for millions of dollars of lost funding to the Lawrence Hall of Science; Further, we are concerned that we may receive additional terminations in the near future as NSF continues its review of current grants.

67. These abrupt terminations have a significant impact on The Lawrence's budget and will result in reductions in time and layoffs for both academic personnel and staff if we are not able to quickly materialize alternative resources.

68. These mid-project terminations will negatively impact the ability of academic personnel and staff members who have been working on these projects to advance our work and careers.

69. While the financial implications are indeed debilitating, the human cost of the termination of these awards is also profound. The projects funded by these grants are important to the thousands of young people, educators and partners that they are designed to engage, serve, and/or impact. The abrupt termination of these grants means that these people and organizations will be negatively impacted by the loss of funding and the direct service it is supposed to support.

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70. Furthermore, the collaborative work with the Ohlone community, will suffer an enormous set back if we are unable to complete the NSF-funded youth-driven exhibits development project, that is currently in a prototype phase. Taken together, this set of terminated projects was set to impact young people, educators in and out of schools, school districts, and community-based organizations well positioned to engage educators and young people across the country.

Role of Class Representative

71. I am ready to assume the responsibilities of serving as a class representative. I understand that I must stay informed regarding developments in the lawsuit, communicate regularly with my attorneys, and act in the best interests of the class. I have no conflicts that would prevent me from assuming this responsibility.

72. I have been in communication with other UC researchers, who would be members of the class, who have suffered the same general type of harm as I describe above, from the abrupt termination of their previously approved research grants. This harm is widespread and I believe it will only increase in scope and impact if classwide relief is not granted.

I declare under penalty of perjury under the laws of the State of California and the United States that the foregoing is true and correct.

Executed this 29th day of May, 2025.

Signed by:
Jedda Foreman
F31DBD7A28824D4...

Jedda Foreman

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EXHIBIT A

COVER SHEET FOR PROPOSAL TO THE NATIONAL SCIENCE FOUNDATION

PROGRAM ANNOUNCEMENT/SOLICITATION NO./ DUE DATE
NSF 22-626 01/11/2023

☐ Special Exception to Deadline Date Policy

FOR NSF USE ONLY
NSF PROPOSAL NUMBER
2314075

FOR CONSIDERATION BY NSF ORGANIZATION UNIT(S) (Indicate the most specific unit known, i.e. program, division, etc.)
DRL - AISL

DATE RECEIVED	NUMBER OF COPIES	DIVISION ASSIGNED	FUND CODE	UEI(Unique Entity Identifier)	FILE LOCATION
01/11/2023	1	11090000 DRL	7259	GS3YEVSS12N6	

EMPLOYER IDENTIFICATION NUMBER (EIN) OR TAXPAYER IDENTIFICATION NUMBER (TIN)
946002123

SHOW PREVIOUS AWARD NO. IF THIS IS
☐ A RENEWAL
☐ AN ACCOMPLISHMENT- BASED RENEWAL

IS THIS PROPOSAL BEING SUBMITTED TO ANOTHER FEDERAL AGENCY? YES ☐ NO ☒ IF YES, LIST ACRONYM(S)

NAME OF ORGANIZATION TO WHICH AWARD SHOULD BE MADE
REGENTS OF THE UNIVERSITY OF CALIFORNIA, THE

AWARDEE ORGANIZATION CODE (IF KNOWN)

ADDRESS OF AWARDEE ORGANIZATION, INCLUDING 9 DIGIT ZIP CODE
1608 4TH ST STE 201
BERKELEY,CA 94710-1749 US

NAME OF PRIMARY PLACE OF PERF
University of California-Berkeley

ADDRESS OF PRIMARY PLACE OF PERF, INCLUDING 9 DIGIT ZIP CODE
1608 4TH ST STE 201
BERKELEY,CA 94710-1749 US

IS AWARDEE ORGANIZATION (Check All That Apply)
☐ SMALL BUSINESS
☐ FOR-PROFIT ORGANIZATION
☐ MINORITY BUSINESS
☐ WOMAN-OWNED BUSINESS

☐ IF THIS IS A PRELIMINARY PROPOSAL THEN CHECK HERE

TITLE OF PROPOSED PROJECT
Understanding the Impact of Outdoor Science and Environmental Learning Experiences Through Community-Driven Outcomes

SHOW LETTER OF INTENT ID IF APPLICABLE

REQUESTED AMOUNT	PROPOSED DURATION (1-60 MONTHS)	REQUESTED STARTING DATE	SHOW RELATED PRELIMINARY PROPOSAL NO. IF APPLICABLE
$ 2,149,437	48 months	01/01/2024	

THIS PROPOSAL INCLUDES ANY OF THE ITEMS LISTED BELOW

☒ TYPE OF PROPOSAL **Research**
☒ COLLABORATIVE STATUS **Non-Collaborative**
☐ BEGINNING INVESTIGATOR
☐ DISCLOSURE OF LOBBYING ACTIVITIES
☐ PROPRIETARY & PRIVILEGED INFORMATION
☐ HISTORIC PLACES
☐ LIVE VERTEBRATE ANIMALS IACUC App. Date
PHS AnimalWelfareAssurance Number

☒ HUMAN SUBJECTS
Human Subjects Assurance Number
Exemption Subsection or IRB App. Date **pending**
☐ FUNDING OF INT'L BRANCH CAMPUS OF U.S IHE
☐ FUNDING OF FOREIGN ORGANIZATION OR FOREIGN INDIVIDUAL
☐ INTERNATIONAL ACTIVITIES: COUNTRY/COUNTRIES INVOLVED
☐ POTENTIAL LIFE SCIENCES DUAL USE RESEARCH OF CONCERN
☐ OFF-CAMPUS OR OFF-SITE RESEARCH

PI/PD DEPARTMENT
The Lawrence Hall of Science

PI/PD FAX NUMBER

PI/PD POSTAL ADDRESS
1 Centennial Drive
Berkeley,CA 94720
US

NAMES(TYPED)	High Degree	Yr of Degree	Telephone Number	EmailAddress
PI/PD NAME **Melissa A Collins**	**PhD**	**2016**	**510-643-1294**	**macollins@berkeley.edu**
CO-PI/PD Valeria Romero	**MA**	**2010**	**510-643-1294**	**valeriafr@berkeley.edu**
CO-PI/PD Jedda Foreman	**MBA**	**2015**	**510-642-7504**	**jforeman@berkeley.edu**
CO-PI/PD				
CO-PI/PD				

CERTIFICATION PAGE

Certification for Authorized Organizational Representative(or Equivalent)
By electronically signing and submitting this proposal, the Authorized Organizational Representative(AOR) is:(1)certifying that statements made here in are true and complete to the best of the individual's knowledge; and(2)agreeing to accept the obligation to comply with NSF award terms and conditions if an award is made as a result of this proposal. Further, the proposer is hereby providing certifications regarding conflict of interest, flood hazard insurance, responsible and ethical conduct of research, organizational support,and safe and inclusive working environments for off-campus or off-site research, as set forth in the NSF Proposal & Award Policies & Procedures Guide(PAPPG).Willful provision of false information in this application and its supporting documents or in reports required under an ensuing award is a criminal offense(U.S.Code,Title 18,Section §1001).

Certification Regarding Conflict of Interest
The AOR is required to complete certifications stating that the organization has implemented and is enforcing a written policy on conflicts of interest (COI), consistent with the provisions of PAPPG Chapter IX.A; and that, to the best of the individual's knowledge, all financial disclosures required by the conflict of interest policy were made; and that conflicts of interest, if any, were, or prior to the organization's expenditure of any funds under the award, will be, satisfactorily managed, reduced or eliminated in accordance with the organization's conflict of interest policy. Conflicts that cannot be satisfactorily managed, reduced or eliminated and research that proceeds without the imposition of conditions or restrictions when a conflict of interest exists, must be disclosed to NSF via use of the Notifications and Requests module with Research.gov

Certification Regarding Flood Hazard Insurance
Two sections of the National Flood Insurance Act of 1968 (42 USC §4012a and §4106) bar Federal agencies from giving financial assistance for acquisition or construction purposes in any area identified by the Federal Emergency Management Agency (FEMA) as having special flood hazards unless the:
(1) community in which that area is located participates in the national flood insurance program; and
(2) building (and any related equipment) is covered by adequate flood insurance.

By electronically signing the Certification Pages, the Authorized Organizational Representative (or equivalent) located in FEMA-designated special flood hazard areas is certifying that adequate flood insurance has been or will be obtained in the following situations:
(1) for NSF awards for the construction of a building or facility, regardless of the dollar amount of the award; and
(2) for other NSF awards when more than $25,000 has been budgeted in the proposal for repair, alteration or improvement (construction) of a building or facility.

Certification Regarding Responsible and Ethical Conduct of Research (RECR)
(This Certification applies to proposals submitted prior to July 31, 2023, and is not applicable to proposals for conferences, symposia, and workshops.)
By electronically signing the Certification Pages, the Authorized Organizational Representative is certifying that, in accordance with the NSF Proposal & Award Policies & Procedures Guide, Chapter IX.B., the institution has a plan in place to provide appropriate training and oversight in the responsible and ethical conduct of research to undergraduates, graduate students and postdoctoral researchers who will be supported by NSF to conduct research. The AOR shall require that the language of this certification be included in any award documents for all subawards at all tiers.

Certification Regarding Responsible and Ethical Conduct of Research (RECR)
(This Certification applies to proposals submitted on or after July 31, 2023, and is not applicable to proposals for conferences, symposia, and workshops.)
By electronically signing the Certification Pages, the Authorized Organizational Representative is certifying that, in accordance with the NSF Proposal & Award Policies and Procedures Guide, Chapter IX.B., the institution has a plan in place to provide appropriate training and oversight in the responsible and ethical conduct of research to undergraduate students, graduate students, postdoctoral researchers, faculty, and other senior personnel who will be supported by NSF to conduct research. As required by Section 7009 of the America Creating Opportunities to Meaningfully Promote Excellence in Technology, Education, and Science (COMPETES) Act (42 USC 1862o–1), as amended, the training addresses mentor training and mentorship.The AOR shall require that the language of this certification be included in any award documents for all subawards at all tiers.

Certification Regarding Organizational Support
By electronically signing the Certification Pages, the Authorized Organizational Representative (or equivalent) is certifying that there is organizational support for the proposal as required by Section 526 of the America COMPETES Reauthorization Act of 2010. This support extends to the portion of the proposal developed to satisfy the Broader Impacts Review Criterion as well as the Intellectual Merit Review Criterion, and any additional review criteria specified in the solicitation. Organizational support will be made available, as described in the proposal, in order to address the broader impacts and intellectual merit activities to be undertaken.

Certification Regarding Dual Use Research of Concern
By electronically signing the certification pages, the Authorized Organizational Representative is certifying that the organization will be or is in compliance with all aspects of the United States Government Policy for Institutional Oversight of Life Sciences Dual Use Research of Concern.

Certification Requirement Specified in the William M.(Mac)Thornberry National Defense Authorization Act for Fiscal Year 2021, Section 223(a)(1) (42 USC 6605(a)(1))
By electronically signing the Certification Pages, the Authorized Organizational Representative is certifying that each individual employed by the organization and identified on the proposal as senior personnel has been made aware of the certification requirements identified in the William M.(Mac) Thornberry National Defense Authorization Act for Fiscal Year 2021, Section 223(a)(1) (42 USC 6605(a)(1)).

Certification Regarding Safe and Inclusive Working Environments for Off-Campus or Off-Site Research
(This certification applies only to proposals in which data/information/samples are being collected off-campus or off-site, such as fieldwork and research activities on vessels and aircraft.)
By electronically signing the Certification Pages, the Authorized Organizational Representative is certifying that, in accordance with the NSF Proposal & Award Policies and Procedures Guide, Chapter II.E.9, the organization has a plan in place **for this proposal** regarding safe and inclusive working environments.

AUTHORIZED ORGANIZATIONAL REPRESENTATIVE	SIGNATURE	DATE
NAME **Mary Bonvillain**	**Electronic Signature**	**Jan 11 2023 12:24 PM**

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Overview.
The Lawrence Hall of Science at the University of California, Berkeley proposes a four-year *Integrating Research and Practice* project to the National Science Foundation's Advancing Informal Science Learning (NSF 22-626) program that will better position informal learning institutions to understand impact by producing a set of science and environmental literacy measures that center the knowledge, expertise, and experience of communities of color. Scientific and environmental literacy are valuable outcomes linked to academic learning, STEM career pathways, and broader engagement in science and environmental causes and advocacy. However, the current tools for measuring these concepts are insufficient; though useful for measuring some dimensions of impact, they are aligned with dominant views that exclude and erase the knowledge and expertise of communities of color. We plan to improve existing measurement tools as well as design new ones by engaging in a community-driven process that will center the voices of communities of color. We will then use these tools to measure the impact of outdoor science and environmental learning (OSEL) experiences on students' scientific and environmental literacy. In Phase 1, we will form a Community Research Network (CRN) composed of youth, educators, leadership, and community members of partnering OSEL organizations. In collaboration with the CRN, we will engage in an iterative process of idea generation, data collection, and sensemaking to articulate and co-develop a set of revised and new outcome measures. In Phase 2, we will validate these measures through a quantitative study that will paint a fuller picture of the impact of OSEL experiences on youth, while also seeking to understand how youth of color make meaning of these experiences through a focal student case study approach. Finally, in Phase 3, we will collaborate with the CRN to share findings with the field, including through a conceptual framework that articulates the outcomes and structures within and adjacent to OSEL organizations that allow for youth to thrive.

Broader Impacts.
The OSEL field is in an intense period of rebuilding after impacts from the COVID-19 pandemic, presenting an opportunity to have a transformative impact on the field, with a long-term impact on STEM education writ large. Within this context, this project is positioned to have a significant impact on research and praxis in the OSEL field, formal and informal education practice, and in broader society. This project is built on the premise that both research and praxis in OSEL have reinforced the oppression and marginalization of people of color; through our community-driven approach and our creation of new community-driven measures, this project will push researchers and practitioners to grapple with what it means to move towards more just and equitable practices in research and practice. This project will generate refined definitions of OSEL outcomes that center the voices and experiences of youth and communities of color and will develop a conceptual framework articulating the relationship between these outcomes and the structures within and adjacent to OSEL organizations that allow for youth of color to thrive. These contributions will build upon ongoing scholarship on how to improve science and environmental literacy, positioning youth for STEM pathways and environmental activism and cultivating the next generation of STEM and environmental leaders. By bringing broader representation to the STEM field, with greater diversity of lived experiences and perspectives, this project will support new ideas and innovation to solve persisting societal challenges not resolved by the status quo. In addition, this project will also contribute new insights on engaging in community-driven, participatory research that can contribute to the field's understanding of how to enact just and equitable mixed methods research.

Intellectual Merit.
This study will contribute new perspectives on how race and culture influence learning, as well as how racism and biases have shaped research and practice to date. This project will produce a suite of psychometrically tested tools that are driven by communities of color, improving the field's ability to measure learning while also taking one step to counteract a long history of marginalization in research. The work will contribute to existing bodies of literature on the benefits of outdoor learning and the role OSEL experiences can play in developing science and environmental literacy, while also contributing new knowledge on how to redefine these outcomes and redesign studies to be more equitable.

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Submitted/PI: Melissa A Collins /Proposal No: 2314075

Understanding the Impact of Outdoor Science and Environmental Learning Experiences Through Community-Driven Outcomes

Melissa Collins, Valeria Fike Romero, and Jedda Foreman

Introduction

The Lawrence Hall of Science at the University of California, Berkeley proposes a four-year *Integrating Research and Practice* project to the National Science Foundation's Advancing Informal Science Learning (NSF 22-626) program that will better position informal learning institutions to understand and measure impact by identifying and defining a set of science and environmental literacy outcomes and measures that center the knowledge, expertise, and experience of communities of color. Environmental and scientific literacy are valuable constructs linked to academic learning, STEM career pathways, and broader engagement in science and environmental causes and advocacy. However, the current tools for understanding and measuring these concepts are insufficient. Though useful for measuring some dimensions of impact, they are aligned with dominant views that most often exclude and erase the knowledge and expertise of communities of color.

We plan to improve existing measurement tools as well as design new ones by engaging in a community-driven process that will center the voices of communities of color, namely Black, Latinx, and Indigenous communities. We will then use these tools to measure the impact of outdoor science and environmental learning experiences on students' scientific and environmental literacy. In Phase 1, we will form a Community Research Network (CRN) composed of youth, educators, leadership, and community members of partnering outdoor science and environmental learning organizations. In collaboration with the CRN, we will engage in an iterative process of idea generation, data collection, and sensemaking to articulate and co-define a set of revised and new outcomes. In Phase 2, we will validate these measures through a large, quantitative study that will paint a fuller picture of the impact of outdoor science and environmental learning experiences on youth, while also seeking to understand how youth of color make meaning of these experiences through a focal student case study approach. Finally, in Phase 3, we will collaborate with Phase 1 participants to share findings and discuss implications for the field, resulting in a proposed conceptual framework that explores the relationship of these outcomes to structures within and adjacent to outdoor science organizations. This work, we argue, will provide conceptual and methodological underpinnings that allow us to more fully understand the myriad of ways that youth of color thrive (e.g., grow, learn, feel valued and successful) in outdoor science and environmental learning experiences.

Project Rationale

Outdoor Science and Environmental Learning (OSEL) organizations are a critical component of the STEM ecosystem (Ardoin & Bowers, 2020; Ardoin et al., 2018), particularly in advancing science and environmental literacy–outcomes that are of increasing importance given the increasingly dire impacts of climate change (California Department of Education, 2015). Over the past decade, national and statewide recognition of the importance of environmental learning, in particular, has elevated the critical role the OSEL field can play in supporting science teaching and learning in the context of the Next Generation Science Standards (NGSS). OSEL refers to programs that provide outdoor-based science learning experiences and can include residential overnight programs, community-based programs, and nature centers. Science learning can include multiple topics, including local ecosystems, environmental justice, community issues, and climate change. In the U.S., young people often encounter OSEL programs at grades 4-8, a critical point in their educational pathways. It is the time at which U.S. performance (and absolute interest in science) compared to other countries begins to drop (Gonzales et al., 2008). Interest and engagement in science by grade eight is an important predictor of whether students will continue their education in science beyond high school (Tai et al., 2006). Cultivating scientific and environmental dispositions can also promote an interest in understanding broader scientific and environmental issues that can support lifelong decision-making and advocacy (Hollweg et al., 2011; Yacoubian, 2018). Learners often report how different and motivating time spent at an OSEL organization is compared with traditional classroom settings. Teachers report they cannot otherwise provide these in-depth and out-of-classroom experiences, and that OSEL are even "transformative" for individual students and/or entire classes (Crompton

& Sellar, 1981; Tal et al., 2019). Research has documented that OSEL experiences can have positive effects on cognitive, social-emotional, behavioral, and academic outcomes. For instance, outdoor learning can support student engagement and interest in learning (Coyle, 2010; Kuo et al., 2018); confidence, leadership, and motivation (McLeod & Allen-Craig, 2007); and improved content learning and retention (Avci & Gümüs, 2020; Carrier, 2009; Fančovičová & Prokop, 2011; Peacock et al., 2021). Collectively these bodies of work continue to amplify that outdoor science programs can play an important role in supporting scientific and environmental learning. While some scholarship has demonstrated the value and effectiveness of outdoor learning, there has been less research that has explicitly focused on the impact of OSEL programs. Further, we argue that outcomes have largely been defined and shaped by White, Eurocentric, male epistemological framings, and therefore have neglected the historical context of the field. To this end, it is imperative we center the expertise and experiences of communities of color in our conceptualization and measurement of outcomes.

Racial Context of the OSEL Field

Scholars and practitioners have raised important empirical questions about how race shapes the design and enactment of learning environments, and subsequently how that impacts youth of color. Mainstream OSEL experiences are most often aligned with the values of White, male, middle-class culture (Lewis & James, 1995; McLean, 2013), obscuring the sociocultural histories of communities of color, rendering their experiences invisible and serving as a barrier to building meaningful relationships with those communities (Finney, 2014; Warren, 2016). Conceptions such as the highly-influential notion of nature deficit disorder (Louv, 2005) privilege the perspective of White heteronormative patriarchal values and assumptions (e.g., by privileging ways of being in nature that are derived largely from the experience of White, middle-class boys, such as building tree houses and forts) and continue to dominate practices and priorities in the field. In this way, these conceptions limit who engages with, or even relates to, the goals of mainstream environmental learning (Nxumalo & Cedillo, 2017). By prescribing how people should encounter and be affected by nature, the dominant White narrative limits the capacity of the OSEL field to consider more inclusive imaginings of diverse and culturally-relevant learning experiences. Additionally, OSEL is situated within a history where settler colonialists seized the land of Indigenous peoples (Voyles, 2015) that led to their removal and the violent erasure of the cultural practices of many communities of color (Tuck et al., 2014). Indigenous and Black communities were targeted for the forced acquisition of land in service of creating regional, state parks, and national parks (TREC, 2021). This has had ripple effects in the establishment and evolution of the OSEL field– shaping which ways of knowing (epistemology) and being (ontology) are uplifted and valued in these spaces. Together, this history has resulted in a mainstream OSEL field that does not understand the needs of communities of color, which is mirrored in the conceptualization of scientific and environmental literacy.

Environmental and Scientific Literacy

In the U.S. and globally, scientific and environmental literacy have been elevated to critical importance to support and deepen our understanding of the environment, the land, and the people, and how science can be used as a tool to mitigate the negative impacts of climate change. Schools and informal learning spaces, like outdoor science and environmental learning organizations, are seen as mechanisms for fostering students' understanding of scientific and environmental concepts, inquiry, and meaning making (Bybee, 1995). Therefore, the definition of scientific and environmental literacy has consequential impacts for the enactment of science and environmental learning.

Since the early 1900s researchers and practitioners have grappled with what scientific and environmental literacy mean. For instance, scientific literacy has been referred to as the cognitive knowledge and skills connected to how one makes use of science information for improvement and social good (Hurd, 1997) that can support innovation and civic engagement (DeBoer, 2000). Scholars that have examined the conceptualization of scientific literacy have identified three overarching visions–Vision 1 emphasizes gaining knowledge of the scientific process and content as a means towards understanding the virtue of science; Vision 2 focuses on scientific practices and the process of science as a means towards seeing the relevance and utility of science; and Vision 3 extends scientific literacy to gain skills and knowledge that position learners to critique the canon of science and develop a sociopolitical consciousness (Roberts, 2007; Yacoubian, 2018; Yore, 2012).

Similarly, since the 1960s, environmental literacy has been deeply tied to and has shaped the environmental conservation movement with its focus on an ecological paradigm (Roth, 1992). Roth notes that in many ways environmental literacy is connected to scientific literacy through a focus on the development of scientific habits of mind (e.g., critical thinking, seeking and organizing information) but in addition there is a concern with understanding how environmental issues and the world have come to be (Roth, 1992). Environmental literacy refers to the "knowledge of environmental concepts and issues; the attitudinal dispositions, motivation, cognitive abilities, and skills, and the confidence and appropriate behaviors to apply such knowledge in order to make effective decisions in a range of environmental contexts" (Hollweg et al., 2011, pp. 15-16), and includes indicators like conceptual knowledge, problem-solving and critical thinking skills, and positive dispositions, attitudes, and action related to the natural world and the environment (Wheaton et al., 2018).

While these notions of scientific and environmental literacy can create great opportunities for learning and supporting young people to be empowered to address scientific and environmental issues in their communities, there is a concern about the ways in which the conceptualization, and subsequently the measurement of these constructs, can neglect the epistemic and ontological practices that youth, particularly youth of color, bring to learning environments. For instance, a recent systematic review of outdoor learning outcomes (Mann et al., 2022) did not once mention cultural relevance or race. Gibson et al. (2022) notes that "the historical roots of environmental literacy are grounded in the Tbilisi Declaration, which defined the outcomes for environmental education as awareness, knowledge, and attitudes about the environment, including skills and participation to solve environmental problems for both individuals and social groups" (UNESCO 1978 as cited in Gibson et al., 2022, p. 1424), and yet environmental literacy is often measured at an individual level. In addition, scholars have noted that what counts as scientific discourse can position students with higher status (Brown, 2004) and thus reify the stratification of knowledge (Anyon, 1981).

What these scholars elevate is that scientific and environmental literacy constructs and measures do not fully account for the racialized experiences of youth of color (Nxumalo, 2021; Pérez and Saavedra, 2017). Further, there is a risk of said constructs and measures reinforcing damage-centered narratives (Tuck, 2009) or narratives that uphold oppressive and racist ideologies of the relationship between communities of color and the environment. Therefore, there is a need to center the knowledge and expertise of youth of color in the conceptualization of these constructs so that we can better understand the experiences of youth, namely youth of color in science and environmental learning environments. As stated by the Learning in Places collaborative (2021), "all communities engage in scientific sensemaking of the natural world, but they may not say it's science" (p. 5). Thus, the OSEL field is in need of ways to more expansively understand how youth and communities of color engage in science and environmental learning and meaning making.

Building on Prior Work

The proposed project builds on prior work by the PI team, who were key personnel on an NSF-funded project (NSF DRL 1612512, *Broad Implementation of the Better Environmental Education, Teaching, Learning, and Expertise Sharing Professional Learning Model for Outdoor Science Programs* [Strang & Dorph]*)* to measure the impact of OSEL experiences on youths' dispositions toward science and the environment. Working with a network of outdoor science programs whose leadership participated in a capacity-building program (also funded through the same grant), the study sought to understand the extent to which these programs supported positive dispositions toward science and the environment for participating youth, as well as whether there were any differences in effects by race/ethnicity or gender. The study found not only that these programs did support positive shifts in dispositions, but also that the effects were greater for youth of color than for their White-identifying peers. The study provided compelling evidence that outdoor science programs may have a disproportionate impact on youth of color, but also relied on status-quo definitions of success in learning environments. The present study builds upon this prior work by seeking to develop and/or refine a new suite of metrics for measuring scientific and environmental literacy that are community-driven and co-developed, thereby redefining success in ways that better characterize and capture the priorities of communities of color.

This study will also build upon the PI team's previous work with the Activation Lab, which offers a theoretical framework, *Science Learning Activation,* that articulates a set of knowledge, dispositions, and skills that position

youth for success in proximal (near-term) and potential distal (long-term) STEM learning experiences (Dorph et al., 2016). The Activation Framework proposes that, when youth have successful experiences in science learning, which includes informal learning contexts such as OSEL, they generate more positive dispositions, resulting in a positive feedback loop that propels learners on pathways towards longer term outcomes such as scientific literacy and persistent participation in science. The present study builds upon this idea that knowledge, dispositions, and skills can position students for success, while also recognizing that these scales were developed using traditional, quantitative/psychometric approaches, and that there are inherent tensions between primarily quantitative approaches and understanding the complexities of being a person of color in White-dominant spaces (Godwin, 2020; Sablan, 2019). Therefore, while the present work is informed by and may draw from existing scales from the Activation Lab, the final outcomes and scales will be developed through a community-driven approach.

Broader Impacts

Currently, the OSEL field is in an intense period of rebuilding after impacts from the COVID-19 pandemic (Collins et al., 2020), and racial equity is the most commonly named priority by organization leaders (Collins et al., 2021). At this critical moment, it is possible to have a significant, transformative impact on the field, with a long-term impact on the greater STEM education field, given the interchange of educators and ideas, and the growing recognition by K-12 schools of the importance of OSEL experiences (Becker et al., 2017). Therefore, we see this project as being positioned to have a transformative impact on research and praxis in the OSEL field, formal and informal education practice, and in broader society.

This project will generate refined definitions of OSEL outcomes that center the voices and experiences of youth and communities of color. This will lead to the development of a conceptual framework that will articulate the relationship between outcomes and the structures within and adjacent to OSEL organizations that allow for youth of color to thrive. In this way, findings will contribute to the field's understanding of youth of color's experiences in OSEL using culturally relevant and meaningful constructs and measures. The study will contribute to building bodies of scholarship that provide evidence on how to improve science and environmental literacy, positioning youth for STEM pathways and environmental activism and cultivating the next generation of STEM and environmental leaders. By bringing broader representation to the STEM field, with greater diversity of lived experiences and perspectives, this project will support new ideas and innovation to solve persisting challenges not resolved by the status quo.

In addition, this project will also contribute to new insights in engaging in community-driven, participatory research. This project is built on the premise that both research and praxis in OSEL have reinforced the oppression and marginalization of people of color; thus pushing researchers, scholars and practitioners to grapple with what it means to move towards more just and equitable practices. This project will explore what it takes to integrate community-driven, participatory approaches in the conceptualization of scientific and environmental literacy and associated outcomes, as well as in the development of measures that will be used at multiple levels of scale. In this way, we will document effective practices and approaches that can contribute to the field's understanding of how to enact just and equitable mixed methods research in the context of OSEL.

Guiding Frameworks: Centering the Racialized Experiences of Youth of Color

One of the underlying premises of this project is that, in order to more fully understand the experiences of youth in OSEL environments, we must center the racialized experiences of youth of color that have been historically ignored. Therefore, we draw on critical race theory (CRT) and the Family and Community Framework for Engagement and Collaboration. Collectively, these frameworks attend to how race shapes the experiences of youth of color in OSEL learning environments, and elevates the "forms of expertise and ways of knowing about the natural world of learners' cultural communities" (Learning in Places, 2021, p. 1). Here we describe each of these frameworks and how they will inform our work.

Critical Race Theory is a framework that stemmed out of the legal field in response to the recognition that embedded structures, policies, and laws perpetuate racism and oppression of Black, Indigenous, and people of color in the U.S. (Bell, 1992; Crenshaw et al., 1995; Ford, 1994; Harris, 1993; Matsuda, 1987; Peller, 1990).

One of the underlying premises of CRT is that structures exist and function to protect Whiteness as property, which is based on the idea that "Whiteness remains a concept based on relations of power, a social construct predicated on White dominance and Black subordination" (Harris, 1993, p. 1761). Within education, Ladson-Billings (1998) describes school curriculum as a master script designed to maintain Whiteness, wherein there are implicit and explicit values and ideologies that serve as the basis for the narratives and content included, and consequently silences multiple voices and perspectives (Ladson-Billings, 1998). In the context of this study, therefore, we aim to explore the ways in which notions of scientific and environmental literacy uphold Whiteness, as a means to reconceptualizing these very constructs that shape OSEL learning environments. Another key tenet of CRT is counterstories, where there is an intent to elevate the experiences and narratives of people of color to disrupt dominant oppressive narratives. In this study, we aim to center the knowledge and expertise of youth, and communities, of color in our conceptualization and measurement of scientific and environmental literacy to re-center narratives to amplify the voices and lived experiences of BIPOC people and communities (Delgado Bernal, 2002; Delgado & Stefancic, 2017), and potentially produce counterstories of the ways in which youth of color experience learning in OSEL programs. A third tenet of CRT is intersectionality (Crenshaw, 1991; Collins, 2000) who argue that intersecting systems of oppression like race, class, gender have compounding and nuanced impacts on groups, namely Black women and girls, based on their social location and identities. In this study, while we focus on understanding the experiences of youth of color, we also recognize the nuanced ways intersecting systems of oppression shape the experiences of youth. In the field of OSEL, there is a call for scholars to draw on intersectionality given the ways race, class, and gender have historically shaped youth experiences in these spaces (Maina-Okori et al., 2018). To this end, we have partnered with organizations who bring a racial justice lens and perspectives that are grounded in the racial diversity of their communities to ensure that we are not essentializing the experiences of youth of color.

Family and Community Framework for Engagement and Collaboration is a learning framework that aims to connect and uplift "the knowledge and practices of diverse families to learning, [which] enables learners to recognize themselves and their families as doing science, and disrupts the ways in which science is often inaccurately portrayed as primarily emerging from western intellectual traditions" (Learning in Places, 2021, p. 1). While this framework is primarily designed for educators, educational leaders, families and communities to inform partnership approaches and educational praxis, we hold that this framework provides an equally important lens for research design and development. Within this project, we aim to uplift youth and community voices and experiences in our understanding, articulation, and measurement of scientific and environmental literacy. To this end, we recognize that, in defining scientific and environmental learning outcomes, we must attend to the varied and expansive ways youth and communities engage in scientific sense-making (complex socio-ecological systems); the intergenerational and communal practices youth and families engage in (culture, families, and communities); and the localized and culturally-specific ways youth and families engage in learning and scientific and environmental practices (field-based science learning). Further, we must recognize how understandings of youth experiences and learning outcomes are situated in broader ideologies about nature-culture relations and shaped by structures of race, class, gender, and power. Therefore, we will draw on this framework as a heuristic to engage in critical reflection about the assumptions that undergird understandings of scientific and environmental literacy and how these assumptions shape what knowledge, practices, and dispositions are seen as important in this context. In addition, we will draw on the framework as a methodological tool to guide how we engage community members, in what ways, and at what time points, to support goals of centering youth and community voice.

Project Design

The proposed research project has two primary goals. First, we seek to better understand the value of OSEL programs for youth (and particularly youth of color) related to science and environmental literacy through the development of intentionally designed and rigorously validated research metrics to measure community-driven, culturally relevant outcomes. The second goal of this project is to understand how to design and engage in research that centers and uplifts the knowledge of youth of color and those that work within outdoor science programs, working to expand paradigms of research in outdoor science programs and bridging research to practice. To work toward Goal #1, we have four research questions (RQs) across two phases of work, as summarized below in Table 1. The evaluation (described in the Evaluation Plan section) will address Goal #2.

Table 1. Research Questions and Methods by Phase

	Research Questions	Methods
Phase 1 - Defining Outcomes	(1) What do scientific literacy and environmental literacy mean to communities of color? (2) What outcomes are most meaningful for youth of color who engage in outdoor science learning experiences, and how can they be measured?	• Establish Community Research Network (CRN) • Facilitate focus groups and interviews with youth, parents, educators, staff, and/or community members at partner organizations • Develop and pilot student survey and organizational leadership survey Sample: youth, educators, leadership, and community members from 3 partner organizations
Phase 2 - Measuring Impact	(3) In what ways do OSEL programs influence scientific and environmental outcomes for youth, particularly youth of color? (4) How do youth of color make meaning of these experiences?	• Student surveys • Organizational leadership Survey • Youth focus groups (case sites) • Educator interviews (case sites) Sample: youth and educators from 20-30 OSEL organizations across the U.S., plus 3 case sites

Methodological Approach: Community Based Participatory Research

Our approach to research aims to cultivate a community-driven approach, in which OSEL community members are authentically and meaningfully informing the design and execution of the study, and engage in sensemaking of findings and collaborative dissemination of findings to the field. To achieve these goals, we will draw on Community Based Participatory Research, a methodological approach that first emerged in the field of public health to respond to the ways in which environmental and public health research often excluded communities in their understanding of how environmental issues were impacting the everyday experiences and lives of peoples (Cornwall & Jewkes, 1995; Israel et al., 2012). Therefore, CBPR aims to engage communities, organizational representatives, and researchers in collaborative research to generate knowledge of phenomena and advocate for social and policy change based on that knowledge (Israel et al., 2012). Israel and colleagues note that CBPR has emerged in multiple disciplines including in education, and may also be referred to as participatory action research, among other labels. Further, Cornwall & Jewkes (1995) note that participatory research can take on many forms that can shape degrees of participation and engagement over time. With that said, Israel et al. (2012) describe nine guiding principles to support the enactment of CBPR efforts: (1) Community is a unit of identity that is socially created and recreated; (2) Communities hold strengths, resources and assets that must be recognized and built upon; (3) Research must attend to social inequalities and facilitate an equitable, power-sharing partnership; (4) Research is a co-learning process that fosters reciprocity; (5) There must be attention to both research and practice in ways that benefit all partners; (6) Foci must be relevant to communities and attend to the specific context of communities; (7) Processes are cyclical and interactive; (8) Dissemination should be led by all partners (e.g., co-author partnerships) and findings must be disseminated to all impacted and involved communities and partners; (9) The process must attend to long-term sustainability (that is co-determined).

In this research, we will draw on the practices of CBPR to guide the research process. One limitation we acknowledge is that CBPR often calls for research questions to be co-constructed– that is, questions emerge from the community. This study, including our empirical questions, builds on prior partnerships and work in OSEL, and therefore we hold that our study is putting forward theoretical questions that are meaningful and relevant to OSEL programs, youth, and broader communities. While we will not co-generate research questions, we will draw on the guiding principles of CBPR to inform the study design. One central feature of this design is the development of a Community Research Network, which will comprise our three organizational partners (NatureBridge, Yes Nature to Neighborhoods, and Wabanaki Youth in Science), that will authentically engage

in both phases of the research described below. To guide our planning and approach, we will engage with Coalition of Communities of Color (CCC), a non-profit racial and data justice organization that supports organizations in thinking about how to center race and community-driven research practices. In what follows we describe our study design, and recognize that within the boundaries of our empirical questions and goals, specific methods may evolve in response to our community partners.

Study Overview

This project will employ a participatory, mixed methods approach across two phases. In Phase 1, we will conduct a qualitative study with participatory elements to articulate key science and environmental literacy outcomes for youth of color participating in outdoor science programs. After identifying the outcomes to focus on, we will co-develop research instruments to measure these outcomes, and will conduct a series of cognitive interviews and a pilot study to refine the instruments, with a particular focus on the survey. Products from Phase 1 will include a preliminary conceptual framework of science and environmental literacy outcomes for youth of color who participate in outdoor science programs, as well as a suite of culturally relevant scales. In Phase 2, we will conduct a mixed methods study to measure the extent to which outdoor science programs support positive changes in participating youths' science and environmental literacy outcomes. The center of the Phase 2 study will be a large, quantitative study using the survey instrument developed in Phase 1. The survey data will be complemented by qualitative interviews to provide context to the quantitative data. Quantitative data analysis will examine the extent to which outdoor science programs promote positive changes in science and environmental literacy outcomes for youth of color, while qualitative data analysis will examine the conditions within and surrounding outdoor science programs that create the environment for youth of color to thrive.

Phase 1 (Years 1-2) will be a qualitative, participatory design-based study conducted in close collaboration with our Community Research Network and Project Advisory Council. In this phase, we aim to (1a) develop a conceptual understanding of key outcomes and indicators of science and environmental learning, and (1b) develop and pilot research instruments to measure outcomes. In this phase, we will facilitate a series of focus groups and semi-structured interviews to explore youth and community perspectives and experiences related to science and environmental learning to identify and/or refine key indicators of environmental and scientific literacy (e.g., practices, knowledge, dispositions). The process will involve iterative cycles of idea generation, data collection, and sensemaking, with the goal of arriving at a set of mutually agreed upon science and environmental literacy outcomes for youth of color who participate in outdoor science programs. Based on these outcomes, we will create and pilot a survey and additional research tools to be used in Phase 2. This development process will be informed by evidence-centered assessment design (Mislevy & Riconscente, 2005), with activities such as domain analysis and modeling to articulate the key concepts within each outcome; development of a conceptual framework to articulate a blueprint for item generation; and finally, implementation of draft items and scales, which will be used in a series of cognitive interviews and subsequent pilot study. Each step of the process will include member checking with the CRN.

Participants This project will be shaped by the expertise, perspectives, and priorities of our partner organizations: Yes Nature to Neighborhoods, NatureBridge, and Wabanaki Youth in Science. These organizations, described in more detail in the Project Management section, have been selected because they serve a racially diverse group of learners, including Latinx, Black, and Indigenous youth One organizational leader of color from each organization will hold a leadership position on the project, including participating on the Advisory Council. These organizational leaders will also assemble 4-6 additional stakeholders (e.g., educators, alumni, family or community members) from their organizations to form the **Community Research Network (CRN)**. The 16-20 individuals on the Community Research Network will play a pivotal role in ground-truthing to steer conceptual development and study design and collaborating to co-design the research plan, co-define constructs, and co-develop research protocols. Partner organizations will also serve as the data collection sites for Phase 1.

Instruments, Procedures, and Analysis - Phase 1 Phase 1 will occur in two parts: *Phase 1a* will engage partner organizations to identify and/or refine indicators and outcomes and develop research tools, including a

survey instrument and scales; Phase 1b will focus on refining the survey design, and other research tools, through cognitive interviews, followed by a quantitative pilot study.

Phase 1a - Idea Generation and Iterative Cycles of Data Collection, Sensemaking, and Instrument Development (Year 1). This phase will be guided by an iterative process that will be co-designed by CRN and Lawrence teams. Throughout the process, the CCC team will be a thought partner to support a study design and process that centers racial justice and community-driven practices. In this way, methods and approaches to how we explore and make sense of community experiences and perspectives related to science and environmental learning may shift and evolve over the course of this phase. With that said, we provide an example of what this process might look like for illustrative purposes. Over the course of Year 1, the CRN and Lawrence teams will meet four times. At the onset of this phase (Meeting #1), the CRN and Lawrence teams will meet to review project goals, research questions and co-develop methods and tools. In this process, we will consider questions like: what do we already know (from research and praxis); how can we elevate the voices of those most marginalized, including youth of color; how can we minimize burden and potential harm? This work will lead to the data collection phase, wherein we will conduct a series of focus groups to explore what indicators and outcomes youth and OSEL community members perceive as meaningful. Following focus groups, the Lawrence team will conduct a preliminary analysis of data and then facilitate a collective sensemaking session (Meeting #2) with the CRN to identify themes, which will include discussing implications for our constructs. This will lead to the development of refined constructs. In collaboration with the CRN, we will then explore how to measure these constructs in a survey and other research methods, such as observations and interviews (Meeting #3). The Lawrence team will take the lead on developing instruments, which then we will engage the CRN in a comprehensive review and feedback of protocols and processes for piloting instruments, such as a sampling plan for pilot survey administration (Meeting #4).

Analysis - Phase 1a. Analysis of Phase 1 data will occur in a phased approach. First, we will conduct thematic analysis of CRN meeting notes and focus group transcripts to compile key themes and constructs that will be used to inform conversations with the CRN and support the development of a draft student survey. Thematic coding will begin inductively, using a "bottom-up" approach to compile themes from the data; we will then proceed to a second round of coding, this time using a deductive approach, using the themes from inductive coding, to identify different manifestations of similar themes across conversations and data sources (Xu & Zammit, 2020). Analyses will also attend to patterns of overlap and divergence in themes based on individuals' racial/ethnic identities and other lived experiences.

Phase 1b - Pilot Study, Sensemaking, and Scale Finalization (Year 2). In this phase, we will pilot research tools with youth and educators, while continuing to actively engage CCC to support integration of racial justice and community-driven practices and approaches. To finalize the pilot survey, we will conduct cognitive lab interviews with youth and educators to ensure questions are clear and relevant. These interviews with participants at the partner organizations will occur iteratively to check for clarity and identify problematic items needing revision. The process will involve interviews where researchers sit with the youth as they complete the instrument (Ericsson & Simon, 1993). Throughout the cognitive lab, the researcher asks the student to articulate the questions in their own words and explain why they have chosen their answer. Researchers then review notes/transcripts across interviews to verify the clarity of the items, understand the uniqueness of interpretation, and determine if there are discrepancies between the item and the response options or if there is evidence of bias or sensitivity. The goal of this process is to establish a link between the outcome of interest, the observed response, and the interpretation of that response for each question (Leighton, 2004). Following each round of cognitive interviews, we will invite the CRN to review interview summaries and provide feedback on revisions to item sets before the next round of interviews. After the cognitive interviews reach a point of diminishing return in terms of identifying changes needed, we will use the finalized pilot survey to conduct a quantitative pilot study with youth and educators at the three partner organizations. Each partner organization will recruit 200 youth (600 total youth) in grades 5-8 to complete the pilot student survey. In addition, all educators at each partner organization will be invited to complete the educator survey.

Phase 1b Analysis. The goal of Phase 1b will be to refine and finalize research tools for Phase 2. A substantial part of this effort will focus on survey analysis to psychometrically test and gather validity evidence for the newly developed youth survey scales. Psychometric analysis of the survey scales will include factor analysis, reliability analysis, and differential item functioning (DIF). To evaluate the dimensionality of the item sets, we will perform confirmatory factor analyses using Mplus 8.4 (Muthén & Muthén, 2020), exploring unidimensional scale models (i.e., one dimension for each scale). Assuming the new scales are ordinal, we will then assess the ordinal scale reliability (Zumbo et al., 2007), the distribution of respondents across items, and the distribution of items across the range of respondents. Moreover, given the goal of these new scales is to create scales with lesser cultural bias than previous measures, it is critical that these tools are not subject to cultural or linguistic bias. Thus, DIF analyses will be conducted by racial ethnic identity, gender identity, and by whether or not English is spoken at home to establish that the items function equally well across these differences in our samples.

Phase 2 (Year 3) In Phase 2, we will use the products of Phase 1 to measure the extent to which outdoor science programs support positive changes in participating youths' science and environmental literacy outcomes, as well as how youth of color make meaning of the experiences. The specific design–including both instruments and methods–of Phase 2 will be largely shaped by learnings in Phase 1. At present, we envision a mixed methods approach, with two tiers of data collection. Tier 1 will include post/ retrospective-pre youth surveys with a large sample of youth and OSEL educators across the country. Tier 2 data collection will include more in-depth data collection at a subset of case sites, with both the quantitative surveys as well as qualitative youth focus groups and educator interviews. Below, we describe our current vision of Phase 2, with recognition that methods may shift through Phase 1.

Participants: The study will draw from the existing network of outdoor science education programs brought together through the BEETLES project, a project of the Lawrence Hall of Science led by Co-PI Foreman. From 2014 to 2019, BEETLES implemented a total of 10 leadership Institutes and worked directly with program leaders from 156 outdoor science organizations to build their capacity to implement high quality science teaching and learning. Leveraging existing relationships formed by the BEETLES program and research projects, we will purposefully recruit a sample of 10-15 programs that are approximately equally split between residential (in which youth travel to the program site) and non-residential (in which youth participate in local programs in their school yards or community). We will also work with our CRN and Project Advisors to identify 10-15 additional organizations not included in the original BEETLES project, with a particular effort made to recruit organizations intentionally engaging youth of color with a multitude of racial and ethnic identities.

For Tier 1, we will work with program leaders to recruit two classrooms of students to participate in our study (n=50 students per program), for a total of approximately 1,000-1,500 youth (grades 5-6). We will also recruit 2 outdoor educators from each program to participate in the educator survey, for a total of 40-60 outdoor educators. For Tier 2, we will purposefully select 3 case sites, with input from our CRN and Advisory Council to identify sites with particularly valuable opportunities to learn about how youth of color make meaning of OSEL experiences. In addition to the Tier 1 surveys at these sites, we will also recruit 4-5 youth from each program to participate in focus groups and two educators from each program to participate in educator interviews.

Phase 2 Instruments, Procedures, and Analysis We currently envision Phase 2 to include youth surveys, educator surveys, youth focus groups, and educator interviews, described below.

Youth Survey. The youth survey will use a post/retrospective pre format. Retrospective pretests have been argued to be preferable to traditional pretests when using self-report measures in informal settings, because of changes in awareness, knowledge, and/or perceptions of the construct being studied over time (Sibthorp et al., 2007). Post/retrospective pre-survey designs are useful to reduce "response shift bias" (Howard et al., 1979), to reduce data loss between pre- and post-testing, and to reduce the burden on respondents (Klatt & Taylor-Powell, 2005). Depending on the final number of scales, we may use a matrix sampling approach, such that each respondent completes a subset of survey scales, counterbalanced so that there are approximately equal numbers of respondents for each scale. This approach will provide sufficient data on each outcome to be able to make

meaningful connections across constructs, while also not overburdening participants with an excessively long survey.

Though the specific scales used in Phase 2 will be designed and piloted in Phase 1, the study will draw upon the expertise developed through the Lawrence's prior work developing, revising, and administering science and STEM attitudinal and dispositional surveys and scales through the Activation Lab, across diverse projects, content areas, settings and populations (e.g., Collins et al., in preparation; Cannady et al., 2022). In addition, depending on the final measures developed in Phase 1, select Activation subscales may be used as a means toward gathering evidence of concurrent criterion validity, or the extent to which the produced measures are predictive of scores on other, related measures (Sirechi, 1998). For example, if one of our final measures relates to youths' sense of efficacy or confidence in science, we may draw on the Science Competency Beliefs subscale (Chung et al., 2016a) as a criterion validity reference point. Similarly, if one of the final measures focuses on the extent to which youth see the utility and value of science in their lives and communities, we will draw on the Science Values Scale (Chung et al., 2016b) as a criterion validity reference point. The PI team has experience with scales measuring interest and curiosity (Science Fascination; Chung et al., 2016c), problem solving (STEM Innovation stance; Chen et al., 2017); scientific sensemaking (Cannady et al., 2019) Comfort in Nature (Nisbet et al., 2008), and environmentally-aware decision making (Collins et al., in preparation).

Educator Survey. The educator survey will include a series of closed- and open-ended questions to gather information on the characteristics of the learning experience in which the surveyed youth participate (e.g., contact hours, content, group size), as well as general information about the organization and the educators themselves. These surveys will be piloted in Phase 1 through cognitive interviews with educators at partner organizations, before being revised and used with all sites in Phase 2.

Case Site Data Collection Case site data collection will be structured to gather data to answer RQ4: How do youth of color make meaning of [OSEL] learning experiences? With support from the organizational partners, we will recruit 5 youth of color per program to serve as focal youth, who will be the focus of data collection activities: the observation, and interviews or youth focus groups.

Program Observations. One member of the research team will travel to each case site to observe program activities, with the aim of understanding how the learning experience supports positive growth in science and environmental literacy and dispositions literacy. The site visit will also include focus groups with youth and interviews with educators.

Youth focus groups or individual interviews. The youth focus group and/or interview protocols, developed in collaboration with the CRN, will be semi-structured with a series of prompts to hear from youth of color about their experiences in the OSEL program and its impact on them, as well as their reflections on how the experience differed from previous learning experiences in a way that allowed them to foster existing interests and/or develop more positive dispositions toward and literacy around science and the environment. Focus groups will be conducted at three timepoints: early in the OSEL experience, near the end of the OSEL experience, and 3-6 months after the conclusion of the OSEL experience, to learn about trajectories of youths' development and shifting perspectives on the experience and their own STEM and environmental literacy and dispositions.

Educator interview protocol. To complement data collected from youth, the semi-structured educator interview protocol will gather educators' perceptions of outcomes for youth participating in the program as well as what features of experiences allow youth of color to thrive.

Analysis - Phase 2. To answer RQ3, we will conduct a series of analyses using multilevel modeling (students nested within programs) to test for differences in science and environmental literacy scores between pre and post. Subgroup analyses will also examine whether there are differences in outcomes or trajectories based on racial, ethnic, or gender identity. Finally, data from the educator survey will be used to investigate patterns in outcomes based on programmatic or organizational features, including whether there are differences in relations between features and outcomes by subgroups of students. To answer RQ4, we will draw largely from Tier 2 (case site) data. We will inductively code youth focus group and educator interview transcripts to identify

themes around the factors influencing youth of color's learning and growth in OSEL experiences. We will also code open-ended responses from the Tier 1 surveys to have a sense of similarities and differences between case site themes and general themes across the national sample. At various points in the analysis, we will engage the CRN in analysis and sensemaking, with a particular focus on informing implications for the field. At the end of Phase 2, in partnership with the CRN, we will begin to explore dissemination approaches and processes to support collaborative authorship and dissemination (see Communication Plan).

Phase 3 (Year 4) Phase 3 will be focused on collaborative sensemaking and dissemination. We will share findings and discuss implications for the field with Phase 1 participants, and together with the CRN, consultants, and advisors, we will develop a proposed conceptual framework that explores the relationship between scientific and environmental literacy outcomes and structures within and adjacent to outdoor science organizations that allow for youth to thrive. We will also co-author research manuscripts, practitioner briefs, and conference presentations. Dissemination strategies are described below.

Communication Plan

We will use a multi-pronged communication strategy to widely disseminate findings and products. These efforts will focus on disseminating both findings related to our process and effective practices for community-driven participatory design efforts in STEM as well as research findings, validated learning outcomes, and the proposed conceptual framework. We will include CRN participants in dissemination efforts, including in co-authoring publications and co-presenting at conferences. Dissemination will be directed toward the following primary audiences: OSEL professionals, informal science professionals, and educational researchers.

We will reach OSEL professionals primarily through the Justice Outside and Lawrence Hall of Science networks for recruitment (over 400 organizations and over 6,000 individual subscribers total) along with multiple national networks including: the People of the Global Majority in the Outdoors, Nature, and Environment (PGM ONE); Cultivating Community Outdoors (a national conference centering center Black, Indigenous, and Communities of Color); North American Association of Environmental Education (NAAEE); NAAEE's State Affiliate network and groups; Association of Nature Center Administrators (ANCA); and National Association of Interpreters (NAI). We will reach educational researchers through: 1) formal education research conference presentations (AERA, NARST, NAAEE Research Symposia) and 2) publication of findings in peer-reviewed publications (e.g., Environmental Education Research). We will also disseminate findings to families and community members at participating OSEL organizations, leveraging the expertise of the CRN to develop public-facing research briefs that are accessible and engaging to the communities they work with.

Evaluation

As an external consultant, Dr. Bernadette Chi will lead the project evaluation and has extensive experience in research and evaluation of educational and community-based programs over the last 20 years, including well-regarded multi-year evaluations of NSF-funded studies across directorates. She will be responsible for the development of evaluation instruments, data collection and analysis, and presentation of findings. Guided by the questions detailed in the table below, the evaluation will focus on systematically gathering feedback from project team leaders and participants through surveys, interviews and focus groups to document implementation of project activities for accountability, and to offer feedback to the project PIs at regular and timely intervals for iteration and improvement by reflecting on what aspects of the project are working well and what could be improved. The evaluation approach is designed to gather diverse perspectives from multiple sources, including the Lawrence team and all partners and collaborators, and to provide both formative feedback and summative reflections. Findings will be provided to project leadership on an ongoing basis through quarterly meetings and learning memos twice a year, as well as through a final report.

Table 2: Evaluation and Assessment Tools

Evaluation Questions	Data Collection Tools and Sources	Deliverables
1) To what extent is the proposed project/study being implemented as planned? What components have worked well? What can be improved? 2) To what extent has the project been designed and implemented to be inclusive and equitable? What has worked well? What can be improved? 3) In what ways, if any, is the proposed project adding value to the OSEL field in terms of both process and outcomes?	○ Participation in project planning meetings ○ Observation of CRN planning meetings ○ Project team reflection focus groups ○ Focus groups with each CRN partner ○ Facilitation of annual advisory team meeting ○ Participant feedback forms post-CRN meetings ○ Ongoing review of project materials	Learning memos twice each year to project PI's and staff to inform program changes Final report to project PIs to submit to NSF

The evaluation activities will include the following:

- Participation in Year 1 Project Team planning meetings to understand and document the process of participatory and equitable design, development and implementation of the research study
- Observations of CRN planning meetings to document how the project is enacting participatory approaches, and what about the process is working well or could be improved.
- Facilitation of project team Reflective Conversations to enable regular opportunities for the project team to document the process and consider what is going well and could be improved, emerging ideas, and priorities/concerns in coming months (quarterly in Year 1; mid-point and end of year sessions to inform adjustments to project activities during Years 2-3; mid-point and end of year session in Year 4 to be more reflective/summative to inform future pathways for the work)
- Facilitation of focus groups with CRN (two focus groups with each partner organization team per year) to document and reflect on partner organizations' experiences with the project, what is working/not working about the current process, and other ways they would like to be involved
- Administration and summary of brief participant feedback forms after each CRN meeting to capture what worked/could be improved, to be shared with project leaders for future planning.
- Planning, facilitation and debrief of annual Advisory Council meetings (Years 1 - 4)
- Review of materials including protocols, surveys, conceptual framework, and findings (all years)
- Development and sharing of learning memos (2x year) in Year 1 will be written and shared after the development of definitions and the survey instrument to collect feedback from CRN, and after the pilot study; in Years 2-4, learning memos to be shared at mid-point and end of each year.)

In conducting the evaluation, Dr. Chi will closely collaborate with the research team to coordinate data collection and analyses to minimize the burden on project participants, as well as secure human subject approval for the evaluation activities. She will meet regularly with the PIs to support the integration of evaluation findings into the ongoing project management.

Project Management

The scope of this research effort requires significant organizational and management expertise, as well as an institutional infrastructure with the capacity to engage in large scale studies of this type. The Lawrence Hall of Science is a trusted and stable institution with a long-standing track record of STEM research and evaluation across diverse settings and scales. The project team has 1) deep expertise and reliable networks within the communities of outdoor, informal and formal science education, 2) successful experience designing professional learning for and research studies with outdoor, informal and formal science educators, 3) deep understanding of the unique challenges and significant opportunities in outdoor science education, and 4) the expertise, experience, and infrastructure for designing and managing large scale assessment, research, and evaluation

efforts and a proven track record of success of doing so. The entire project team and Advisory Council includes experts in science and environmental learning, research and evaluation. The entire team is described in detail below.

Leadership Team

Melissa Collins Ph.D. (PI), will provide overall intellectual, technical, and operational leadership of the project. Dr. Collins is a Senior Research Lead in the Environmental Learning Initiative at the Lawrence Hall of Science at the University of California, Berkeley. Together with Romero, she was research lead on the BEETLES project, which studied (1) the implementation of a capacity-building model to improve teaching and learning in outdoor science organizations, (2) the impact of these organizations on youths' dispositions toward science and the environment, and (3) the impact of the COVID-19 pandemic on the OSEL field. Collins received her Ph.D. in Applied Developmental and Educational Psychology from Boston College and her BA in Psychology from Harvard College.

Valeria Romero, M.A. (Co-PI) will lead project activities as a research specialist with an emphasis on equity and participatory methods. Romero is a Senior Research Lead in the Environmental Learning Initiative at the Lawrence Hall of Science at the University of California, Berkeley. Romero has over a decade of experience conducting research and evaluation in the field of OSEL, with an emphasis on centering racial equity. She received her master's degree in educational leadership from Mills College.

Jedda Foreman, M.B.A. (Co-PI), will lead project activities as an Environmental Learning Specialist with an emphasis on equity in the OSEL field. Foreman is the Director of the Environmental Learning Initiative at the Lawrence Hall of Science at the University of California, Berkeley. Foreman brings over fourteen years of environmental education field experience, curriculum and professional learning development, and project management. She is project director on the BEETLES project from which the current work stems. She has a B.A. from Carleton College, an MBA from California College of the Arts, and a Graduate Certificate in Field Science and Place-Based Education from Teton Science Schools.

Results from Prior NSF Support

The PIs have a successful history of collaborating on NSF-funded projects.

DRL 1949586: $1,471,693 (9/1/2020-8/31/2024). Collins and Romero are Co-PIs of Youth Engaged in STEM and Service. *Intellectual Merit*: This project contributes to the field's understanding of how to design culturally relevant programs for middle school youth of color and girls through two summer camps integrating solar power, engineering, and STEM identity development. The research study, through surveys, observations, and interviews, seeks to understand the impact, strengths, and challenges of the two program designs, with important implications for STEM programmatic decision-making. The evaluation, through observations and interviews, will contribute to understanding on how to cultivate equitable partnerships and a sustainable program model. *Broader Impacts:* The project will enable broader participation in STEM by pushing researchers and program designers to think critically about culturally responsive program design and how to build our collective capacity to provide equitable and inclusive STEM learning experiences. *Publications*: No publications have been published to date. *Products*: The project has designed curricula for two two-week, solar-technology summer programs for middle school youth.

DRL 2005829: 1,999,323 (9/1/2020-8/31/2023). Romero and Foreman are Co-PIs of Working Toward Equitable Organizations: Building Capacity for Leadership of Color in Outdoor and Environmental Science Education. *Intellectual Merit*: This project contributes to innovative approaches to building the capacity of OESE program leaders and professionals of color to work towards equitable workplaces. The research component aims to understand, through surveys and case studies, for whom and under what conditions organizations are able to make equitable institutional change. The project evaluation, using survey data feedback forms, supports ongoing improvements and enhancements to the design and implementation of the professional learning model. *Broader Impacts*: The project directly impacts 20 OESE nationwide, 150 organization leaders, and 90 professionals of color. *Publications*: So far, this project has resulted in five conference presentations.

Additional Project Team Members **Craig Strang**, former Associate Director of the Lawrence Hall of Science, will provide expertise on the OSEL field and science and environmental literacy. **Alex Sanchez,** Research

Coordinator at the Lawrence Hall of Science, will support data collection, analysis, and dissemination of results. **Corinne Calhoun**, Environmental Learning Coordinator at the Lawrence Hall of Science, will serve as project coordinator. **Tim Hurt,** Computer Science Education Lead at the Lawrence Hall of Science, will support data management, psychometric analysis, and multilevel modeling.

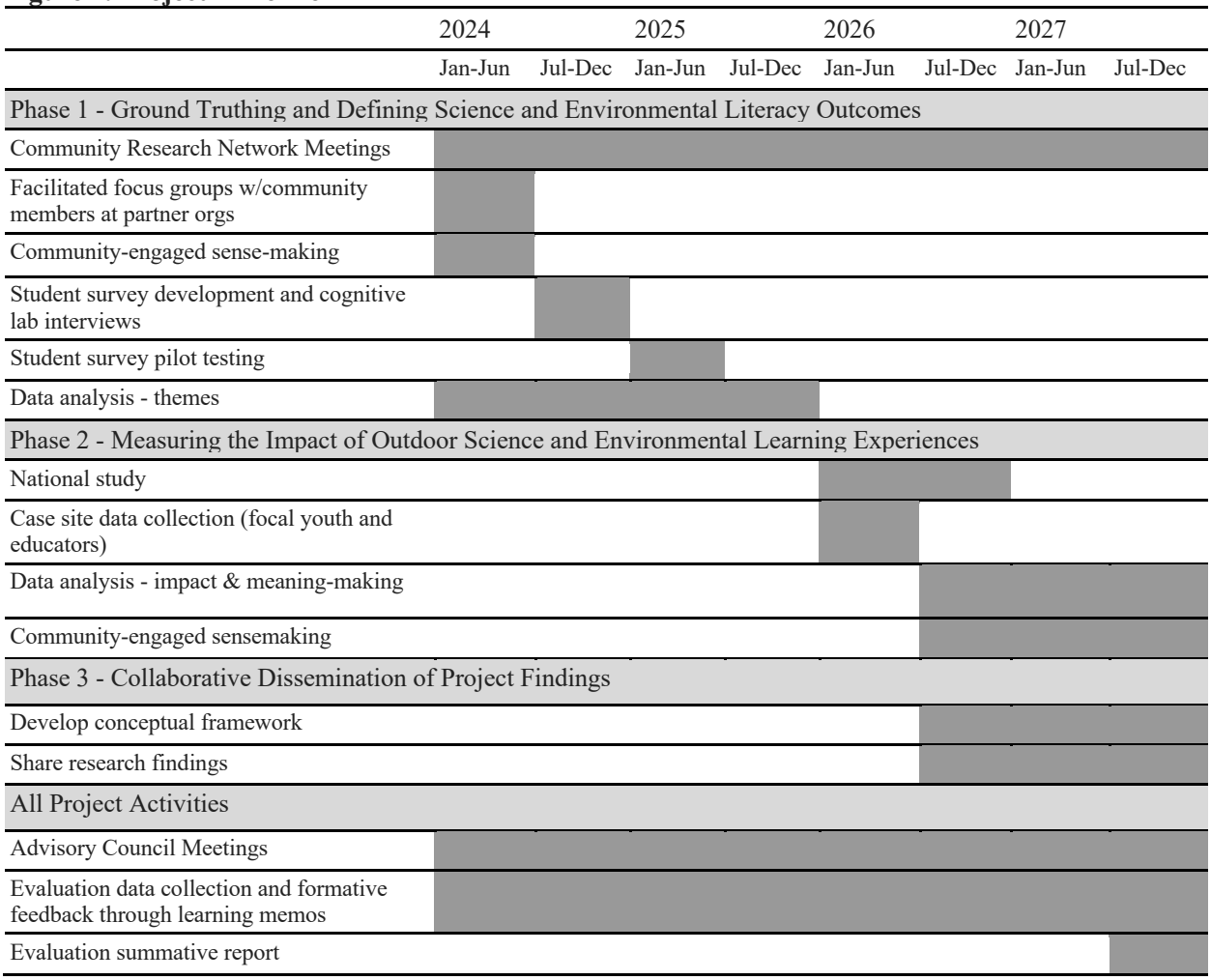
Partners. Organization partners will have a seat on the project Advisory Council and will support recruitment of the Community Research Network and research participants, support the piloting of student surveys, and contribute to writing and disseminating findings. An annual stipend to one organization leader at each partner site will be provided to compensate for project activities all four years. Community Research Network members will also receive an honorarium in years 1, 2, and 4. The three organizations were chosen to reflect a diversity of organizational structures, histories, and approaches to equity. **Yes Nature to Neighborhoods** (YES) is a community organization based in Richmond, California. YES focuses on cultivating leadership among Richmond youth, adults, and whole families through year-round training, strong mentorship, and profound experiences in nature; increasing access and breaking down barriers for those historically excluded from the outdoors; and collaborating at the forefront of the movement to increase equity and inclusivity in the outdoors. YES has over 50 community partners and a network of over 500 actively involved community members attending and participating in events. **NatureBridge** is the largest education partner of the National Park Service. Through multi-day, residential outdoor school programming in four sites in Yosemite National Park and the Golden Gate National Recreation Area in California, Olympic National Park in Washington, and Prince William Forest Park in Virginia, NatureBridge connects over 35,000 students from 700 schools each year to the wonder and science of the natural world. **Wabanaki Youth in Science (WaYS)** is a grass roots, community-based educational model that started in 2013 with initial financial support from the National Science Foundation's Experimental Program to Stimulate Competitive Research (NSF EPSCoR). WaYS serves to support Maine Native youth to persist in science through collaborations with Cultural Knowledge Sharer (CKS) and western science professionals at camps, after-school programs and internships. All programs focus on Traditional Ecological Knowledge (TEK) and the concept "two eyed learning" or students being able to learn about the world through both western science and cultural science vantage points.

Research & Data Equity Consultants The Research Justice Institute (RJI) at the Coalition of Communities of Color (CCC) will act as consultants on research design and implementation. In particular, CCC will support the team in 1) creating a BIPOC-led research design, including addressing equitable community involvement in the research process, prioritizing common goals, and centering BIPOC voices; 2) ensuring equitable research strategies; and 3) ensuring data equity strategies. Across Phases 1 and 2, they will participate in CRN, research planning, and Advisory Council meetings; review instruments; contribute to collaborative sensemaking; and support dissemination efforts.

Advisory Council The Advisory Council will ensure the research study in its design and broader impacts are situated within and responsive to the current state of research in the fields of outdoor science, environmental learning and informal science. In years 1 through 3, advisors will provide input on the study design (e.g., sampling approaches and inclusion criteria) and instruments (i.e., surveys and interview/focus group protocols). In year 4, Advisory Council members will be instrumental in framing findings and implications for the outdoor and environmental learning field to ensure relevance and impact for both research and practice. Advisors for this project have been carefully selected to provide expertise on 1) equity and justice (2) the landscape of the OSEL field, and 3) best practices in research and evaluation. Advisors will include: **Laura Rodriguez**, Chief Program Officer, Justice Outside, who brings expertise in racial equity, inclusion, and cultural relevance in the outdoors; **Cathy Jordan**, Director of Leadership & Education, Institute on the Environment at University of Minnesota, who brings expertise on nature exposure and child development; **Marc Stern,** Professor of Forest Resources Environmental Conservation at Virginia Tech, who brings expertise on environmental attitudes and actions research and evaluation; representatives from the project's three partner organizations: **Miho Aida**, Director of Equity, Inclusion & Diversity, NatureBridge; **Tish Carr**, Executive Director, Wabanaki Youth in Science (WaYS); **Blanca Hernández**, Director of Programs & Partnerships, YES Nature to Neighborhoods; and **Dr. Andres Lopez**, Research Director, Coalition of Communities of Color.

Project Management Plan. Our project management plan builds on the detailed and successful practices currently in place for the previous work completed by the PI team. These practices include: clearly defined team roles, weekly team meetings along with brief check-ins as necessary, bi-weekly leadership team meetings, and online document sharing. Our team uses Box for Business to share, manage, and work collaboratively on documents. We also make use of shared Google calendars to maintain a consistent and reliable schedule, and the UC Berkeley server for document backup and long-term storage. The team uses Zoom for distance meetings with advisors, consultants, and partners. We use cloud-based platforms, like Google Drive, to communicate with off-site partners in order to quickly share and exchange documents and information, track important dates and meetings, and maintain a forum for discussion and community between partners. The timeline below delineates the work plan for this project.

Figure 1. Project Timeline



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Submitted/PI: Melissa A Collins /Proposal No: 2314075

SUMMARY PROPOSAL BUDGET

YEAR 1

FOR NSF USE ONLY		
PROPOSAL NO.	DURATION (months)	
	Proposed	Granted
2314075		
AWARD NO.		

ORGANIZATION: University of California-Berkeley

PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR: Melissa Collins

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-months CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. Melissa Collins - Principal Inv	3.6			36,474	
2. Jedda Foreman	2.4			28,772	
3. Valeria Romero	3.6			37,501	
4.					
5.					
6. ( ) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	0.0			0	
7. (3) TOTAL SENIOR PERSONNEL (1 - 6)	9.6			102,747	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (0) POST DOCTORAL SCHOLARS	0.0			0	
2. (3) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	8.6			61,840	
3. (0) GRADUATE STUDENTS				0	
4. (1) UNDERGRADUATE STUDENTS				1,382	
5. (0) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				0	
6. (0) OTHER				0	
TOTAL SALARIES AND WAGES (A + B)				165,969	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				60,420	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				226,389	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
TOTAL EQUIPMENT				0	
E. TRAVEL 1. DOMESTIC (INCL. U.S. POSSESSIONS)				105	
2. INTERNATIONAL				0	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ 0					
2. TRAVEL 0					
3. SUBSISTENCE 0					
4. OTHER 0					
TOTAL NUMBER OF PARTICIPANTS (0) TOTAL PARTICIPANT COSTS				0	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				750	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				0	
3. CONSULTANT SERVICES				27,400	
4. COMPUTER SERVICES				0	
5. SUBAWARDS				0	
6. OTHER				43,150	
TOTAL OTHER DIRECT COSTS				71,300	
H. TOTAL DIRECT COSTS (A THROUGH G)				297,794	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) Modified Total Direct Costs (Rate: 60.5, Base:297801)					
TOTAL INDIRECT COSTS (F&A)				180,170	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				477,964	
K. FEE				0	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				477,964	

M. COST SHARING PROPOSED LEVEL $ 0 AGREED LEVEL IF DIFFERENT $

PI/PD NAME: Melissa Collins

ORG. REP. NAME*: Eb Thorpe

FOR NSF USE ONLY		
INDIRECT COST RATE VERIFICATION		
Date Checked	Date Of Rate Sheet	Initials - ORG

*ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET

Submitted/PI: Melissa A Collins /Proposal No: 2314075

SUMMARY PROPOSAL BUDGET

YEAR 2

FOR NSF USE ONLY		
PROPOSAL NO.	DURATION (months)	
	Proposed	Granted
2314075		
AWARD NO.		

ORGANIZATION: University of California-Berkeley

PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR: Melissa Collins

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-months CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. Melissa Collins - Principal Inv	3.6			37,568	
2. Jedda Foreman	2.4			35,303	
3. Valeria Romero	3.0			32,188	
4.					
5.					
6. ( ) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	0.0			0	
7. (3) TOTAL SENIOR PERSONNEL (1 - 6)	9.0			105,059	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (0) POST DOCTORAL SCHOLARS	0.0			0	
2. (3) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	10.8			85,871	
3. (0) GRADUATE STUDENTS				0	
4. (1) UNDERGRADUATE STUDENTS				1,416	
5. (0) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				0	
6. (0) OTHER				0	
TOTAL SALARIES AND WAGES (A + B)				192,346	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				69,821	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				262,167	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
TOTAL EQUIPMENT				0	
E. TRAVEL 1. DOMESTIC (INCL. U.S. POSSESSIONS)				4,169	
2. INTERNATIONAL				0	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ 0					
2. TRAVEL 0					
3. SUBSISTENCE 0					
4. OTHER 0					
TOTAL NUMBER OF PARTICIPANTS (0) TOTAL PARTICIPANT COSTS				0	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				2,350	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				0	
3. CONSULTANT SERVICES				25,600	
4. COMPUTER SERVICES				0	
5. SUBAWARDS				0	
6. OTHER				30,645	
TOTAL OTHER DIRECT COSTS				58,595	
H. TOTAL DIRECT COSTS (A THROUGH G)				324,931	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) Modified Total Direct Costs (Rate: 60.5, Base:324938)					
TOTAL INDIRECT COSTS (F&A)				196,587	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				521,518	
K. FEE				0	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				521,518	

M. COST SHARING PROPOSED LEVEL $ 0 AGREED LEVEL IF DIFFERENT $

PI/PD NAME: Melissa Collins

ORG. REP. NAME*: Eb Thorpe

FOR NSF USE ONLY		
INDIRECT COST RATE VERIFICATION		
Date Checked	Date Of Rate Sheet	Initials - ORG

*ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET

Submitted/PI: Melissa A Collins /Proposal No: 2314075

SUMMARY PROPOSAL BUDGET

YEAR 3

FOR NSF USE ONLY		
PROPOSAL NO.	DURATION (months)	
	Proposed	Granted
2314075		
AWARD NO.		

ORGANIZATION: University of California-Berkeley

PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR: Melissa Collins

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-months CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. Melissa Collins - Principal Inv	3.6			42,827	
2. Jedda Foreman	2.4			36,362	
3. Valeria Romero	2.4			29,356	
4.					
5.					
6. ( ) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	0.0			0	
7. (3) TOTAL SENIOR PERSONNEL (1 - 6)	8.4			108,545	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (0) POST DOCTORAL SCHOLARS	0.0			0	
2. (3) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	10.8			90,767	
3. (0) GRADUATE STUDENTS				0	
4. (1) UNDERGRADUATE STUDENTS				1,452	
5. (0) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				0	
6. (0) OTHER				0	
TOTAL SALARIES AND WAGES (A + B)				200,764	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				72,866	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				273,630	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
TOTAL EQUIPMENT				0	
E. TRAVEL 1. DOMESTIC (INCL. U.S. POSSESSIONS)				27,516	
2. INTERNATIONAL				0	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ 0					
2. TRAVEL 0					
3. SUBSISTENCE 0					
4. OTHER 0					
TOTAL NUMBER OF PARTICIPANTS (0) TOTAL PARTICIPANT COSTS				0	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				3,000	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				0	
3. CONSULTANT SERVICES				25,090	
4. COMPUTER SERVICES				0	
5. SUBAWARDS				0	
6. OTHER				34,445	
TOTAL OTHER DIRECT COSTS				62,535	
H. TOTAL DIRECT COSTS (A THROUGH G)				363,681	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) Modified Total Direct Costs (Rate: 60.5, Base:363689)					
TOTAL INDIRECT COSTS (F&A)				220,032	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				583,713	
K. FEE				0	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				583,713	

M. COST SHARING PROPOSED LEVEL $ 0 AGREED LEVEL IF DIFFERENT $

PI/PD NAME: Melissa Collins

ORG. REP. NAME*: Eb Thorpe

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INDIRECT COST RATE VERIFICATION		
Date Checked	Date Of Rate Sheet	Initials - ORG

*ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET

Submitted/PI: Melissa A Collins /Proposal No: 2314075

SUMMARY PROPOSAL BUDGET

YEAR 4

FOR NSF USE ONLY		
PROPOSAL NO.	DURATION (months)	
	Proposed	Granted
2314075		
AWARD NO.		

ORGANIZATION: University of California-Berkeley

PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR: Melissa Collins

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-months CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. Melissa Collins - Principal Inv	3.6			44,112	
2. Jedda Foreman	2.4			37,453	
3. Valeria Romero	3.0			37,795	
4.					
5.					
6. ( ) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	0.0			0	
7. (3) TOTAL SENIOR PERSONNEL (1 - 6)	9.0			119,360	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (0) POST DOCTORAL SCHOLARS	0.0			0	
2. (3) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	7.8			66,202	
3. (0) GRADUATE STUDENTS				0	
4. (1) UNDERGRADUATE STUDENTS				1,488	
5. (0) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				0	
6. (0) OTHER				0	
TOTAL SALARIES AND WAGES (A + B)				187,050	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				67,784	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				254,834	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
TOTAL EQUIPMENT				0	
E. TRAVEL 1. DOMESTIC (INCL. U.S. POSSESSIONS)				24,872	
2. INTERNATIONAL				0	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ 0					
2. TRAVEL 0					
3. SUBSISTENCE 0					
4. OTHER 0					
TOTAL NUMBER OF PARTICIPANTS (0) TOTAL PARTICIPANT COSTS				0	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				750	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				0	
3. CONSULTANT SERVICES				28,690	
4. COMPUTER SERVICES				0	
5. SUBAWARDS				0	
6. OTHER				43,650	
TOTAL OTHER DIRECT COSTS				73,090	
H. TOTAL DIRECT COSTS (A THROUGH G)				352,796	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) Modified Total Direct Costs (Rate: 60.5, Base:352804)					
TOTAL INDIRECT COSTS (F&A)				213,446	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				566,242	
K. FEE				0	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				566,242	

M. COST SHARING PROPOSED LEVEL $ 0 AGREED LEVEL IF DIFFERENT $

PI/PD NAME: Melissa Collins

ORG. REP. NAME*: Eb Thorpe

FOR NSF USE ONLY		
INDIRECT COST RATE VERIFICATION		
Date Checked	Date Of Rate Sheet	Initials - ORG

*ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET

Submitted/PI: Melissa A Collins /Proposal No: 2314075

SUMMARY PROPOSAL BUDGET

Cumulative

ORGANIZATION	FOR NSF USE ONLY: PROPOSAL NO.	DURATION (months) Proposed	Granted
University of California-Berkeley	2314075		
PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR: Melissa Collins	AWARD NO.		

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-months CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. Melissa Collins - Principal Inv	14.4			160,981	
2. Jedda Foreman	9.6			137,890	
3. Valeria Romero	12.0			136,840	
4.					
5.					
6. ( ) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)					
7. (3) TOTAL SENIOR PERSONNEL (1 - 6)	36.0			435,711	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (0) POST DOCTORAL SCHOLARS	0.0			0	
2. (12) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	38.0			304,680	
3. (0) GRADUATE STUDENTS				0	
4. (4) UNDERGRADUATE STUDENTS				5,738	
5. (0) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				0	
6. (0) OTHER				0	
TOTAL SALARIES AND WAGES (A + B)				746,129	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				270,891	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				1,017,020	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
TOTAL EQUIPMENT				0	
E. TRAVEL 1. DOMESTIC (INCL. U.S. POSSESSIONS)				56,662	
2. INTERNATIONAL				0	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ 0					
2. TRAVEL 0					
3. SUBSISTENCE 0					
4. OTHER 0					
TOTAL NUMBER OF PARTICIPANTS (0) TOTAL PARTICIPANT COSTS				0	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				6,850	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				0	
3. CONSULTANT SERVICES				106,780	
4. COMPUTER SERVICES				0	
5. SUBAWARDS				0	
6. OTHER				151,890	
TOTAL OTHER DIRECT COSTS				265,520	
H. TOTAL DIRECT COSTS (A THROUGH G)				1,339,202	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE)					
TOTAL INDIRECT COSTS (F&A)				810,235	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				2,149,437	
K. FEE				0	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				2,149,437	

M. COST SHARING PROPOSED LEVEL $ 0 AGREED LEVEL IF DIFFERENT $

PI/PD NAME	FOR NSF USE ONLY: INDIRECT COST RATE VERIFICATION		
Melissa Collins	Date Checked	Date Of Rate Sheet	Initials - ORG
ORG. REP. NAME* Eb Thorpe			

*ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET

Budget Justification

The proposed budget goes toward:

A. ***Senior Personnel***:
PI Melissa Collins, Ph.D., will provide overall intellectual, technical, and operational leadership at 30% FTE in Years 1 through 4. Drawing from experience in scale development and quantitative research, Collins's responsibilities will include providing intellectual oversight on construct development, with a focus on scale development; overseeing research design; leading quantitative data collection and analysis; monitoring the budget and project milestones; and disseminating project results, with a focus on academic audiences.

Co-PI Valeria Romero, M.A., will lead project activities as a Research Specialist with an emphasis on equity and participatory methods at 30% FTE in Year 1, 25% FTE in Year 2 and 4, and 20% in Year 3. Romero's responsibilities will include providing intellectual oversight of construct development, with a focus on cultural relevance and equity; overseeing participatory research design; leading qualitative data collection and analysis; and disseminating project results, with a focus on community audiences.

Co-PI Jedda Foreman, M.B.A, will lead project activities as an Environmental Learning Specialist with an emphasis on equity in the outdoor science and environmental learning (OSEL) field at 20% FTE in Years 1 through 4. Foreman's responsibilities will include providing intellectual oversight on construct development, with a focus on relevance for OSEL field; serving as liaison between UCB Berkeley project staff, community partners, the advisory board, and the external evaluator; tracking timelines; and disseminating project results, with a focus on OSEL practitioner audiences.

In accordance with the PAPPG (Chapter II.C.2.g.(i)), the salary compensation requested in the proposal budget for the following senior personnel exceeds two months of salary compensation per year: PI Collins, Co-PI Romero, and Co-PD Foreman. The proposed levels of effort for this project are appropriate for the scope of work and are required in order to fulfill the objectives of the project within the proposed performance period. In addition, these investigators do not hold faculty appointments and are not core funded. Thus, their respective salaries are dependent on extramural funds. These funds will be expended in accordance with NSF and University requirements. For the purposes of determining NSF's 2-month annual effort limit on senior personnel compensation, the University of California, Berkeley defines a "year" as the organization's fiscal year that spans from July 1 to June 30.

B. ***Other Personnel:***
B.2 Other Professionals:
Corinne Calhoun, Environmental Learning Coordinator at the Lawrence Hall of Science, will serve as project coordinator at 30% FTE in Year 1, 35% in Years 2 and 3, and 25% in Year 4.

Alex Sanchez, Research Coordinator at the Lawrence Hall of Science, will support data collection, analysis, and dissemination of results at 40% FTE in Years 1 through 3, and 35% in Year 4.

Tim Hurt, Computational Thinking Lead at the Lawrence Hall of Science, will support data management, psychometric analysis, and multilevel modeling at 2% FTE in year 1, 15% FTE in years 2 and 3, and 5% FTE in year 4.

B.4 Undergraduate Student: An undergraduate student will provide support with research data processing and transcription in years 1–4, estimated at 80 hours/year (3.8% FTE), based on University rates and policies for undergraduate student employees.

Salaries are based on (9/1/2022) actual salaries and are projected to include an annual cost-of-living adjustment (and merit, if applicable) effective each year.

C. ***Fringe Benefits***: The University of California, Berkeley Composite Fringe Benefit Rates (CFBR) have been reviewed and federally approved by the Department of Health and Human Services (DHHS) for use by all fund sources through FY21. Rates beyond June 30, 2021 are estimates and are provided for planning purposes only. Future CFBR rates are subject to review and approval by DHHS on an annual or bi-annual basis. Fringe benefits are assessed as a percentage of the respective employee's salary. The benefit rates are as follows:

	Proposed		Projections for Planning Purposes		
CFBR Rate Group	**FY22**	**FY23**	**FY24**	**FY25**	**FY26**
Academic	35.9%	35.4%	35.4%	35.4%	35.4%
Staff	43.8%	42.8%	42.8%	42.8%	42.8%
Students (Graduate and Undergraduate)	2.8%	2.8%	2.3%	2.3%	2.3%

For more information, please see: https://spo.berkeley.edu/policy/benefits/benefits.html

E. ***Travel*****:** Domestic: Cost estimates are based on past similar charges and current prices via ConnexUC, a web portal with access to University of California's Systemwide Travel Program offering comprehensive discounted rates and benefits for all those affiliated with UC. Cost estimates follow the UC Travel Regulations, Policy G-28 (see: https://policy.ucop.edu/doc/3420365/BFB-G-28). A travel budget of $56,662 is requested broken down as follows:

1. $8,128 is requested for a PI/Co-PI and one community member to attend the AISL PI meeting in Years 2 and 4. The amount includes airfare, meals, lodging, ground transportation (car rental), mileage to/from the airport, and parking. Per university practice, mileage to/from the home airport is based on estimated miles using the institutional mileage reimbursement rate ($0.655/mile, or approximately $50 RT) and parking rates at the airport (estimated at $30/day). Ground transportation (car rental or taxi/Lyft) at the destination is estimated at $60/day. The estimated breakdown of costs is as follows:

PI Meeting Travel

Year	# Trips	# Days/ Nights	# People	Airfare per person per trip	Meals per person per day	Lodging per person per night	Ground transportation (car rental) per person per trip	Airport mileage and parking per person per trip	Total
Y2	1	3/3	2	$650	$79	$275	$180	$140	$4,064
Y4	1	3/3	2	$650	$79	$275	$180	$140	$4,064

2. $41,616 is requested for eight persons to each attend one (1) annual 3-day conference in Years 3 and 4 to disseminate project results. Four people will be UC Berkeley project personnel (three co-PIs plus a research assistant) and 4 will be community partners. We will have individuals attend different major conferences such as the North American Association for Environmental Education, American Educational Research Association, Association for Environmental and Outdoor Education, Justice

Outside, or Children and Nature Network, to ensure that our findings are disseminated to multiple audiences. We estimate that conferences will be held at similar venues as previously held conferences such as Chicago and Phoenix. The amount includes airfare, meals, lodging, ground transportation, mileage and parking, and registration fees. Per university practice, mileage to/from the home airport is based on estimated miles using the institutional mileage reimbursement rate ($0.655/mile, or approximately $50 RT) and parking rates at the airport (estimated at $30/day). Ground transportation (car rental or taxi/Lyft) at the destination is estimated at $60/day. The estimated breakdown of costs is as follows:

Conference Travel

Year	# Trips	# Days/ Nights	# People	Airfare per person per trip	Meals per person per day	Lodging per person per night	Ground transportation (car rental) per person per trip	Airport mileage and parking per person per trip	Reg. Fees per person per trip	Total
Y3	1	4/3	8	$650	$79	$275	$240	$170	$400	$20,808
Y4	1	4/3	8	$650	$79	$275	$240	$170	$400	$20,808

3. $6,603 is requested for three visits to case sites for Tier 2 data collection for 1 member of the research team (PI, Co-PI, project coordinator, or research coordinator) in Year 3. The amount includes airfare, meals/lodging, ground transportation, and mileage/parking. Sites will be located all across the country, so we used SFO to Washington, DC to estimate flights. Per university practice, mileage to/from the home airport is estimated using the institutional mileage reimbursement rate ($0.655/mile, or $50 RT) and parking rates at the airport (estimated at $30/day). Ground transportation (car rental or taxi/Lyft) at the destination is estimated at $60/day. The estimated breakdown of costs is as follows:

Case Site Visits

	# Trips	# Days/ Nights	# People	Airfare per person per trip	Meals per person per day	Lodging per person per night	Ground transportation (car rental) per person per trip	Airport mileage and parking per person per trip	Total
Year 3	3	4/3	1	$650	$79	$275	$240	$170	$6,603

4. $315 is requested for mileage to drive to data collection at local sites for Phase 1 (Years 1 and 2) and Phase 2 case site (Year 3) data collection. Members of the team will travel from Berkeley, CA to local sites in CA. Using the University of California's institutional mileage rate ($0.655/mile), the estimated breakdown of costs is as follows: Average 20 miles RT from Berkeley, CA to Richmond, CA @ $0.655/ml x 1 person x 8 trips per year =$105 per year in Years 1, 2, and 3.

G. Other Direct Costs

G.1 Materials and supplies at $750 in each grant year for supplies (no food) and printing expenses for Community Research Network meetings, advisory council meetings, and data collection.
G.2 Printing and shipping youth surveys at $3,850 total, or $1,600 in Year 2 and $2,250 in Year 3. Year 2 (piloting) is calculated as $800 for printing (10 pages * 100 surveys * 16 sites * $.05 per page) and $800 for shipping ($50 roundtrip shipping per site * 16 sites). Year 3 is calculated as $900 for printing (10 pages * 50 surveys * 30 sites * $.05 per page) and $1,500 for shipping ($50 roundtrip shipping per site * 30 sites). Because of the variability in Wi-Fi and technology access at sites, we anticipate having to ship paper copies to most organizations. These rates are based on similar services used for a recently completed NSF-funded project, BEETLES.

G.3 Consultant services.
a. **Research and Data Equity Consultant Services – Andres Lopez, Ph.D. and Mira Mohsini, Ph.D. of Coalition of Communities of Color,** will consult on all aspects of research design and implementation, including community relationship building, research methods, instrument development, and dissemination. In particular, CCC will support the team by contributing their expertise in 1) creating a BIPOC-led research design, including addressing equitable community involvement in the research process, prioritizing common goals, and centering BIPOC voices in question development, data collection, analysis and interpretation, and dissemination; 2) ensuring equitable research strategies, including in methodology, analysis, and dissemination; and 3) ensuring data equity strategies, including survey modernization, disaggregation strategies, and quantitative and qualitative approaches. Services will be provided at $6,600 in Year 1, $6,600 in Year 2, $5,700 in Year 3, and $9,300 in Year 4, for a total of $28,200. This amount covers approximately 20 hours of work in Years 1-3 and 31 hours in Year 4 at CCC's consulting rate of $300/hr.

b. External Evaluation - Dr. Bernadette Chi, an independent consultant, will function as an external evaluator for the project to provide formative evaluation, share stakeholder feedback, liaison with project advisors and facilitate regular advisory board meetings, and produce annual progress reports as well as a summative report in Year 4. Dr. Chi brings expertise in research and evaluation of K-12 STEM and civic education. Services will be provided at $20,800 in Year 1, $19,000 in Year 2, and $19,390 per year in Year 3 and Year 4, for a total of $78,580. This amount covers approximately 100 hours of work in Year 1, 91 hours of work in Year 2, and 83 hours of work per year in Years 3 and 4, at Dr. Chi's consulting rate of $200/hr.

G.6 Other:
a. **Individual payments for partner organization liaisons** for four people at $4,000 each in Year 1, $1,500 each in Year 2, $4,000 each in Year 3, and $2,500 each in Year 4, for a total of $48,000. Partner Organization Liaisons will be the primary point of contact for each partner organization supporting coordination with the project team. They will recruit members for the Community Research Network (CRN), support data collection with youth, and contribute to dissemination. This amount covers approximately 20 hours of work per year in Year 1, 10 hours in Year 2, 20 hours in Year 3, and 15 hours in Year 4 at a rate of $300/hr.
b. **Honoraria** for 8 advisory board members budgeted at $44,000. These 8 advisors will provide critical feedback and guidance regarding the overall design and development of the various project activities. Advisors are not under contract for consulting or professional services. Seven of the advisors will receive modest honoraria, budgeted at $1,000 per person per year in all years of the project, to show appreciation for service to the project (total = $28,000). This amount covers approximately 4-8 hours of work per person per year. One advisor, an expert in QuantCrit, will receive $4,000 per year (total=$16,000) to cover their time and expertise through an increased role, including advising on research design, data analysis, and dissemination, estimated at about 20 hours/year.
c. **Research incentives** for a total of $11,500, including:

1. Focus groups: To demonstrate our valuing of youths' and community members' time and perspectives, we would like to offer $50 for 60 people participating in 1-hour focus groups (5 youth and/or community members per focus group x 12 focus groups), in Year 1, for a total of $3,000.
2. Educators to support coglabs with youth in Year 1: Because they will be supporting our data collection and contributing about 5 hours of time, we will demonstrate our gratitude for educators' time by offering $250 per educator for 8 educators in Year 3, for a total of $2,000.
3. Youth interviews: To demonstrate our valuing of youths' time and perspectives, we would like to offer $25 per 45-min interview for each of 20 youth from case site organizations participating in 3 interviews per youth (or $75 total per youth), in Year 3, for a total of $1,500.

4. Educator interviews, To demonstrate our valuing of educators' time and perspectives, we would like to offer $50 to to 8 educators from case site organizations who participate in a 1-hour interview, for a total of $400 in Year 3;
5. Educators to administer youth surveys: Because they will be supporting our data collection and contributing about 2 hours of time, we will demonstrate our gratitude for educators' time by offering $100 per educator for 16 educators in Year 2 ($1,600) and 30 educators, in Year 3 ($3,000) for a total of $4,600.

d. **Translation services** for translating project documents, including consent forms, data collection instruments, and dissemination products, at $1000 in Years 1 and 2, $1,500 in Year 3, and $2,000 in Year 4, for $5,500 total. Based on prior work with diverse populations, we anticipate needing to translate documents into a number of languages, including Spanish, Chinese, Arabic, and others. These estimates are based on similar services used for ongoing NSF-funded projects led by two of the Co-PIs, using rates quoted for that project (approximately $0.20 per word), estimating 1000 words into 5 languages in Year 1 and 2, 1500 words into 5 languages in Year 3, and 2,000 words into 5 languages in Year 4.

e. **Transcription services** of audio recordings, estimated at $150/year all years for a total of $600. These estimates are based on annual subscription rates for similar services (e.g., Descript) used for ongoing NSF-funded projects led by two of the Co-PIs.

f. **mPlus software** for multilevel modeling at $895 per year in Year 2 and 3 for a total of $1790

g. **Open access journal fees** of $2,500 to publish 2 articles in open access journals (estimated at $1,000-1,500 per journal) in Year 4

h. **Individual Payments for Community Research Network** (CRN; estimated 6-8 hours per year) at $500 each for 20 people in Years 1, 2, and 4; for a subtotal of $30,000; plus, an additional $2000 for 4 people in Year 4 to engage in co-authoring research dissemination products (estimated 24 hours of work), for a subtotal of $8,000, and a grand total of $38,000. The CRN will play an essential role in centering community perspectives in construct development, survey design, recruitment, data collection, and dissemination.

I. Indirect Costs: Indirect Costs are requested at $810,217. Indirect costs are based on University negotiated rates with the Department of Health and Human Services and are applied at the Research, on campus rate as follows:

	7/1/2021 through 6/30/2022	7/1/2022 until amended
Research, On-campus	**60.5%**	**60.5%**

Indirect costs are calculated using the modified total direct cost (MDTC) formula as per the approved rate agreement dated June 25, 2020. Modified total direct costs, consisting of all direct salaries and wages, applicable fringe benefits, materials, supplies, services, travel and up to the first $25,000 of each subaward (regardless of the period of performance of the subawards under the award). Modified total direct costs shall exclude equipment, capital expenditures, charges for patient care, student tuition remission, rental costs of off-site facilities, scholarships, and fellowships, participant support costs and the portion of each subaward in excess of $25,000. For more information, please see: Https://spo.berkeley.edu/policy/fa.html. The rates after July 1, 2022 are provisional and subject to change based upon our updated federally negotiated indirect cost rate agreement.

Understanding the Impact of Outdoor Science and Environmental Learning Experiences Through Community-Driven Outcomes

Submitted to the National Science Foundation (NSF), solicitation NSF 22-626

Submitted by: Melissa Collins, Ph.D. (Principal Investigator), Valeria Romero, M.A. (Co-Principal Investigator), and Jedda Foreman, M.B.A. (Co-Principal Investigator)
The Lawrence Hall of Science • University of California, Berkeley

Facilities, Equipment, and Other Resources

The Lawrence Hall of Science's (the Lawrence) mission is to inspire and engage through science, discovery and learning in ways that advance equity and opportunity. The Lawrence is the public science center of the University of California, Berkeley, and an innovative leader in the field of science and mathematics education. As a national leader in the development of science and mathematics instructional materials, its approaches, programs, and tools are replicated, scaled up, and disseminated nationally in preK-12, college, and informal science education settings. The Lawrence Hall of Science also supports a network of teachers that test new, cutting-edge instructional materials in classrooms nationwide.

The public museum has a total of 30,000 square feet of programmatic spaces. This includes exhibition space, a planetarium/digital dome, an outdoor science park, a state-of-the-art auditorium that seats 275 people, and 10 teaching classrooms and laboratories that provide a venue for learning experiences. The building also has dedicated office space for project staff and volunteers in the building equipped with standard furnishing including networked computers, phones, printers, and high-speed internet connections. In addition, the Lawrence houses several large meeting rooms suitable for Advisory Board and other large group meetings.

The Lawrence Hall of Science employs a cloud-based file server, hosted and managed at the University of California Data Center, that provides all desktops and laptops with reliable shared storage for project information. A dedicated in-house backup facility exists for all project data stored on the cloud server, and backup is also provided by the Data Center. Many of the ongoing projects either have an online presence or deliver a significant amount of content over the Internet, so the technical staff members maintain web servers, web applications, and online file storage services hosted and managed by the University of California Data Center, and its approved commercial partners. The department has a total of 9 terabytes of managed storage. The Berkeley network gateway is connected to both the California educational network and the commodity Internet via redundant links. The museum also works with campus departments and third-party systems to provide an event calendaring system, registration for educational and professional development services, and a networked display control system.

The **Learning Group** at The Lawrence advances four Strategic Initiatives through research, design, development in ways that expand knowledge, affect practice, influence policy, and impact people nationally and globally. These Strategic Initiatives include:

- Advancing Science in K-12 Systems
- Advancing Environmental Learning
- Transforming Science and Society
- Transforming STEM Pathways

The Lawrence Hall of Science's **Advancing Environmental Learning Initiative** is a multidisciplinary team that aims to advance environmental learning in education systems while centering communities bearing the burdens of environmental injustice. In addition to designing, implementing, and studying

learning experiences for youth, the team also offers a variety of outstanding inquiry-based science professional development options that exemplify sound teaching strategies and are researched to address the needs of all learners. The Lawrence Hall of Science connects with over 20,000 teachers annually—regionally, nationally, and even internationally through collaborations with partner sites, publishers, school districts from NYC to LA, and partners as distant as Japan and Jordan. In addition, the Lawrence Hall of Science's Research Strand is charged with providing evidence and insights to foster high quality, equitable, and innovative science and mathematics learning experiences. This team rigorously investigates and evaluates learning opportunities to inform program refinement and to contribute to generalizable knowledge for field of STEM education.

Other Resources:

Our evaluator, Bernadette Chi, has the necessary office space and resources to provide evaluation services.

Our research justice and equity consultants – Mira Mohsini and Andres Lopez from the Coalition of Communities of Color – have the necessary office space and resources to provide contracted services.

Submitted/PI: Melissa A Collins /Proposal No: 2314075

Effective 10/04/2021 **NSF BIOGRAPHICAL SKETCH** **OMB-3145-0058**

NAME: Melissa Collins

POSITION TITLE & INSTITUTION: Senior Research Lead, Lawrence Hall of Science, UC Berkeley

A. PROFESSIONAL PREPARATION - (see PAPPG Chapter II.C.2.f.(i)(a))

INSTITUTION	LOCATION	MAJOR/AREA OF STUDY	DEGREE (if applicable)	YEAR (YYYY)
Harvard College	Cambridge, MA	Psychology	Bachelor of Arts	2008
Boston College	Chestnut Hill, MA	Applied Developmental & Educational Psychology	Ph.D.	2016

B. APPOINTMENTS - (see PAPPG Chapter II.C.2.f.(i)(b))

From - To	Position Title, Organization and Location
2022 - Present	Senior Research Lead, Advancing Environmental Learning Initiative, Lawrence Hall of Science; University of California, Berkeley
2020 - 2022	Senior Research Lead, The Research Group, Lawrence Hall of Science; University of California, Berkeley
2016 - 2019	Research Specialist, The Research Group, Lawrence Hall of Science; University of California, Berkeley
2016	Consultant - Summative Data Analysis, The Achievement Network
2015 - 2016	Teaching Fellow/Instructor, Department of Counseling, Developmental & Educational Psychology; Boston College Lynch School of Education
2011 - 2015	Graduate Research Assistant, Department of Counseling, Developmental & Educational Psychology; Boston College Lynch School of Education
2014 - 2015	Math Assessment Assistant, The Achievement Network
2011	Research & Evaluation Coordinator, Jumpstart
2009 - 2011	Research Assistant, Center for Social Development & Education, University of Massachusetts, Boston

BS-1 of 3

C. PRODUCTS - (see PAPPG Chapter II.C.2.f.(i)(c)) Products Most Closely Related to the Proposed Project

Collins, M. A., Pande, A., Strang, C., Foreman, J., & Dorph, R. (2021). Impacts from COVID-19: Resilient outdoor science programs need support as challenges persist. Policy brief. Lawrence Hall of Science, University of California, Berkeley; California. https://www.lawrencehallofscience.org/wp-content/uploads/2022/02/impacts-from-covid-19-osps_2-2022.pdf

Collins, M. A., Dorph, R., Foreman, J., Pande, A., Strang, C., & Young, A. (2020). A field at risk: The impact of COVID-19 on environmental and outdoor science education: Policy brief. Lawrence Hall of Science, University of California, Berkeley; California. https://www.lawrencehallofscience.org/wpcontent/uploads/2021/10/EE_A_Field_at_Risk_ Policy_Brief.pdf

Romero, V. F., Collins, M., Young, A., Laina, V., Dorph, R., Pande, A., Strang, C., & Foreman, J. (2022). Improving outdoor science teaching and learning: The implementation of a capacity-building model in outdoor science programs. Berkeley, CA: The Lawrence Hall of Science, University of California, Berkeley.

Collins, M. A., Totino, J., Hartry, A., Pedroso, R., Romero, V., & Nava, R. (2019). Service learning as a lever to support STEM engagement for underrepresented youth. Journal of Experiential Education, 43(1), 55-70. doi: 10.1177/1053825919887407

Hurt, T., Greenwald, E., Allan, S., Cannady, M., Krakowski, A., Brodsky, L., Collins, M. A., Montgomery, R., & Dorph, R. (in press). The computational thinking for science framework: Operationalizing CT-S for K-12 science education researchers and educators. International Journal of STEM Education.

Other Significant Products, Whether or Not Related to the Proposed Project

Collins, M. A., & Laski, E. (2019). Digging deeper: Shared deep structures of early literacy and mathematics involve symbolic mapping and relational reasoning. Early Childhood Research Quarterly, 46(1), 201-212. doi: 10.1016/j.ecresq.2018.02.008

Coley, R. L., Votruba-Drzal, E., Collins, M. A., & Cook, K. D. (2016). Comparing public, private, and informal preschool programs in a national sample of low-income children. Early Childhood Research Quarterly, 36, 91-105. doi:10.1016/j.ecresq.2015.11.002

Collins, M. A., & Laski, E. V. (2015). Preschoolers' strategies for solving visual pattern tasks. Early Childhood Research Quarterly, 32, 204-214. doi:10.1016/j.ecresq.2015.04.004

Votruba-Drzal, E., Coley, R. L., Collins, M. A., & Miller, P. (2015). Center-based preschool and school readiness skills of children from immigrant families. Early Education and Development, 26, 549-573. doi: 10.1080/10409289.2015.1000220

Coley, R. L., Votruba-Drzal, E., Collins, M. A., & Miller, P. (2014). Selection into early education and care settings: Differences by developmental status. Early Childhood Research Quarterly, 29, 319-332. doi:/10.1016/j.ecresq.2014.03.006

D. SYNERGISTIC ACTIVITIES - (see PAPPG Chapter II.C.2.f.(i)(d))

Cannady, M.A., Montgomery, R., Hurt, T., Collins, M., Allan, S., Brodsky, L., Greenwald, E., Krakowski, A., & Dorph, R. (2022). Technical report: Measuring Computational Thinking for Science (CT-S). Berkeley, CA: Lawrence Hall of Science at University of California, Berkeley. Retrieved from: https://www.lawrencehallofscience.org/research/

Webinar: Collins, M. A., Young, A., Pande, A., & Romero, V. (2021, September). The impact of outdoor science programs on youths' dispositions toward science and the environment. Webinar presented to the Better Environmental Education Teaching, Learning, and Expertise Sharing (BEETLES) Network

Invited Speaker (2016, July): Educational psychology: Learning principles from cognitive science. Lecture for Tokyo University of Social Welfare's summer program in collaboration with Harvard University, Cambridge, MA.

Member: North American Association for Environmental Education (2020-Present)

Member: American Educational Research Association (2021, 2012-2013),

Submitted/PI: Melissa A Collins /Proposal No: 2314075

Effective 10/04/2021 **NSF BIOGRAPHICAL SKETCH** **OMB-3145-0058**

NAME: Jedda Foreman

POSITION TITLE & INSTITUTION: Dir.of Environmental Literacy Programs, The Lawrence Hall of Science

A. PROFESSIONAL PREPARATION - (see PAPPG Chapter II.C.2.f.(i)(a))

INSTITUTION	LOCATION	MAJOR/AREA OF STUDY	DEGREE (if applicable)	YEAR (YYYY)
Carleton College	Northfield, MN	Psychology/Education	B.A.	2008
California College of Arts	San Francisco, CA	Design Strategy	M.B.A.	2015

B. APPOINTMENTS - (see PAPPG Chapter II.C.2.f.(i)(b))

From - To	Position Title, Organization and Location
2022-present	Initative Director, Advancing Environmental Learning, The Lawrence Hall of Science, UC Berkeley. Berkeley, CA.
2019–2022	Director of Environmental Literacy Programs, The Lawrence Hall of Science, UC Berkeley. Berkeley, CA.
2017–present	Director, Advancing Equity and Inclusion in Environmental Education, The Lawrence Hall of Science, UC Berkeley. Berkeley, CA.
2015–present	Project Lead, The Lawrence Hall of Science in Partnership with ChangeScale, a collective impact backbone organization in San Francisco, CA.
2012–present	Project Manager, BEETLES: Better Environmental Education, Teaching, Learning & Expertise Sharing (NSF AISL grant #1612512), The Lawrence Hall of Science, UC Berkeley. Berkeley, CA
2011–2012	Program Manager, Quality of Life Foundation, San Francisco, CA.
2009–2019	Program Assistant and Field Instructor, Teton Science Schools, Kelly, WY.
2006–2008	Mentor-Education, Gender and Sexuality Center, Carleton College, Northfield, MN

C. PRODUCTS - (see PAPPG Chapter II.C.2.f.(i)(c)) Products Most Closely Related to the Proposed Project

Romero, V., Foreman, J., Strang, C., Rodriguez, L., Payan, R., Moore Bailey, K., & Olsen, S. (2022). Racial equity and inclusion in U.S.-based environmental education organizations: A critical examination of priorities and practices in the work environment. Journal of Outdoor and Environmental Education.

Foreman, J., Beals, K., Barakos, L., Lygren, E., and Strang, C. (2022). Guide for Outdoor Science Program and Organization Leaders. Lawrence Hall of Science, Berkeley, CA. Accessed at: http://beetlesproject.org.

Foreman, J., Strang, C., Rodriguez, L., Payan, R. (2020). Racial Equity in Outdoor Science and Environmental Education: Re-Establishing the Field with Intention. Lawrence Hall of Science, University of California, Berkeley; California.

Hernandez, B., Romero, V., Foreman, J., & Strang, C. (2020). Building Towards an Inclusive Organizational Culture: Insights and Lessons Learned from YES Nature to Neighborhoods: Practice Brief. Lawrence Hall of Science, University of California, Berkeley; California.

Romero, V., Foreman, J., Strang, C., Maybury, C., Pepito, E., & Rocca, C. (2019). Intentional hiring and recruitment through the lens of equity and inclusion: Insights and lessons learned from Crissy Field Center, Golden Gate National Parks Conservancy. Berkeley, CA.

Other Significant Products, Whether or Not Related to the Proposed Project

Foreman, J., Mitchel, B., Elkin, T., Pedemonte, S., Strang, C., & Lujan, V. (2021). An Approach to Walking Field Trips. National Outdoor Learning Library, Green Schoolyards America. https://www.greenschoolyards.org/walking-field-trips.

Collins, M., Pande, A. Strang, C., Foreman, J., & Dorph, R. (2021). Impacts from covid-19: resilient outdoor science programs need support as challenges persist. Lawrence Hall of Science, University of California, Berkeley; California.

Pedemonte, S., Lujan, V., Strang, C., & Foreman, J. (2021). Full In-person Instructional Plans. National Outdoor Learning Library, Green Schoolyards America. https://www.greenschoolyards.org/in-person-instructional-plans

Foreman, J., Pedemone, S., Strang, C., Jen, T., Totino, J., Snyder, J., Binding, M., (2021). Environmental Literacy Curriculum Connections. Lawrence Hall of Science, University of California, Berkeley; California. https://lawrencehallofscience.org/curriculum/environmental-literacy-curriculum/

Romero, V., Foreman, J., Strang, C., Rodriguez, L., Payan, R., & Moore Bailey, K. (2019). Equitable and inclusive work environments in environmental education: Perspectives from the field and implications for organizations. Lawrence Hall of Science, Berkeley, CA. Accessed at: http://beetlesproject.org.

D. SYNERGISTIC ACTIVITIES - (see PAPPG Chapter II.C.2.f.(i)(d))

• Advisory board member for “Beyond Birds: Using Audubon’s Guided Nature Experiences to Engage 18-25 Year-Olds with STEM and Climate-Science Content” a NSF-supported project of the National Audubon Society
• I am a member of the North American Association of Environmental Education professional association (2015-present)
• Many products listed above in section C are results of the BEETLES project and were developed in conjunction with other educators and scientists. They are in use in hundreds of informal organizations across the county and internationally.

Submitted/PI: Melissa A Collins /Proposal No: 2314075

Effective 10/04/2021 **NSF BIOGRAPHICAL SKETCH** **OMB-3145-0058**

NAME: Valeria Fike Romero

POSITION TITLE & INSTITUTION: Senior Research Lead, Lawrence Hall of Science, UC Berkeley

A. PROFESSIONAL PREPARATION - (see PAPPG Chapter II.C.2.f.(i)(a))

INSTITUTION	LOCATION	MAJOR/AREA OF STUDY	DEGREE (if applicable)	YEAR (YYYY)
Holy Names University	Oakland	Sociology and Psychology	B.A.	2005
Mills College	Oakland	Educational Leadership	M.A.	2010
UC Davis	Davis	Education	Ph.D.	2024

B. APPOINTMENTS - (see PAPPG Chapter II.C.2.f.(i)(b))

From - To	Position Title, Organization and Location
2011- Present	Senior Research Lead, Lawrence Hall of Science; University of California, Berkeley, Berkeley, CA
2010-2011	Resident Fellow, Chicana/Latino Student Development Office; University of California, Berkeley, Berkeley, CA
2010	Program Assistant, Division of Student Life; Mills College, Oakland, CA
2007-2009	Higher Education Fellow, The Greenlining Institute, Berkeley, CA
2007-2008	2007 – 2008 Lead Organizer, Students and Families for Tuition Relief Now, Berkeley, CA

Revised Proposal Budget Revision #1 for 2314075 Submitted On Tue Jul 18 10:22:27 EDT 2023 Electronic Signature

C. PRODUCTS - (see PAPPG Chapter II.C.2.f.(i)(c)) Products Most Closely Related to the Proposed Project

Romero, V.F, Foreman, J., Strang, C., Rodriguez, L., Payan, R., Moore-Bailey, K., & Olsen, S. (2022). Racial equity and inclusion in United States of America-based environmental education organizations: A critical examination of priorities and practices in the work environment. Journal of Outdoor and Environmental Education, 1-26.

Romero, V. F., Collins, M., Young, A., Laina, V., Dorph, R., Pande, A., Strang, C., & Foreman, J. (2022). Improving Outdoor Science Teaching and Learning: The Implementation of a Capacity-Building Model in Outdoor Science Programs. Berkeley, CA: The Lawrence Hall of Science, University of California, Berkeley

Romero, V., Laina, V., Pande, A., Chi, B., & Snow, J.Z., (2021). BEETLES: An evaluation of a capacity building model to support outdoor science programs. Berkeley, CA: The Lawrence Hall of Science, University of California, Berkeley.

Gonzalez, J., Arciniega, M., Romero, V., & Pande, A. (2021). Centering equity and inclusion in cultivating community. Berkeley, CA: The Lawrence Hall of Science, University of California, Berkeley. http://beetlesproject.org/resources/centering-equity/

Romero, V., Foreman, J., Strang, C., Maybury, C., Pepito, E., & Rocca, C. (2019). Intentional hiring and recruitment through the lens of equity and inclusion: Insights and lessons learned from Crissy Field Center, Golden Gate National Parks Conservancy. Berkeley, CA.

Other Significant Products, Whether or Not Related to the Proposed Project

Dorph, R., Romero, V.F., & Cannady, M. (2022). Informal science institution-designed efforts to broaden participation in STEM learning and career pathways. Poster presented at the American Educational Association Annual Conference, 2022, San Diego, CA.

Sanchez. A. & Romero, V.F. (2021). Teacher leadership: A Review of the Literature. Report submitted to the National Geographic Society. Berkeley, CA: The Lawrence Hall of Science, University of California, Berkeley.

Romero, V., Cuff, K., Cannady, M.A., Nava, R. & Dorph, R. (2019). Fostering Environmental Activism through Community-Based Research Investigations. Poster presented at the American Educational Research Association annual meeting, Toronto, Canada.

Trahan, L., Romero, V., & Blinderman, E. (2019). From the classroom to the floor: Applying language supports to new museum contexts. Journal of Museum Education, 44(4), 418-426.

Collins, M. A., Totino, J., Hartry, A., Pedroso, R., Romero, V., & Nava, R. (2019). Service learning as a lever to support STEM engagement for underrepresented youth. Journal of Experiential Education. 43(1). 55-70.

D. SYNERGISTIC ACTIVITIES - (see PAPPG Chapter II.C.2.f.(i)(d))

- Member: American Educational Research Association
- Peer Reviewer: Science Education
- Peer Reviewer: American Journal of Evaluation
- Co-Chair, Lawrence Hall of Science Equity Leadership Team
- JEDI Strand Lead, Lawrence Hall of Science

Other Personnel Biographical Information

Data Not Available

Effective 10/04/2021 **NSF CURRENT AND PENDING SUPPORT** **OMB-3145-0058**

*PI/co-PI/Senior Personnel Name: Melissa Collins

***Required fields**

Note: NSF has provided 15 project/proposal and 10 in-kind contribution entries for users to populate. Please leave any unused entries blank.

Project/Proposal Section:

Current and Pending Support includes all resources made available to an individual in support of and/or related to all of his/her research efforts, regardless of whether or not they have monetary value.[1] Information must be provided about all current and pending support, including this project, for ongoing projects, and for any proposals currently under consideration from whatever source, irrespective of whether such support is provided through the proposing organization or is provided directly to the individual. This includes, for example, Federal, State, local, foreign, public or private foundations, non-profit organizations, industrial or other commercial organizations, or internal funds allocated toward specific projects. Concurrent submission of a proposal to other organizations will not prejudice its review by NSF, if disclosed.[2]

[1] If the time commitment or dollar value is not readily ascertainable, reasonable estimates should be provided.
[2] The Biological Sciences Directorate exception to this policy is delineated in PAPPG Chapter II.D.2.

Projects/Proposals

1. *Project/Proposal Title : Collaborative Research: Learning probability through AI problem-solving in a Game-based Environment

*Status of Support : (•) Current ( ) Pending ( ) Submission Planned ( ) Transfer of Support

Proposal/Award Number (if available): 2201424

*Source of Support: National Science Foundation

*Primary Place of Performance : University of California, Berkeley

Project/Proposal Start Date (MM/YYYY) (if available) : 07/2022

Project/Proposal End Date (MM/YYYY) (if available) : 06/2025

*Total Award Amount (including Indirect Costs): $ 809,155

*Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1. 2023	1.20	4.	
2. 2024	1.40	5.	
3. 2025	1.40		

*Overall Objectives : The project aims to use technology-supported learning to improve current practice in high school math education. In this project, we will revisit current practice of high school probability education and design AI problem-solving to connect probability (e.g., independent and conditional probability) and AI (such as Bayesian networks) concepts.

*Statement of Potential Overlap : No overlap

Projects/Proposals

2. *Project/Proposal Title : Youth Engaged in STEM and Service (YESS)

*Status of Support : (•) Current ( ) Pending ( ) Submission Planned ( ) Transfer of Support

Proposal/Award Number (if available): 1949586

*Source of Support: National Science Foundation

*Primary Place of Performance : University of California, Berkeley

Project/Proposal Start Date (MM/YYYY) (if available) : 09/2020

Project/Proposal End Date (MM/YYYY) (if available) : 08/2024

*Total Award Amount (including Indirect Costs): $ 1,471,693

*Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1. 2023	2.40	4.	
2. 2024	2.40	5.	
3.			

*Overall Objectives : This project (YESS) explores the potential for culturally-relevant, STEM-based experiences to support improved STEM attitudes, dispositions, and skills in rising ninth grade youth, with a particular focus on female-identifying and Black and brown youth. We will design, implement, and study two approaches to creating a culturally relevant, solar-based summer programs: one focused on local relevance, and one focused on service learning.

*Statement of Potential Overlap : No overlap

Projects/Proposals

3. *Project/Proposal Title : Natural Hazards Engineering Research Infrastructure: Computational Modeling and Simulation Center 2021-2025

*Status of Support : (•) Current ( ) Pending ( ) Submission Planned ( ) Transfer of Support

Proposal/Award Number (if available): 2131111

*Source of Support: UCB Civil and Environmental Engineering/ NSF NHERI

*Primary Place of Performance : University of California, Berkeley

Project/Proposal Start Date (MM/YYYY) (if available) : 10/2021

Project/Proposal End Date (MM/YYYY) (if available) : 09/2025

*Total Award Amount (including Indirect Costs): $ 12,750,000

*Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1. 2023	0.40	4.	
2. 2024	0.40	5.	
3. 2025	0.40		

*Overall Objectives : To provide a new platform of tools and resources to support numerical simulations in natural hazards engineering (NHE) and to build and support a national network of interdisciplinary researchers and practitioners. The usability evaluation gathers data on the usefulness and impact of SimCenter's tools and resources on the NHE field.

*Statement of Potential Overlap : No overlap

Projects/Proposals

4. *Project/Proposal Title : Math Activation: How does culturally responsive mathematics pedagogy support positive dispositions toward mathematics?

*Status of Support : ○ Current ◉ Pending ○ Submission Planned ○ Transfer of Support

Proposal/Award Number (if available): 2300848

*Source of Support: National Science Foundation

*Primary Place of Performance : University of California, Berkeley

Project/Proposal Start Date (MM/YYYY) (if available) : 04/2023

Project/Proposal End Date (MM/YYYY) (if available) : 03/2026

*Total Award Amount (including Indirect Costs): $ 1,499,759

*Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1. 2024	2.40	4.	
2. 2025	3.00	5.	
3. 2026	3.00		

*Overall Objectives : This project aims to examine how pedagogical approaches that leverage students' assets may influence students' mathematical perceptions, dispositions, and practices, in turn positioning them for success in learning school mathematics. The project will develop measures of Math Activation and culturally responsive mathematics pedagogy to explore their interaction and encourage asset-based approaches to math instruction.

*Statement of Potential Overlap : No overlap

Projects/Proposals

5. *Project/Proposal Title : Understanding the Impact of Outdoor Science and Environmental Learning Through Community-Driven Outcomes (this proposal)

*Status of Support : ○ Current ◉ Pending ○ Submission Planned ○ Transfer of Support

Proposal/Award Number (if available):

*Source of Support: National Science Foundation

*Primary Place of Performance : University of California, Berkeley

Project/Proposal Start Date (MM/YYYY) (if available) : 01/2024

Project/Proposal End Date (MM/YYYY) (if available) : 12/2027

*Total Award Amount (including Indirect Costs): $ 1,998,911

*Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1. 2024	3.00	4. 2027	3.60
2. 2025	3.00	5.	
3. 2026	3.60		

*Overall Objectives : Using community-driven, participatory methods and approaches, this project will develop conceptual understandings and measures of scientific and environmental literacy that center the voices and experiences of youth of color. In addition, we will use developed measures to examine the impact of outdoor science and environmental education experiences on youth, and in particular aim to understand how youth of color make meaning of their experiences.

*Statement of Potential Overlap : N/A this proposal

Projects/Proposals

6. *Project/Proposal Title : Advancing Science Teaching and English Language Development through Content and Collaboration

*Status of Support : ○ Current ◉ Pending ○ Submission Planned ○ Transfer of Support

Proposal/Award Number (if available): 2300284

*Source of Support: National Science Foundation

*Primary Place of Performance : University of California, Berkeley

Project/Proposal Start Date (MM/YYYY) (if available) : 04/2023

Project/Proposal End Date (MM/YYYY) (if available) : 03/2027

*Total Award Amount (including Indirect Costs): $ 2,423,071

*Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1. 2024	1.20	4. 2027	1.20
2. 2025	1.20	5.	
3. 2026	1.20		

*Overall Objectives : This project is focused on designing English Language Development (ELD) instructional units that help elementary teachers support science learning and English language development of their emergent multilingual students (EMLs).

*Statement of Potential Overlap : No overlap

Effective 10/04/2021 **NSF CURRENT AND PENDING SUPPORT** **OMB-3145-0058**

*PI/co-PI/Senior Personnel Name: Foreman, Jedda

***Required fields**

Note: NSF has provided 15 project/proposal and 10 in-kind contribution entries for users to populate. Please leave any unused entries blank.

Project/Proposal Section:

Current and Pending Support includes all resources made available to an individual in support of and/or related to all of his/her research efforts, regardless of whether or not they have monetary value.[1] Information must be provided about all current and pending support, including this project, for ongoing projects, and for any proposals currently under consideration from whatever source, irrespective of whether such support is provided through the proposing organization or is provided directly to the individual. This includes, for example, Federal, State, local, foreign, public or private foundations, non-profit organizations, industrial or other commercial organizations, or internal funds allocated toward specific projects. Concurrent submission of a proposal to other organizations will not prejudice its review by NSF, if disclosed.[2]

[1] If the time commitment or dollar value is not readily ascertainable, reasonable estimates should be provided.
[2] The Biological Sciences Directorate exception to this policy is delineated in PAPPG Chapter II.D.2.

Projects/Proposals

1. *Project/Proposal Title : Working Toward Equitable Organizations: Building Capacity for Leadership of Color in Outdoor and Environmental Science Education

*Status of Support : (•) Current ( ) Pending ( ) Submission Planned ( ) Transfer of Support

Proposal/Award Number (if available): 2005829

*Source of Support: National Science Foundation

*Primary Place of Performance : University of California, Berkeley

Project/Proposal Start Date (MM/YYYY) (if available) : 09/2020

Project/Proposal End Date (MM/YYYY) (if available) : 08/2023

*Total Award Amount (including Indirect Costs): $ 1,999,323

*Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1. 2021	3.60	4.	
2. 2022	3.60	5.	
3. 2023	3.60		

*Overall Objectives : Addresses inequities in the outdoor and environmental science education by broadening participation of people of color, including African Americans, Latinx, and Native Americans in the leadership and staff of outdoor science programs (OSP) by supporting the development of vertical leadership teams to create and sustain equitable, inclusive, and culturally relevant workplaces and learning environments, and 2) supporting professionals of color currently working in participating OSPs.

*Statement of Potential Overlap : There is no known overlap between this project and the proposed project in terms of scope, budget, or person-months planned.

Projects/Proposals

2. *Project/Proposal Title : Building Capacity in EE through Subnational Networks

*Status of Support : ◉ Current ○ Pending ○ Submission Planned ○ Transfer of Support

Proposal/Award Number (if available): 21-00589

*Source of Support: Pisces Foundation

*Primary Place of Performance : University of California, Berkeley

Project/Proposal Start Date (MM/YYYY) (if available) : 06/2021

Project/Proposal End Date (MM/YYYY) (if available) : 05/2023

*Total Award Amount (including Indirect Costs): $ 206,000

*Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1. 2022	1.80	4.	
2. 2023	2.40	5.	
3.			

*Overall Objectives : Addresses the lack of support for current and emerging network leaders in the environmental education field by creating a national backbone network.

*Statement of Potential Overlap : There is no known overlap between this project and the proposed project in terms of scope, budget, or person-months planned.

Projects/Proposals

3. *Project/Proposal Title : Connecting to Nature through Outdoor Science

*Status of Support : (•) Current ( ) Pending ( ) Submission Planned ( ) Transfer of Support

Proposal/Award Number (if available): 053517

*Source of Support: Woka Foundation

*Primary Place of Performance : University of California, Berkeley

Project/Proposal Start Date (MM/YYYY) (if available) : 06/2022

Project/Proposal End Date (MM/YYYY) (if available) : 05/2024

*Total Award Amount (including Indirect Costs): $ 249,216

*Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1. 2023	0.60	4.	
2. 2024	0.60	5.	
3.			

*Overall Objectives : Creates learning experiences for the Lawrence Hall of Science's Outdoor Nature Lab. These experiences will be pilot tested for national dissemination to nature centers and other nature destinations that are visited by the general public.

*Statement of Potential Overlap : There is no known overlap between this project and the proposed project in terms of scope, budget, or person-months planned.

Projects/Proposals

4. *Project/Proposal Title : Working Toward Racial Equity:
Building Capacity to Institutionalize Equity in Outdoor and Environmental Science Education

*Status of Support : ○ Current ◉ Pending ○ Submission Planned ○ Transfer of Support

Proposal/Award Number (if available):

*Source of Support: National Science Foundation

*Primary Place of Performance : University of California, Berkeley

Project/Proposal Start Date (MM/YYYY) (if available) : 01/2024

Project/Proposal End Date (MM/YYYY) (if available) : 12/2028

*Total Award Amount (including Indirect Costs): $ 4,549,645

*Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1. 2024	3.00	4. 2027	3.00
2. 2025	3.00	5. 2028	3.00
3. 2026	3.00		

*Overall Objectives : Addresses debilitating racial inequities in the OESE field by increasing the capacity of organizations to build more racially just and equitable work environments through a multi-phase cohort-based professional learning approach as well as the creation of a Racial Equity Transformation Tool Kit.

*Statement of Potential Overlap : There is no known overlap between this project and the proposed project in terms of scope, budget, or person-months planned.

Projects/Proposals

5. *Project/Proposal Title : Advancing Organization Transformation for Racial Equity in Environmental Education

*Status of Support : ○ Current ◉ Pending ○ Submission Planned ○ Transfer of Support

Proposal/Award Number (if available):

*Source of Support: Spencer Foundation (RPP)

*Primary Place of Performance : University of California, Berkeley

Project/Proposal Start Date (MM/YYYY) (if available) : 08/2023

Project/Proposal End Date (MM/YYYY) (if available) : 07/2026

*Total Award Amount (including Indirect Costs): $ 397,899

*Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1. 2024	0.60	4.	
2. 2025	0.60	5.	
3. 2026	1.20		

*Overall Objectives : Conducts a landscape assessment to understand the current state of racial equity and justice within the environmental education (EE) field across the United States.

*Statement of Potential Overlap : There is no known overlap between this project and the proposed project in terms of scope, budget, or person-months planned.

Projects/Proposals

6. *Project/Proposal Title : DTI: Indigenous Mixed Reality Science Experiences (IMRSE): Fostering Cultural and Science Identity through Youth Participatory Design of Mixed Reality Experiences

*Status of Support : ○ Current ◉ Pending ○ Submission Planned ○ Transfer of Support

Proposal/Award Number (if available): 2241805

*Source of Support: National Science Foundation

*Primary Place of Performance : University of California, Berkeley

Project/Proposal Start Date (MM/YYYY) (if available) : 09/2023

Project/Proposal End Date (MM/YYYY) (if available) : 08/2026

*Total Award Amount (including Indirect Costs): $ 1,292,298

*Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1. 2024	1.80	4.	
2. 2025	1.80	5.	
3. 2026	1.80		

*Overall Objectives : Develops and studies a model that strengthens Indigenous youths' capacity for, and disposition toward STEM pathways through the collaborative design of mixed reality Indigenous science experiences.

*Statement of Potential Overlap : There is no known overlap between this project and the proposed project in terms of scope, budget, or person-months planned.

Projects/Proposals

7. *Project/Proposal Title : Understanding the Impact of Outdoor Science and Environmental Learning Through Community-Driven Outcomes (this proposal)

*Status of Support : ○ Current ◉ Pending ○ Submission Planned ○ Transfer of Support

Proposal/Award Number (if available):

*Source of Support: National Science Foundation

*Primary Place of Performance : University of California, Berkeley

Project/Proposal Start Date (MM/YYYY) (if available) : 01/2024

Project/Proposal End Date (MM/YYYY) (if available) : 12/2027

*Total Award Amount (including Indirect Costs): $ 1,998,911

*Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1. 2024	2.40	4. 2027	2.40
2. 2025	1.80	5.	
3. 2026	1.80		

*Overall Objectives : Using community-driven, participatory methods and approaches, this project will develop conceptual understandings and measures of scientific and environmental literacy that center the voices and experiences of youth of color. In addition, we will use developed measures to examine the impact of outdoor science and environmental education experiences on youth, and in particular aim to understand how youth of color make meaning of their experiences.

*Statement of Potential Overlap : this proposal

Effective 10/04/2021 NSF CURRENT AND PENDING SUPPORT OMB-3145-0058

*PI/co-PI/Senior Personnel Name: Romero, Valeria Fike

***Required fields**

Note: NSF has provided 15 project/proposal and 10 in-kind contribution entries for users to populate. Please leave any unused entries blank.

Project/Proposal Section:

Current and Pending Support includes all resources made available to an individual in support of and/or related to all of his/her research efforts, regardless of whether or not they have monetary value.[1] Information must be provided about all current and pending support, including this project, for ongoing projects, and for any proposals currently under consideration from whatever source, irrespective of whether such support is provided through the proposing organization or is provided directly to the individual. This includes, for example, Federal, State, local, foreign, public or private foundations, non-profit organizations, industrial or other commercial organizations, or internal funds allocated toward specific projects. Concurrent submission of a proposal to other organizations will not prejudice its review by NSF, if disclosed.[2]

[1] If the time commitment or dollar value is not readily ascertainable, reasonable estimates should be provided.
[2] The Biological Sciences Directorate exception to this policy is delineated in PAPPG Chapter II.D.2.

Projects/Proposals

1. *Project/Proposal Title : Working Toward Equitable Organizations: Building Capacity for Leadership of Color in Outdoor and Environmental Science Education

*Status of Support : (•) Current ( ) Pending ( ) Submission Planned ( ) Transfer of Support

Proposal/Award Number (if available): 2005829

*Source of Support: National Science Foundation

*Primary Place of Performance : University of California, Berkeley

Project/Proposal Start Date (MM/YYYY) (if available) : 09/2020

Project/Proposal End Date (MM/YYYY) (if available) : 08/2023

*Total Award Amount (including Indirect Costs): $ 1,999,323

*Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1. 2021	3.60	4.	
2. 2022	3.60	5.	
3. 2023	3.60		

*Overall Objectives : Addresses inequities in the outdoor and environmental science education by broadening participation of people of color, including African Americans, Latinx, and Native Americans in the leadership and staff of outdoor science programs (OSP) by supporting the development of vertical leadership teams to create and sustain equitable, inclusive, and culturally relevant workplaces and learning environments, and 2) supporting professionals of color currently working in participating OSPs.

*Statement of Potential Overlap : There is no known overlap between this project and the proposed project in terms of scope, budget, or person-months planned.

Projects/Proposals

2. *Project/Proposal Title : Youth Engaged in STEM and Service (YESS)

*Status of Support : (•) Current ( ) Pending ( ) Submission Planned ( ) Transfer of Support

Proposal/Award Number (if available): 1949586

*Source of Support: National Science Foundation

*Primary Place of Performance : University of California, Berkeley

Project/Proposal Start Date (MM/YYYY) (if available) : 09/2020

Project/Proposal End Date (MM/YYYY) (if available) : 08/2024

*Total Award Amount (including Indirect Costs): $ 1,471,693

*Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1. 2021	1.80	4. 2024	1.80
2. 2022	1.80	5.	
3. 2023	1.80		

*Overall Objectives : Project team is co-designing and implementing two summer camp models that engage youth in project-based learning experiences through the lens of either (1) local relevance or (2) global service learning. The research examines the design, development and implementation of the summer camp models. In addition, the research draws on quasi-experimental mixed methods approach to examine the impact of camp experiences on youth's cognitive and social-emotional outcomes.

*Statement of Potential Overlap : There is no known overlap between this project and the proposed project in terms of scope, budget, or person-months planned.

Projects/Proposals

3. *Project/Proposal Title : Advancing Organization Transformation for Racial Equity in Environmental Education

*Status of Support : ○ Current ◉ Pending ○ Submission Planned ○ Transfer of Support

Proposal/Award Number (if available):

*Source of Support: Spencer Foundation (RPP)

*Primary Place of Performance : University of California, Berkeley

Project/Proposal Start Date (MM/YYYY) (if available) : 08/2023

Project/Proposal End Date (MM/YYYY) (if available) : 07/2026

*Total Award Amount (including Indirect Costs): $ 397,899

*Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1. 2024	1.40	4.	
2. 2025	1.40	5.	
3. 2026	1.40		

*Overall Objectives : Conducts a landscape assessment to understand the current state of racial equity and justice within the environmental education (EE) field across the United States.

*Statement of Potential Overlap : There is no known overlap between this project and the proposed project in terms of scope, budget, or person-months planned.

Projects/Proposals

4. *Project/Proposal Title : Calendar in the Sky: Learning Astronomy from Indigenous Mexican Cultures

*Status of Support : ○ Current ◉ Pending ○ Submission Planned ○ Transfer of Support

Proposal/Award Number (if available):

*Source of Support: Institute of Museum and Library Services

*Primary Place of Performance : University of California, Berkeley

Project/Proposal Start Date (MM/YYYY) (if available) : 09/2023

Project/Proposal End Date (MM/YYYY) (if available) : 08/2026

*Total Award Amount (including Indirect Costs): $ 1,394,140

*Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1. 2024	2.40	4.	
2. 2025	2.40	5.	
3. 2026	2.40		

*Overall Objectives : Calendar in the Sky will engage local communities in learning about astronomical traditions of Mexican & Central American cultures. We will work with local Mexican & Central American communities to co-design programming in the Planetarium at the Lawrence Hall of Science and in Festivals, outreach events held within community neighborhoods. Project activities will result in a series of learning guides and best practices about how to co-design astronomy-focused museum programming.

*Statement of Potential Overlap : There is no known overlap between this project and the proposed project in terms of scope, budget, or person-months planned.

Projects/Proposals

5. *Project/Proposal Title : DTI: Justice and Equity Centered Online Learning Design: Attending to ethics and collaboration in AI systems learning

*Status of Support : ○ Current ◉ Pending ○ Submission Planned ○ Transfer of Support

Proposal/Award Number (if available): 2241576

*Source of Support: National Science Foundation

*Primary Place of Performance : University of California, Berkeley

Project/Proposal Start Date (MM/YYYY) (if available) : 09/2023

Project/Proposal End Date (MM/YYYY) (if available) : 08/2026

*Total Award Amount (including Indirect Costs): $ 1,294,766

*Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1. 2024	2.40	4.	
2. 2025	2.40	5.	
3. 2026	2.40		

*Overall Objectives : Design, test, and iteratively revise TechHive:AI, a learning experience for high school aged youth that integrates AI technical learning with ethics principles.

*Statement of Potential Overlap : There is no known overlap between this project and the proposed project in terms of scope, budget, or person-months planned.

Projects/Proposals

6. *Project/Proposal Title : Understanding the Impact of Outdoor Science and Environmental Learning Through Community-Driven Outcomes (this proposal)

*Status of Support : ○ Current ◉ Pending ○ Submission Planned ○ Transfer of Support

Proposal/Award Number (if available):

*Source of Support: National Science Foundation

*Primary Place of Performance : University of California, Berkeley

Project/Proposal Start Date (MM/YYYY) (if available) : 01/2024

Project/Proposal End Date (MM/YYYY) (if available) : 12/2027

*Total Award Amount (including Indirect Costs): $ 1,998,891

*Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1. 2024	3.00	4. 2027	3.00
2. 2025	2.40	5.	
3. 2026	2.40		

*Overall Objectives : Using community-driven, participatory methods and approaches, this project will develop conceptual understandings and measures of scientific and environmental literacy that center the voices and experiences of youth of color. In addition, we will use developed measures to examine the impact of outdoor science and environmental education experiences on youth, and in particular aim to understand how youth of color make meaning of their experiences.

*Statement of Potential Overlap : this proposal

Projects/Proposals

7. *Project/Proposal Title : Working Toward Racial Equity:
Building Capacity to Institutionalize Equity in Outdoor and Environmental Science Education

*Status of Support : ○ Current ◉ Pending ○ Submission Planned ○ Transfer of Support

Proposal/Award Number (if available):

*Source of Support: National Science Foundation

*Primary Place of Performance : University of California, Berkeley

Project/Proposal Start Date (MM/YYYY) (if available) : 01/2024

Project/Proposal End Date (MM/YYYY) (if available) : 12/2028

*Total Award Amount (including Indirect Costs): $ 4,036,340

*Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1. 2024	2.40	4. 2027	2.40
2. 2025	2.40	5. 2028	2.40
3. 2026	2.40		

*Overall Objectives : Addresses debilitating racial inequities in the OESE field by increasing the capacity of organizations to build more racially just and equitable work environments through a multi-phase cohort-based professional learning approach as well as the creation of a Racial Equity Transformation Tool Kit.

*Statement of Potential Overlap : There is no known overlap between this project and the proposed project in terms of scope, budget, or person-months planned.

Projects/Proposals

8. *Project/Proposal Title : Transforming Leadership Structures to Disrupt Systemic Racism by Elevating Staff of Color in Informal Science Education

*Status of Support : ○ Current ◉ Pending ○ Submission Planned ○ Transfer of Support

Proposal/Award Number (if available):

*Source of Support: National Science Foundation

*Primary Place of Performance : University of California, Berkeley

Project/Proposal Start Date (MM/YYYY) (if available) : 07/2023

Project/Proposal End Date (MM/YYYY) (if available) : 06/2028

*Total Award Amount (including Indirect Costs): $

*Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1.		4.	
2.		5.	
3.			

*Overall Objectives : This project will generate (1) a theoretical understanding of leadership that centers the voices and experiences of staff of color in informal science education, (2) learnings about what it takes to build organizational and individual capacities to examine, discern, and transform racialized systems, and (3) a case study that explores the ways in which a university-affiliated science institution can work to enact racially just notions and structures of leadership that elevates and supports Staff of Color.

*Statement of Potential Overlap : There is no known overlap between this project and the proposed project in terms of scope, budget, or person-months planned.

Table 1

1	Your Name:	Your Organizational Affiliation(s), last 12 mo	Last Active Date
	Collins, Melissa A.	University of California, Berkeley	

Table 2

2	Name:	Type of Relationship	Optional (email, Department)	Last Active Date

Table 3

3	Advisor/Advisee Name:	Organizational Affiliation	Optional (email, Department)
G	Laski, Elida	Boston College	elida.laski@bc.edu
T	Vasilyeva, Marina	Boston College	marina.vasilyeva@bc.edu
T	Paez, Mariela	Boston College	mariela.paez@bc.edu

Table 4

4	Name:	Organizational Affiliation	Optional (email, Department)	Last Active Date
C	Hartry, Ardice	University of California, Berkeley		
A	Cannady, Matthew	University of California, Berkeley		
A	Dorph, Rena	University of California, Berkeley		
A	Romero, Valeria	University of California, Berkeley		
A	Pande, Aparajita	Northwestern University		
A	Laski, Elida	Boston College		
A	Coley, Rebekah	Boston College		
A	Votruba-Drzal, Elizabeth	University of Pittsburgh		
A	DeMeo Cook, Kyle	Education Development Center		
A	Nava, Rosalinda	University of California, Berkeley		
A	Pedroso, Rosio	Pedroso Consulting, Inc.		
A	Chi, Bernadette	Independent Consultant		
A	Sacco, Kalie	University of California, Berkeley		
A	Miller, Portia	University of Pittsburgh		
A	Totino, Joanna	University of California, Berkeley		
A	Foreman, Jedda	University of California, Berkeley		
A	Young, Aujanee	University of California, Berkeley		

A	Strang, Craig	University of California, Berkeley		
A	Hurt, Tim	University of California, Berkeley		
A	Greenwald, Eric	University of California, Berkeley		
A	Allan, Sara	University of California, Berkeley		
A	Brodsky, Lauren	University of California, Berkeley		
C	Asturias, Harold	University of California, Berkeley		
C	Mayfield-Ingram, Karen	University of California, Berkeley		
C	Ford, Ben	Sonoma State University		
C	Virmani, Rajeev	Sonoma State University		
C	Wang, Ning	University of Southern California		
C	Pynadath, David	University of Southern California		

Table 5

5	Name:	Organizational Affiliation	Journal/Collection	Last Active Date

Table 1

1	Your Name:	Your Organizational Affiliation(s), last 12 mo	Last Active Date
	Foreman, Jedda	University of California, Berkeley	

Table 2

2	Name:	Type of Relationship	Optional (email, Department)	Last Active Date
R				

Table 3

3	Advisor/Advisee Name:	Organizational Affiliation	Optional (email, Department)
G			
T			

Table 4

4	Name:	Organizational Affiliation	Optional (email, Department)	Last Active Date
C	Dorph, Rena	University of California, Berkeley		
A	Strang, Craig	University of California, Berkeley		
C	Lujan, Vanessa	University of California, Berkeley		
A	Olsen, Sarah	University of California, Berkeley		
C	Beals, Kevin	University of California, Berkeley		
A	Romero, Valeria	University of California, Berkeley		
A	Mitchell, Betsy	University of California, Berkeley		
C	Lygren, Emilie	University of California, Berkeley		
C	Pedemonte, Sarah	University of California, Berkeley		
A	Elkin, Terri	Alameda Unified School District		
C	Storksdieck, Martin	Oregon State University		
A	Rodriguez, Laura	Justice Outside		
A	Payan, Rena	Justice Outside		
A	Moore Bailey, Kim	Justice Outside		
C				
C				

Table 5

5	Name:	Organizational Affiliation	Journal/Collection	Last Active Date

B	John Quay	University of Melbourne	Journal of Outdoor and Environmental Education	
E	Tonia Gray	Western Sydney University	Journal of Outdoor and Environmental Education	

Table 1

1	Your Name:	Your Organizational Affiliation(s), last 12 mo	Last Active Date
	Romero, Valeria	University of California, Berkeley	

Table 2

2	Name:	Type of Relationship	Optional (email, Department)	Last Active Date
R	Kelly, Greg	Mentor	Pennsylvania State University	
R				
R				
R				

Table 3

3	Advisor/Advisee Name:	Organizational Affiliation	Optional (email, Department)
G	Patterson, Alexis	UC Davis	School of Education
G	Quijada, Patricia	UC Davis	School of Education
G	Martinez, Danny C.	UC Davis	School of Education
G	McAfee, Myosha	The Equitect	

Table 4

4	Name:	Organizational Affiliation	Optional (email, Department)	Last Active Date
A	Strang, Craig	University of California, Berkeley		
A	Foreman, Jedda	University of California, Berkeley		
A	Rodriguez, Laura	Justice Outside		
A	Collins, Melissa	University of California, Berkeley		
A	Olsen, Sarah	University of California, Berkeley		
A	Grindstaff, Kelly	University of California, Berkeley		
A	Cannady, Matthew	University of California, Berkeley		
C	Chi, Bernadette	Independent Consultant		
C	Dorph, Rena	University of California, Berkeley		
C	Hartry, Ardice	University of California, Berkeley		
C	Voussougi, Shirin	Northwestern University		
A	Young, Aujanee	University of California, Berkeley		
A	Sanchez, Alex	University of California, Berkeley		
C	Koo, Ben	University of California, Berkeley		
C	Mayfield, Karen	University of California, Berkeley		

C	Garibay, Cecila	Garibay Group		
C	Arnold, Michael	Informing Change		
C				
C				
C				

Table 5

5	Name:	Organizational Affiliation	Journal/Collection	Last Active Date
B	George Julnes		American Journal of Evaluation	
B	Tonia Gray		International Journal of Environmental Education	
B	Sherry Southerland		Science Education	
B	John Settlage		Science Education	

Understanding the Impact of Outdoor Science and Environmental Learning Experiences Through Community-Driven Outcomes

Submitted to the National Science Foundation (NSF), solicitation NSF 22-626

Submitted by: Melissa Collins, Ph.D. (Principal Investigator), Valeria Romero, M.A. (Co-Principal Investigator), and Jedda Foreman, M.B.A. (Co-Principal Investigator)
The Lawrence Hall of Science • University of California, Berkeley

Data Management Plan

Data Description. The proposed project will include human subjects data consisting of (1) audio recordings from semi-structured interviews with key stakeholders (e.g., youth, educators, alumni, family, and/or community members); (2) audio recordings from focus group interviews with key stakeholders; (3) youth survey data, including demographic information, collected either on paper or electronically through an online database; (4) educator survey data, including demographic information, collected either on paper or electronically through an online database; (5) observation notes collected during learning experiences; (6) review of documents, products, meeting notes, and artifacts from Community Research Network discussions; and (7) project related metadata (e.g., interview and observational protocols, syntax for statistical analyses).

Responsibility. The principal investigators (PIs) will have overall responsibility for data management and dissemination over the course of the research project and will monitor compliance with the plan. In the case that the PIs leave UC Berkeley, they will take the data with them and implement an analogous data management plan at the transfer institution.

Data Storage. All data collected will be stored securely in compliance with the University of California Office for the Protection of Human Subjects. Paper data, including observation notes, interview notes and transcripts will be stored, without names, in a locked cabinet. Electronic data will be encrypted and stored on a password-protected server that is only accessible to members of the research and/or evaluation teams. Human subject consent forms will be stored in a locked file cabinet that is only accessible to members of the research and/or evaluation teams.

Confidentiality. Since these data will be from human subjects, approval for human subjects research will be obtained through UC Berkeley's institutional review boards. Whenever possible, data will be collected anonymously. Names will not be used in any study data. When it is necessary to link data over time or across data sources (e.g., youth survey and focal youth interview), to protect subject confidentiality, each subject will be assigned an arbitrary code, which will be included with data instead of names. One file or key that contains the correspondence between subject names and codes will be kept in an encrypted password-controlled file and stored separately from the data. After the completion of data collection, this file will be deleted.

Only members of the project teams, including the PIs, Co-PIs, and Research Assistants, will have access to participants' identities. These personnel must have access to participant names, addresses, and telephone numbers in order to perform their duties (i.e., maintaining follow-up contact with participants). Contact information will be encrypted, password protected, and stored separately from study data. All such staff members will be required to pass the CITI course and have current CITI certification. All data

will be presented in an aggregated format so that no person or school can be identified. To maintain the privacy of the participants, any report of individual responses, such as quotes, will be reported with pseudonyms.

Data Access and Sharing. Upon completion of the project, members of the project analysis team will have exclusive access to the data for ten years. During this time, the team will (1) analyze data to address specific aims; and (2) conceptualize, present, write and publish the study findings. If requested, access to the de-identified data will be provided by contacting the PI. Data will, in principle, be available for access and sharing as soon as is reasonably possible, normally not longer than one year after publication. Where possible given desire to maintain confidentiality, anonymized data will be made generally available without requiring an explicit request by a third party through a project associated website. Any data collected by the research team and subsequently shared with the External Evaluator will be deidentified before being shared.

The data acquired and preserved in the context of this proposal will be further governed by the University of California's policies pertaining to intellectual property, record retention, and data management, and constraints imposed by the University of California's IRB. We do not anticipate that significant intellectual property issues involved with these data will arise. Reports or publications resulting from the project will be submitted to NSF and be made available through research conferences and journals. However, in the event that discoveries or inventions are made in direct connection with these data, access to the data will be granted upon request once appropriate invention disclosures and/or provisional patent filings are made.

Products produced by this project. The proposed project will result in validated youth outcome measures (such as survey scales), a conceptual framework, and an educator survey available for use by education researchers and OSEL professionals.

Dissemination of products. The proposed project will disseminate research findings to education research and outdoor science education and environmental learning (OSEL) audiences, as well as families and community members tied to OSEL programming. Research and OSEL audiences will be reached through multiple channels including journal articles, conferences, websites, and online communities to share what we have developed and lessons learned. The PI team will leverage its existing network of OSEL professionals to ensure wide dissemination. Families and community members related to OSEL programming will be reached through summary reports shared by OSEL partners. Products will also be made available on the Lawrence Hall of Science website and social media accounts, as well as our partner organizations' websites and online community websites, as appropriate. Educational products developed through this grant as well as derivative products will become property of the Regents of the University of California.

Understanding the Impact of Outdoor Science and Environmental Learning Experiences Through Community-Driven Outcomes

Supplementary Documents

Table of Contents

Understanding the Impact of Outdoor Science and Environmental Learning Experiences Through Community-Driven Outcomes

A proposal submitted to the National Science Foundation (NSF 22-626) Program

Submitted by:

PI Melissa Collins and Co-PIs: Valeria Fike Romero and Jedda Foreman
The Lawrence Hall of Science • University of California, Berkeley

List of All Personnel and Institutions Participating in the Project

1. Melissa Collins; Lawrence Hall of Science, University of California, Berkeley; PI
2. Valeria Fike Romero; Lawrence Hall of Science, University of California, Berkeley; co-PI
3. Jedda Foreman; Lawrence Hall of Science, University of California, Berkeley; co-PI
4. Alex Sanchez; Lawrence Hall of Science, University of California, Berkeley; Research Coordinator
5. Corinne Calhoun; Lawrence Hall of Science, University of California, Berkeley; Project Coordinator
6. Craig Strang; Lawrence Hall of Science, University of California, Berkeley; Environmental Learning Expert
7. Tim Hurt; Lawrence Hall of Science, University of California, Berkeley; Data Analyst
8. Bernadette Chi; Chi Evaluation; Evaluator
9. Andres Lopez; Coalition of Communities of Color; Research and Data Justice Consultant
10. Mira Mohsinil; Coalition of Communities of Color; Research and Data Justice Consultant
11. Laura Rodriguez; Justice Outside; Advisor
12. Marc J. Stern; Virginia Tech, College of Natural Resources and Environment; Advisor
13. Cathy Jordan; Children and Nature Network; Advisor
14. Eric Aaholm; YES Nature to Neighborhoods; Partner
15. Blanca Hernandez; YES Nature to Neighborhoods; Partner
16. Tish Carr; University of Maine, Wabanaki Youth in Science; Partner
17. Phillip Kilbridge, NatureBridge, Partner
18. Miho Aida, NatureBridge, Partner

BERNADETTE CHI, PH.D. *CONSULTANT*

1463 Mountain Boulevard, Oakland, CA 94611 bchiconsulting@gmail.com 510-693-6981

December 9, 2022

Melissa Collins
Lawrence Hall of Science
University of California
Berkeley, CA 94720-5200

RE: Letter of Commitment

If the proposal submitted by Dr. Melissa Collins entitled *Understanding the Impact of Outdoor Science and Environmental Learning Experiences Through Community-Driven Outcomes* is selected for funding by NSF, it is my intent to collaborate and/or commit resources as detailed in the Project Description or the Facilities, Equipment and Other Resources section of the proposal.

Sincerely,

Bernadette Chi, PhD
Independent Consultant

Coalition of Communities of Color

13 December 2022

Andres Lopez, PhD
Research Director
Coalition of Communities of Color
221 NW 2nd Ave., Ste 303
Portland, OR 97209

If the proposal submitted by Melissa Collins entitled *Understanding the Impact of Outdoor Science and Environmental Learning Through Community-Driven Outcomes* is selected for funding by NSF, it is my intent to collaborate as detailed in the Project Description.

The Research Justice Institute (RJI) is the research arm of the Coalition of Communities of Color (CCC) in Portland, Oregon. Formed in 2001, the CCC is an alliance of culturally-specific community based organizations with representation from the following communities of color: African, African American, Asian, Latino, Middle Eastern and North African, Native American, Pacific Islander, and immigrant and refugee populations. The CCC supports a collective racial justice effort to improve outcomes for communities of color through policy analysis and advocacy, environmental justice, culturally-appropriate data and research, and leadership development in communities of color.

The RJI works towards research and data justice by conducting research that defers to BIPOC communities, elevates the everyday knowledge and strategies of BIPOC communities as data, and bridges the divide between community and dominant institutions through the power and uses of community data. The RJI conducts various community-led research projects, provides expert consultation to public and private institutions, and builds the research and data capacity of member and non-member organizations.

Andres Lopez, PhD

JUSTICE OUTSIDE

December 12, 2022

Melissa Collins
Lawrence Hall of Science
University of California
Berkeley, CA 94720-5200

If the proposal submitted by Melissa Collins entitled *Understanding the Impact of Outdoor Science and Environmental Learning Through Community-Driven Outcomes* is selected for funding by NSF, it is my intent to collaborate as an advisor.

I understand that the purpose of the Advisory Board is to provide an external review of key project instruments. As a member of the Advisory Board, I will participate in yearly meetings, as well as periodic reviews of research, design concepts, and content materials.

Regarding my qualification to serve as an advisor, I am the Chief Program Officer for Justice Outside, and have been with the organization for eight years. Within that time, I have supported and collaborated with dozens of non-profit organizations within the outdoor science and environmental education fields with their equity, inclusion, and justice initiatives. I have additionally served as project lead within our partnerships with the Lawrence Hall of Science for over five years.

Sincerely,

Laura Rodriguez,
Chief Program Officer

1624 Franklin St Suite 520
Oakland, CA 94612
info@justiceoutside.org

T 510.839.0731
F 510.839.0651
justiceoutside.org

Submitted/PI: Melissa A Collins /Proposal No: 2314075

UNIVERSITY OF MINNESOTA

Institute on the Environment

325 LES Bldg
1954 Buford Avenue
St. Paul, MN 55108
612-626-9553

December 7, 2022

Melissa Collins
Lawrence Hall of Science
University of California
Berkeley, CA 94720-5200

If the proposal submitted by Melissa Collins entitled *Understanding the Impact of Outdoor Science and Environmental Learning Through Community-Driven Outcomes* is selected for funding by NSF, it is my intent to collaborate as an advisor.

I understand that the purpose of the Advisory Board is to provide an external review of key project instruments. As a member of the Advisory Board, I will participate in yearly meetings, as well as periodic reviews of research, design concepts, and content materials.

Regarding my qualification to serve as an advisor, in addition to my role as the Director for Leadership Development & Sustainability Education at the University of Minnesota's Institute on the Environment, I serve as the Consulting Director of Research for the Children & Nature Network. I have previous NSF funding to study the impact of outdoor science learning. I am well-versed with the literature on nature-based learning and environmental education, have practical experience with outdoor science learning, and with community engagement and participatory processes.

Cathy Jordan

Cathy Jordan, PhD
Director of Leadership & Education, Institute on the Environment
Consulting Director of Research, Children & Nature Network
Jorda003@umn.edu
651-334-3973

COLLEGE OF NATURAL RESOURCES AND ENVIRONMENT
FOREST RESOURCES AND ENVIRONMENTAL CONSERVATION
VIRGINIA TECH.

Forest Resources and Environmental Conservation
310 West Campus Drive
Blacksburg, Virginia 24061
P: (540) 231-7418
mjstern@vt.edu

December 8, 2022

Melissa Collins
Lawrence Hall of Science
University of California
Berkeley, CA 94720-5200

If the proposal submitted by Melissa Collins entitled *Understanding the Impact of Outdoor Science and Environmental Learning Through Community-Driven Outcomes* is selected for funding by NSF, it is my intent to collaborate as an advisor.

I understand that the purpose of the Advisory Board is to provide an external review of key project instruments. As a member of the Advisory Board, I will participate in yearly meetings, as well as periodic reviews of research, design concepts, and content materials.

Regarding my qualification to serve as an advisor, I am an expert in survey research methods and instrument design, particularly within the realm of environmental education and informal science learning, having published over 40 peer-reviewed journal articles specifically within this domain. I have also taught Social Science Research Methods graduate level courses for nearly 20 years.

Sincerely,

Marc J. Stern, Professor

Submitted/PI: Melissa A Collins /Proposal No: 2314075

NatureBridge

naturebridge.org

December 2, 2022

Melissa Collins
Lawrence Hall of Science
University of California
Berkeley, CA 94720-5200

If the proposal submitted by Melissa Collins entitled Understanding the Impact of Outdoor Science and Environmental Learning Through Community-Driven Outcomes is selected for funding by NSF, it is NatureBridge's intent to collaborate as detailed in the Project Description.

NatureBridge connects over 35,000 students and 700 schools each year to the wonder and science of the natural world, igniting self-discovery and inspiring stewardship of our planet. We operate in Yosemite National Park and the Golden Gate National Recreation Area in California, Olympic National Park in Washington, and Prince William Forest Park in Virginia.

As the largest education partner of the National Park Service, we are proud to support their mission to preserve unimpaired the natural and cultural resources and values of the National Park System for the enjoyment, education and inspiration of this and future generations.

Phillip Kilbridge
President & CEO

28 Geary Street, Suite 650
San Francisco, CA 94108
TEL 415-992-4700
FAX 415-992-4711

Founded as Yosemite Institute in 1971

YOSEMITE • GOLDEN GATE • OLYMPIC • SANTA MONICA MOUNTAINS • CHANNEL ISLANDS • PRINCE WILLIAM FOREST

YES
Nature to Neighborhoods

November 30, 2022

Melissa Collins
Lawrence Hall of Science
University of California
Berkeley, CA 94720-5200

To Whom It May Concern:

If the proposal submitted by Melissa Collins entitled *Understanding the Impact of Outdoor Science and Environmental Learning Through Community-Driven Outcomes* is selected for funding by NSF, it is my intent to collaborate as detailed in the Project Description.

In partnership with nature, YES Nature to Neighborhoods (YES) nurtures leaders who champion the wellbeing of our community. YES was founded in 1999 as a summer enrichment program, and quickly expanded to provide wraparound support for youth to attend weeklong nature-based summer camps. Rooted in the belief that profound experiences in nature are a catalyst for individual and community transformation, YES has evolved to provide year-round outdoor and leadership development programming, aligned within a progressive leadership pathways model for underrepresented youth, adults, and families of color.

Our 10-year Youth Leadership Pathways model provides youth ages 8-18, and their families, with progressive experiences in both nearby nature and wild places, while providing mentoring, education, and wrap-around support through a cultural and historical lens.

If selected, YES's Executive Director, Eric Aaholm, and Director of Programs & Partnerships, Blanca Hernandez, will serve as lead stewards of the project and serve on the advisory council. Together, Eric and Blanca have over 30 years of experience at YES and have worked on multiple projects with the Lawrence Hall of Science.

Sincerely,

Eric Aaholm
Executive Director

3029 Macdonald Avenue, Richmond, CA 94804 | 510.232.3032 | www.yesfamilies.org

WABANAKI YOUTH IN SCIENCE

Integrating Wabanaki Traditional Cultural Knowledge with Technology and Science

December 19, 2022

Melissa Collins, Ph.D.
Lawrence Hall of Science
University of California
Berkeley, CA 94720-5200

Dear Dr. Collins,

If the proposal submitted by Melissa Collins entitled *Understanding the Impact of Outdoor Science and Environmental Learning Through Community-Driven Outcomes* is selected for funding by NSF, it is the intent of the Wabanaki Youth in Science (WaYS) to collaborate as detailed in the Project Description.

The Wabanaki Youth in Science (WaYS) program is a grassroots, community-based educational model that started in 2013 with initial financial support from the National Science Foundation's Experimental Program to Stimulate Competitive Research (NSF EPSCoR). The last nine years have seen consistent growth in the involvement of Maine Native youth to persist in science through collaborations with Cultural Knowledge Sharers (CKS) and western science professionals at camps, after-school programs, and internships. Over that time, with the dedicated support from the Wabanaki communities and multiple grants to support WaYS, the program has seen a dramatic increase in the number of students working on long-term natural resource programs within their individual communities. The program has not only opened doors to potential careers in natural resources but taught the value that cultural science brings to the western science perspective.

The hands-on learning is accomplished through a multi-prong approach with one week-long earth camp during the summer, three weekend mini-camps in spring, fall, and winter: after-school programs, and internships. All of these programs incorporate our preferred means of learning by being hands-on, place-based that integrates CKS and western resource professionals in an outdoor learning environment.

Regards,

tish carr, Ph.D.
Executive Director

List of Suggested Reviewers

Data Not Available

List of Reviewers Not to Include

Data Not Available

EXHIBIT B

NATIONAL SCIENCE FOUNDATION

Award Notice

Award Number (FAIN): 2314075
Managing Division Abbreviation: DRL **Amendment Number:** 000

RECIPIENT INFORMATION

Recipient (Legal Business Name): REGENTS OF THE UNIVERSITY OF CALIFORNIA, THE
Recipient Address: 1608 4TH ST STE 201 BERKELEY, CA 94710-1749
Official Recipient Email Address: spoawards@berkeley.edu
Unique Entity Identifier (UEI): GS3YEVSS12N6

AMENDMENT INFORMATION

Amendment Type: New Project
Amendment Date: 08/22/2023
Amendment Number: 000
Proposal Number: 2314075
Amendment Description:

The National Science Foundation hereby awards a Continuing Grant for support of the project described in the proposal referenced above as modified by revised budget dated 07/18/2023.

No work with human subjects, including recruitment, may be conducted under this protocol or grant until IRB approval has been obtained.

Incentive payments or gifts to participants must be made in accordance with written institutional policies and procedures and supported by auditable documentation. The allowability of these costs will ultimately be based on the awardee institution's ability to adequately demonstrate that the incentives have been disbursed in accordance with its policies and procedures.

Costs of entertainment, amusement, diversion and social activities, and any costs directly associated with such activities (such as meals, lodging, rentals, transportation and gratuities) are unallowable. When certain meals are an integral and necessary part of a conference or meeting (i.e., working meals where business is transacted), grant funds may be used for such meals. Grant funds may also be used to furnish a reasonable amount of coffee or soft drinks for conference or meeting participants and attendees during coffee breaks.

No NSF funds may be spent on meals or coffee breaks for intramural meetings of an organization or any of its components, including, but not limited to, laboratories, departments and centers.

PIs are required to submit the final Summative Evaluation of or other knowledge-building product(s) from the project for posting to the web site http://www.informalscience.org (or other sites designated by AISL) as part of submission of the Final Report. Final reports will not be approved before the

summative evaluation/knowledge-building products are posted for the project. As a condition of this award, the grantee agrees to work with an NSF third-party evaluator for the purpose of program evaluation.

Broadcasts and all other materials produced as a part of this project, including digital media and World Wide Web pages, must include a clear indication of the source of support and must include the NSF logo all in a manner to be approved by NSF. NSF credits normally should be included at both the heads and tails of both broadcast and non-broadcast programs and placed on the cover of cover of publications. All promotional materials for the project produced under the control of the grantee must include NSF funding credit. All television programs must have closed captions encoded on the master and broadcast with closed captions.

AWARD INFORMATION

Award Number (FAIN): 2314075
Award Instrument: Continuing Grant
Award Date: 08/22/2023
Award Period of Performance: Start Date: 01/01/2024 End Date: 12/31/2027
Project Title: Understanding the Impact of Outdoor Science and Environmental Learning Experiences Through Community-Driven Outcomes
Managing Division Abbreviation: DRL
Research and Development Award: Yes
Funding Opportunity: NSF 22-626 Advancing Informal STEM Learning
Assistance Listing Number(s) and Name(s): 47.076 Education and Human Resources (Predominant source of funding for SEFA reporting)

FUNDING INFORMATION

Amount Obligated by this Amendment: $1,583,195
Total Intended Award Amount: $2,149,437
Total Approved Cost Share or Matching Amount: $0
Total Amount Obligated to Date: $1,583,195
Expenditure Limitation: Not Applicable

Contingent on the availability of funds and scientific progress of the project, NSF expects to continue support at approximately the following level:

Fiscal Year	Increment Amount
2026	$566,242

PROJECT PERSONNEL

Principal Investigator: Melissa A Collins	**Email:** macollins@berkeley.edu	**Organization:** REGENTS OF THE UNIVERSITY OF CALIFORNIA, THE
co-Principal Investigator:	**Email:** valeriafr@berkeley.edu	**Organization:** REGENTS OF

Valeria Romero

THE UNIVERSITY OF CALIFORNIA, THE

co-Principal Investigator:
Jedda Foreman

Email: jforeman@berkeley.edu

Organization: REGENTS OF THE UNIVERSITY OF CALIFORNIA, THE

NSF CONTACT INFORMATION

Managing Grants Official
(Primary Contact)
Name: Cartia Brown-Morgan
Email: cbrownmo@nsf.gov
Phone: (703) 292-8709

Awarding Official
Name: Denise M. Martin
Email: dmartin@nsf.gov

Managing Program Officer
Name: Ellen L McCallie
Email: emccalli@nsf.gov
Phone: (703) 292-5115

GENERAL TERMS AND CONDITIONS

This is awarded pursuant to the authority of the National Science Foundation Act of 1950, as amended (42 U.S.C. 1861-75) and is subject to Research Terms and Conditions (RTCs) dated 11/12/2020, and NSF Agency Specific Requirements, dated 01/30/2023, available at https://www.nsf.gov/awards/managing/rtc.jsp.

This institution is a signatory to the Federal Demonstration Partnership (FDP) Phase VI Agreement which requires active institutional participation in new or ongoing FDP demonstrations and pilots.

This award is made in accordance with the provisions of NSF Solicitation: NSF 22-626 Advancing Informal STEM Learning.

BUDGET

A. Senior Personnel	
Senior Personnel Count	9.00
Senior Personnel Calendar Months	27.00
Senior Personnel Academic Months	0.00
Senior Personnel Summer Months	0.00
Senior Personnel Amount	$316,351
B. Other Personnel	
Post Doctoral Scholars	
Post Doctoral Count	0.00
Post Doctoral Calendar Months	0.00
Post Doctoral Academic Months	0.00

Post Doctoral Summer Months	0.00
Post Doctoral Amount	$0
Other Professionals	
Other Professionals Count	9.00
Other Professionals Calendar Months	30.20
Other Professionals Academic Months	0.00
Other Professionals Summer Months	0.00
Other Professionals Amount	$238,478
Graduate Students	
Graduate Students Count	0.00
Graduate Students Amount	$0
Undergraduate Students	
Undergraduate Students Count	3.00
Undergraduate Students Amount	$4,250
Secretarial - Clerical	
Secretarial - Clerical Count	0.00
Secretarial - Clerical Amount	$0
Other	
Other Count	0.00
Other Amount	$0
Total Salaries and Wages (A+B)	$559,079
C. Fringe Benefits	$203,107
Total Salaries, Wages, Fringe Benefits (A + B + C)	$762,186
D. Equipment	$0
E. Travel	
Domestic	$31,790
International	$0
F. Participant Support Costs	
Participant Support Costs Stipends	$0
Participant Support Costs Travel	$0
Participant Support Costs Subsistence	$0
Participant Support Costs Other	$0
Total Number of Participants	0.00
Total Participant Costs (F)	$0
G. Other Direct Costs	
Materials Supplies	$6,100

Publication Costs	$0
Consultant Services	$78,090
Computer Services	$0
Subawards	$0
Other	$108,240
Total Other Direct Costs (G)	$192,430
H. Total Direct Costs (A Through G)	**$986,406**
I. Indirect Costs*	**$596,789**
J. Total Direct and Indirect Costs (H + I)	$1,583,195
K. Fees	$0
L. Total Amount of Request (J) OR (J + K)	**$1,583,195**
M. Cost Sharing Proposed Level	$0

*Indirect Cost Rates

Item Name	Indirect Cost Rate
Modified Total Direct Costs	60.5000%

These rates are at the time of award and are based upon the budget submitted to the NSF. It does not include any out-year adjustments. The NSF will not modify awards simply to correct indirect cost rates cited in the award notice. See the Proposal & Award Policies & Procedures Guide (PAPPG) Chapter X.A.3.a. for guidance on re-budgeting authority.

EXHIBIT C

COVER SHEET FOR PROPOSAL TO THE NATIONAL SCIENCE FOUNDATION

PROGRAM ANNOUNCEMENT/SOLICITATION NO./ DUE DATE
NSF 22-634 01/17/2023

☐ Special Exception to Deadline Date Policy

FOR NSF USE ONLY
NSF PROPOSAL NUMBER
2315277

FOR CONSIDERATION BY NSF ORGANIZATION UNIT(S) (Indicate the most specific unit known, i.e. program, division, etc.)
DRL - Racial Equity in STEM Ed

DATE RECEIVED	NUMBER OF COPIES	DIVISION ASSIGNED	FUND CODE	UEI(Unique Entity Identifier)	FILE LOCATION
01/17/2023	1	11090000 DRL	191Y	GS3YEVSS12N6	

EMPLOYER IDENTIFICATION NUMBER (EIN) OR TAXPAYER IDENTIFICATION NUMBER (TIN)
946002123

SHOW PREVIOUS AWARD NO. IF THIS IS
☐ A RENEWAL
☐ AN ACCOMPLISHMENT- BASED RENEWAL

IS THIS PROPOSAL BEING SUBMITTED TO ANOTHER FEDERAL AGENCY? YES ☐ NO ☒ IF YES, LIST ACRONYM(S)

NAME OF ORGANIZATION TO WHICH AWARD SHOULD BE MADE
REGENTS OF THE UNIVERSITY OF CALIFORNIA, THE

AWARDEE ORGANIZATION CODE (IF KNOWN)

ADDRESS OF AWARDEE ORGANIZATION, INCLUDING 9 DIGIT ZIP CODE
1608 4TH ST STE 201
BERKELEY,CA 94710-1749 US

NAME OF PRIMARY PLACE OF PERF
University of California-Berkeley

ADDRESS OF PRIMARY PLACE OF PERF, INCLUDING 9 DIGIT ZIP CODE
1 Centennial Drive
Berkeley,CA 94720-5200 US

IS AWARDEE ORGANIZATION (Check All That Apply)
☐ SMALL BUSINESS
☐ FOR-PROFIT ORGANIZATION
☐ MINORITY BUSINESS
☐ WOMAN-OWNED BUSINESS

☐ IF THIS IS A PRELIMINARY PROPOSAL THEN CHECK HERE

TITLE OF PROPOSED PROJECT
Working Toward Racial Equity: Building Capacity to Institutionalize Equity in Outdoor and Environmental Science Education

SHOW LETTER OF INTENT ID IF APPLICABLE

REQUESTED AMOUNT	PROPOSED DURATION (1-60 MONTHS)	REQUESTED STARTING DATE	SHOW RELATED PRELIMINARY PROPOSAL NO. IF APPLICABLE
$ 4,723,028	60 months	01/01/2024	

THIS PROPOSAL INCLUDES ANY OF THE ITEMS LISTED BELOW

☒ TYPE OF PROPOSAL **Research**
☒ COLLABORATIVE STATUS **Collaborative from one organization**
☐ BEGINNING INVESTIGATOR
☐ DISCLOSURE OF LOBBYING ACTIVITIES
☐ PROPRIETARY & PRIVILEGED INFORMATION
☐ HISTORIC PLACES
☐ LIVE VERTEBRATE ANIMALS IACUC App. Date
PHS AnimalWelfareAssurance Number

☒ HUMAN SUBJECTS
Human Subjects Assurance Number
Exemption Subsection or IRB App. Date **pending**
☐ FUNDING OF INT'L BRANCH CAMPUS OF U.S IHE
☐ FUNDING OF FOREIGN ORGANIZATION OR FOREIGN INDIVIDUAL
☐ INTERNATIONAL ACTIVITIES: COUNTRY/COUNTRIES INVOLVED
☐ POTENTIAL LIFE SCIENCES DUAL USE RESEARCH OF CONCERN
☐ OFF-CAMPUS OR OFF-SITE RESEARCH

PI/PD DEPARTMENT
Jedda Foreman

PI/PD FAX NUMBER

PI/PD POSTAL ADDRESS
1 Centennial Drive
UC Berkeley #5200
Berkeley,CA 94720
US

NAMES(TYPED)	High Degree	Yr of Degree	Telephone Number	EmailAddress
PI/PD NAME **Jedda Foreman**	**MBA**	**2015**	**510-642-7504**	**jforeman@berkeley.edu**
CO-PI/PD Craig Strang	**BA**	**1984**	**510-642-9809**	**cstrang@berkeley.edu**
CO-PI/PD Valeria Romero	**MA**	**2010**	**510-643-1294**	**valeriafr@berkeley.edu**
CO-PI/PD				
CO-PI/PD				

CERTIFICATION PAGE

Certification for Authorized Organizational Representative(or Equivalent)
By electronically signing and submitting this proposal, the Authorized Organizational Representative(AOR) is:(1)certifying that statements made here in are true and complete to the best of the individual's knowledge; and(2)agreeing to accept the obligation to comply with NSF award terms and conditions if an award is made as a result of this proposal. Further, the proposer is hereby providing certifications regarding conflict of interest, flood hazard insurance, responsible and ethical conduct of research, organizational support,and safe and inclusive working environments for off-campus or off-site research, as set forth in the NSF Proposal & Award Policies & Procedures Guide(PAPPG).Willful provision of false information in this application and its supporting documents or in reports required under an ensuing award is a criminal offense(U.S.Code,Title 18,Section §1001).

Certification Regarding Conflict of Interest
The AOR is required to complete certifications stating that the organization has implemented and is enforcing a written policy on conflicts of interest (COI), consistent with the provisions of PAPPG Chapter IX.A; and that, to the best of the individual's knowledge, all financial disclosures required by the conflict of interest policy were made; and that conflicts of interest, if any, were, or prior to the organization's expenditure of any funds under the award, will be, satisfactorily managed, reduced or eliminated in accordance with the organization's conflict of interest policy. Conflicts that cannot be satisfactorily managed, reduced or eliminated and research that proceeds without the imposition of conditions or restrictions when a conflict of interest exists, must be disclosed to NSF via use of the Notifications and Requests module with Research.gov

Certification Regarding Flood Hazard Insurance
Two sections of the National Flood Insurance Act of 1968 (42 USC §4012a and §4106) bar Federal agencies from giving financial assistance for acquisition or construction purposes in any area identified by the Federal Emergency Management Agency (FEMA) as having special flood hazards unless the:
(1) community in which that area is located participates in the national flood insurance program; and
(2) building (and any related equipment) is covered by adequate flood insurance.

By electronically signing the Certification Pages, the Authorized Organizational Representative (or equivalent) located in FEMA-designated special flood hazard areas is certifying that adequate flood insurance has been or will be obtained in the following situations:
(1) for NSF awards for the construction of a building or facility, regardless of the dollar amount of the award; and
(2) for other NSF awards when more than $25,000 has been budgeted in the proposal for repair, alteration or improvement (construction) of a building or facility.

Certification Regarding Responsible and Ethical Conduct of Research (RECR)
(This Certification applies to proposals submitted prior to July 31, 2023, and is not applicable to proposals for conferences, symposia, and workshops.)
By electronically signing the Certification Pages, the Authorized Organizational Representative is certifying that, in accordance with the NSF Proposal & Award Policies & Procedures Guide, Chapter IX.B., the institution has a plan in place to provide appropriate training and oversight in the responsible and ethical conduct of research to undergraduates, graduate students and postdoctoral researchers who will be supported by NSF to conduct research. The AOR shall require that the language of this certification be included in any award documents for all subawards at all tiers.

Certification Regarding Responsible and Ethical Conduct of Research (RECR)
(This Certification applies to proposals submitted on or after July 31, 2023, and is not applicable to proposals for conferences, symposia, and workshops.)
By electronically signing the Certification Pages, the Authorized Organizational Representative is certifying that, in accordance with the NSF Proposal & Award Policies and Procedures Guide, Chapter IX.B., the institution has a plan in place to provide appropriate training and oversight in the responsible and ethical conduct of research to undergraduate students, graduate students, postdoctoral researchers, faculty, and other senior personnel who will be supported by NSF to conduct research. As required by Section 7009 of the America Creating Opportunities to Meaningfully Promote Excellence in Technology, Education, and Science (COMPETES) Act (42 USC 1862o–1), as amended, the training addresses mentor training and mentorship.The AOR shall require that the language of this certification be included in any award documents for all subawards at all tiers.

Certification Regarding Organizational Support
By electronically signing the Certification Pages, the Authorized Organizational Representative (or equivalent) is certifying that there is organizational support for the proposal as required by Section 526 of the America COMPETES Reauthorization Act of 2010. This support extends to the portion of the proposal developed to satisfy the Broader Impacts Review Criterion as well as the Intellectual Merit Review Criterion, and any additional review criteria specified in the solicitation. Organizational support will be made available, as described in the proposal, in order to address the broader impacts and intellectual merit activities to be undertaken.

Certification Regarding Dual Use Research of Concern
By electronically signing the certification pages, the Authorized Organizational Representative is certifying that the organization will be or is in compliance with all aspects of the United States Government Policy for Institutional Oversight of Life Sciences Dual Use Research of Concern.

Certification Requirement Specified in the William M.(Mac)Thornberry National Defense Authorization Act for Fiscal Year 2021, Section 223(a)(1) (42 USC 6605(a)(1))
By electronically signing the Certification Pages, the Authorized Organizational Representative is certifying that each individual employed by the organization and identified on the proposal as senior personnel has been made aware of the certification requirements identified in the William M.(Mac) Thornberry National Defense Authorization Act for Fiscal Year 2021, Section 223(a)(1) (42 USC 6605(a)(1)).

Certification Regarding Safe and Inclusive Working Environments for Off-Campus or Off-Site Research
(This certification applies only to proposals in which data/information/samples are being collected off-campus or off-site, such as fieldwork and research activities on vessels and aircraft.)
By electronically signing the Certification Pages, the Authorized Organizational Representative is certifying that, in accordance with the NSF Proposal & Award Policies and Procedures Guide, Chapter II.E.9, the organization has a plan in place **for this proposal** regarding safe and inclusive working environments.

AUTHORIZED ORGANIZATIONAL REPRESENTATIVE	SIGNATURE	DATE
NAME **Jeffrey Bui**	**Electronic Signature**	**Jan 17 2023 06:46 PM**

TELEPHONE NUMBER	EMAIL ADDRESS	FAX NUMBER
510-642-0120	**jeffreybui@berkeley.edu**	

Submitted/PI: Jedda Foreman /Proposal No: 2315277

Working Toward Racial Equity:
Building Capacity to Institutionalize Equity in Outdoor and Environmental Science Education

Overview

The Lawrence Hall of Science at the University of California, Berkeley and Justice Outside propose a 5-year Racial Equity in STEM Education project to advance racial equity in outdoor and environmental science education (OESE) by developing a replicable model for organizational capacity building, Working Towards Racial Equity (WTRE). Using a theoretical approach that has emerged from our partnership activities, the Racialized Conditions of Systems Change, we will support leaders from each of five organizations to facilitate and guide organization-wide discussions related to racial equity, setting the foundation for each organization to participate in a systems change-focused racial equity design process. Through this process, we will develop and formalize a Racial Equity Transformation Tool Kit to activate field-wide change. Concurrent research will investigate the conditions and outcomes necessary to move toward more racially just and equitable work environments by paying particular attention to the experiences of Professionals of Color within their organization and the OESE field. The evaluation focuses on the WTRE model and will examine how and to what extent the model supports individuals to do equity work in their organizations. Mechanisms embedded within programming, research, and evaluation efforts, such as a focus on “ground truthing,” BIPOC Affinity Spaces, and the Research Evaluation Advisory Group, ensure that the voices, knowledge, and experiences of those experiencing inequities caused by systemic racism are at the center of all project activities. Multiple members of the project’s leadership team and Advisory board add additional perspectives as individuals who have experienced inequities caused by systemic racism.

Keywords: environmental learning, systems change, equity, pláticas, critical race theory

Broader Impacts

The immediate beneficiaries will be the employees of the five participating OESE organizations, particularly Professionals of Color, and the participants in those organizations’ programs, particularly students of color. Further, a replicable model for broadening participation along with the Racial Equity Transformation Tool Kit and associated research and evaluation findings will benefit the entire OESE field. Systems change is attainable in OESE organizations. The number of organizations in the OESE field is on the scale of hundreds and OESE organizations can typically implement change relatively easily when given the appropriate capacity-building scaffolds and approaches (Romero, Laina, et al., 2021). Currently, the OESE field is in an intense period of rebuilding after impacts from the COVID-19 pandemic, and racial equity is the most commonly named priority by OESE organization leaders (Collins et al., 2021). At this critical moment, it is possible to have a significant, transformative impact on the field.

Intellectual Merit

This project has important implications for capacity building and research praxis that aims to advance racial justice and systems change in the OESE field. Drawing on methodologies and frameworks that center the experiences and voices of Professionals of Color, this study will build theoretical understandings of the conditions and outcomes that are necessary and meaningful to address systemic racism and promote work environments in OESE organizations that are racially just and equitable. This study will use and build an understanding of methodological approaches and tools to research *with* rather than *on* participants, by co-constructing knowledge through centering experiences, stories, and interpretations of participants, which will contribute to the advancement of more equitable research practices in the field of science and environmental learning research. This project will also advance scholarship about the necessary approaches, tools, and programmatic elements that can position organizational leaders and staff of predominantly white OESE institutions to facilitate conversations about racial equity in relation to OESE work environments and lead to transformative systems change.

TABLE OF CONTENTS

For font size and page formatting specifications, see PAPPG section II.B.2.

*Proposers may select any numbering mechanism for the proposal. The entire proposal however, must be paginated. Complete both columns only if the proposal is numbered consecutively.

Working Toward Racial Equity:
Building Capacity to Institutionalize Equity in Outdoor and Environmental Science Education

Submitted to: Racial Equity in STEM Education, NSF 22-634
Submitted by: Jedda Foreman, Valeria Romero, Craig Strang, Laura Rodriguez
Lawrence Hall of Science & Justice Outside

Introduction

The Lawrence Hall of Science at the University of California, Berkeley and Justice Outside propose a 5-year Racial Equity in STEM Education project to advance racial equity in outdoor and environmental science education (OESE) by developing a replicable model for organizational capacity building, Working Towards Racial Equity (WTRE). This project addresses debilitating racial inequities in the OESE field by increasing the capacity of organizations to build more racially just and equitable work environments. We will support a team of leaders from each of five organizations to facilitate and guide organization-wide discussions related to racial equity. These discussions will set the foundation for a larger distributed leadership team from each organization to participate in systems change-focused racial equity design process. We will develop and formalize a Racial Equity Transformation Tool Kit, a key part of the model, to activate field-wide change. The Tool Kit will include three components: 1) Facilitator's Reflection Guide, 2) Foundations of Racial Equity Guide, and 3) Organization Systems Change Tools.

The project includes research and evaluation components to inform the project activities, assess the effectiveness of the capacity-building model, and examine how race and power shape the everyday experiences of Professionals of Color and the organizational journey to advance systems change. The research will investigate the conditions and outcomes necessary to move toward more racially just and equitable work environments by paying particular attention to the experiences of Professionals of Color within their organization and the OESE field. The evaluation focuses on the WTRE model and will examine how and to what extent the model supports individuals to do equity work in their organizations.

This proposal is led by a partnership of researchers, practitioners, and organizational leaders who share a commitment to amplifying the lived experiences and voices within communities of color in the OESE field. The model emerges from prior research of ours and others, and from a unique synthesis across multiple lines of previous work by the project partners over the last several years, resulting in five publications to date and two workshops series, one currently funded by the National Science Foundation AISL program (grant no. 2005829). This proposal addresses the challenges and incorporates the successes of these projects to build a scalable and replicable model for broad implementation.

A. Rationale

I. Current Context

The OESE field is made up of nearly all-White practitioners, leaders, researchers, and funders, resulting in a call for organizations to examine how to better attract and retain Professionals of Color (Johnson, 2019; Romero et al., 2019; Mclean, 2013; Miller, 2018; Sherman, 2020; Stapleton, 2020). For example, in a 2014 study (Snow & Romero), 94% of residential OESE programs were led by White organization leaders. However, scholars continue to highlight that undergraduate and graduate Students of Color value, are interested in, and have similar preparation for environmental-related jobs as White students (Taylor, 2018; Weintraub et al., 2011). Systemic structures and practices continue to discourage People of Color from applying for jobs due to the actual or perceived lack of equity within organizations (Advisory Committee for Academic Diversity, 2017; Johnson and Okoro, 2016; Weintraub et al., 2011).

In addition, many OESE professionals are reflecting on and examining workplace practices to move beyond the nearly homogenous White workforce that has resulted from decades of marginalization of communities of color (Foreman et al., 2022; Johnson, 2019; Taylor, 2014). Romero et al. (2022) highlight three interconnected reasons that Professionals of Color are pushed out of OESE: 1) they feel tokenized,

burdened, and burnt-out; 2) they perceive differences between their and their organizations' definitions of equity; and 3) they experience White organization leaders naming equity as a priority, but giving it superficial attention, particularly in the work environment. There was a disconnect between Professionals of Color, who experience marginalization and exclusion within OESE organizations, and OESE organization leaders, who report that they prioritized equity, inclusion, and diversity. These findings highlight how White-led equity initiatives can unintentionally reinforce status quo systemic racism and surface the need for critical conversations about race (Johnson, 2019; Lewis and James, 1995).

II. Working Towards Institutionalizing Change

Throughout OESE, there is a call for transformative movements that center systems change to understand, shift and transform policies and practices that guide organizations and the field (McGhee et al., 2018; Romero et al., 2019; Rowland et al., 2020; Taylor, 2014, 2018). There is increasing recognition of the need to address history, culture, politics, and power in OESE in terms of educational content (Cole, 2007) and the common practices of the profession (Johnson, 2019). OESE organizations must attend to the pervasive issues of inequity and exclusion in the work environment that are influenced by the shared perspectives, underlying assumptions, values, norms, and practices that shape satisfaction, sense of group membership, relationships, and work processes (ERC, 2019; Heathfield, 2020; Kaplan and Owings, 2013; Skaalvik and Skaalvik, 2011). Equitable working environments increase connection, improve educator retention, and protect against burnout (Badawy, 2015; Badri et al., 2013; Choi et al., 2017).

Recent initiatives in informal education have identified several practices that center equity, such as: ensuring that the organization's vision and mission statements reflect a core commitment to equity and justice; creating systems of shared leadership (Garibay and Migus, 2014); developing shared language and communication skills (Jennings and Jones-Rizzi, 2017); having greater transparency, especially about career development and advancement opportunities (Advisory Committee for Academic Diversity, 2017); establishing long-term goals and metrics around equity and justice (Johnson, 2019); and supporting representative leadership teams, boards, and staff (Rowland-Shea et al. 2020). This project will further this research within OESE by exploring new metrics for understanding equitable organizational change that do not unintentionally reinforce the status quo.

III. Leveraging Successes & Addressing Challenges to Develop a Scalable Model

This project builds from successes and lessons learned from Working Toward Equitable Organizations: Building Capacity for Leadership of Color in Outdoor and Environmental Science Education (NSF #2005829). The 2020 project required significant adjustments to account for the impact of the COVID-19 pandemic. Each of 20 OESE organizations assembled a distributed/vertical leadership team (aka Organization Systems Change, or OSC, Team) that engaged in a 2-year workshop series focused on organization systems change, and a Professionals of Color team (PoC Team) that engaged in a concurrent 2-year workshop series focused on community, relationship-building, career development, and healing. Both teams focused on building organization-wide capacity for creating a more equitable and just work environment. Both workshop series included a virtual "intensive" (50 hours of workshop time over three months), followed by 20 months of customized organization support, monthly meetings, peer consultation, and mentorship structures. Evaluation study findings highlight the efficacy and transformative impact of the model on individuals and organizations (Informing Change, 2022). Evaluation data is from surveys and feedback forms from 118 OSC strand participants, 35 POC strand participants, and 16 individuals who participated in both strands.

Participants self-reported that intensive workshops offered a productive space to advance equity work individually and organizationally. One PoC participant reported, "The tools for self-reflection and a retrospective look at my career to this point are guiding me toward being a more empathetic listener, and thus, a better leader as I strive to grow with our organization and move into a higher level of management

and leadership." An OSC participant shared, "Although I knew my organization had a lot of work to do toward racial equity, I wasn't aware of all of the biases and structures in place that work against this. I think bringing these to light—and having our highest level of leadership a part of the process—puts us in a great place to move forward with making real changes."

Evidence of the model's success surfaced three thematic strengths: **Transformative Impact is Possible**: More than 70% of respondents reported feeling the project would have a significant or transformative impact on their organization. Respondents saying the impact was "transformative" represent 15 of the 20 organizations, including four organizations with 50% or more of their respondents answering this way, and six organizations with more than one respondent who did. Of those participants who explained their rating, 48% described a shift in their organization's thinking resulting from session content, tools, the development of shared language, or increased accountability. **Multidimensional Framework**: Participants confirmed the importance of a framework that included foundational, personal, interpersonal, and organizational topics, and the relationships among them. Over 78% found the intensive workshop relevant to their organization and the equity work they are pursuing. Many of the frameworks presented were new to over a third of participants. There was a pronounced upward trend on both familiarity and perceived relevance; an overwhelming majority felt each framework was highly relevant to equity work within their organizations. **Value of Facilitation**: Participants reported the frameworks and material covered in the intensive were challenging. They felt the project team was successful in facilitating Brave Spaces for having these discussions (Arao & Clemens, 2013), setting the tone, and creating the environment to learn and grow around the material. Equally important to participants was the way the project team centered care and compassion, modeling self-care, respect, and vulnerability in a supportive environment. The model depends on facilitators who understand the content and can create these environments that hold many complicated or challenging components.

The evaluation study also provided a foundation for critical improvements to the model that will be addressed in the design of the proposed project: **Value of one goal/one team**: 20% of participants perceived the impact of the project to be transformative for their organization. On OSC teams, 22% of participants saw evidence for transformative impact, while 10% of PoC team participants saw such evidence. However, 42% of participants who participated on both teams reported seeing evidence of transformative impact. This finding speaks to the value of not separating goals for the PoC teams from the goals of the OSC teams. **Organization-wide clarity on key terms and concepts**: OSC teams were challenged to "ground truth" (see p. 7) their organization's understanding of key problems causing an inequitable work environment and the conditions holding those problems in place. As these discussions unfolded, a need emerged for organization-wide foundational understandings and common language to talk about racial equity and justice. Many OSC team members felt they had important learning experiences together that were not shared by the rest of their organization colleagues, and this made discussions difficult. **Increased individual facilitation**: Participants highly valued the project team's facilitation of whole-cohort sessions, and they routinely requested more facilitation of discussions within their own organization teams. **Model building**: Working with 20 organizations was invaluable in understanding the range of cadences and patterns of implementation across a wide range of characteristics. Now, we need to work deeply with a few organizations to observe the fine-grained challenges and tipping points that accompany implementation and are necessary to build a model.

IV. Broader Impacts

This project will broaden participation in the workforce and the intended audience of the OESE field. The immediate beneficiaries will be the employees, particularly the Professionals of Color, and the participants, particularly the Students of Color, in the five participating organizations. The entire field will also benefit from the development of a replicable model, including the Racial Equity Transformation Tool Kit. To succeed, the OESE community must find the intersection between its mission to create a science

and environmentally literate society and the needs and priorities of communities of color. Every member of society, including People of Color and low-income people, has a right to experience the awe, wonder, and healing power of being outdoors. As OESE organizations become more equitable and just, Professionals of Color will experience fewer barriers to enter, stay, and advance in the field.

Changes in the demographics of the OESE workforce impact the youth who participate. They see themselves better reflected among OESE educators, and experience more culturally relevant programming and instruction. Evidence suggests that OESE experiences may benefit Students of Color and English learners more than other youth populations (American Institute for Research, 2005; Danforth, Waliczek, Macey, & Zajicek, 2008; Collins et al., in preparation). As Coyle (2010) notes, “regular outdoor time, especially time in natural surroundings, has become just minutes per day and is verging on becoming a thing of the past….The research reveals that outdoor education and time spent outdoors is particularly effective at helping under-resourced, low-income students perform measurably better in school, and quantitatively increases student motivation and enthusiasm to learn.” The benefits from these experiences include social and personal growth and a myriad of health benefits that come from simply spending time outside (Coyle, 2010; Liddicoat & Kransy, 2014; Powell, et. al., 2011; Stern, et. al., 2010).

Systems change is more possible in OESE organizations than in the larger K-12 education system. The number of organizations in the OESE field is on the scale of hundreds. Romero, Laina, et al. (2021) note that while OESE organizations are typically small, nimble, and can implement change relatively easily when given the appropriate capacity-building scaffolds and approaches, they are also frequently small, geographically isolated, and often do not have the infrastructure and capacity required for reflection and improvement. This magnifies the importance of capacity-building thought partners like the Lawrence Hall of Science and Justice Outside. The OESE field is in an intense period of rebuilding from the COVID-19 pandemic, during which Students of Color were disproportionately impacted, experiencing higher rates of learning loss, and less time outdoors at school, and in OESE programs (Collins, 2020). Racial equity is the most commonly named priority by OESE leaders (Collins et al., 2021). At this critical moment, it is possible to have a significant, transformative impact on the field, and thus on the students in greatest need.

Transformation in the OESE field will have a long-term impact on STEM education, given the interchange of educators and ideas, and the growing recognition by K-12 schools of the importance of OESE experiences (Becker et al., 2017). OESE programs accelerate science learning and engage youth in meaningful and memorable experiential learning, that results in positive cognitive/academic, dispositional, social-emotional, and health outcomes (Ardoin et al., 2020; Ardoin et al., 2018, Thomas et al., 2019). OESE programs are not, however, routinely available within typical (and especially not within under-resourced) classrooms. This project will create a model that could impact other sectors with similar challenges. Understanding how to promote equity and justice, and how to support Professionals of Color working within the OESE field, will result in tools, frameworks, and a model that will support organizations and workforces across other educational settings.

B. Project Design

The goals of this project are to 1) Develop a model for organizations to continuously improve their capacity to make transformational systemic improvements for working toward equity and justice; 2) Codify essential practitioner tools, resources, and professional learning experiences for efficient use in the field; and 3) Publish research findings, insights, best practices, and approaches to racial equity transformation to advance the work of OESE researchers and organizations.

Theoretical Approach. We draw upon The Water of Systems Change framework (Kania et al., 2018) to explore the organizational capacities that support an organization's ability to create change. These capacities include the ability to improve “policies, practices, and resources [structural change]; relationships and power dynamics [relational change]; and the tacit assumptions of its board and staff

[mental models]" (p. 5). This framework, however, lacks an explicit focus on how race influences systems change efforts. McKinney de Royston and Nasir's (2017) sociopolitical analytical framework of Racialized Learning Ecologies contextualizes how individual experiences within learning environments are mediated by race at four levels: (1) social, (2) institutional, (3) cultural, and (4) individual. Taken together, these frameworks inform a new theoretical approach that has emerged from our partnership activities, the Racialized Conditions of Systems Change (Figure 1).

The Racialized Conditions of Systems Change approach proposes that when organizations center race and racialized contexts in their understanding of organizational systems, they can build the capacities necessary to move toward a more equitable and just work environment where Professionals of Color can thrive. Indicators of a just and equitable work environment may include how Professionals of Color form belonging and gain access to opportunities for professional growth and positional leadership. This project will build on this approach by centering the voices and experiences of Professionals of Color to explore and articulate meaningful indicators of an equitable and just work environment. Feedback from Professionals of Color in our current NSF AISL research has documented how prioritizing outcomes like sense of belonging and advancement can lead to assimilation into the dominant culture, reinforcing power and status differentials. It is critical to understand how systems change work shows up (or doesn't) in ordinary and nuanced ways (McAfee, 2014) beyond shifts in statements and DEI plans. Our research will explore the meaningful outcomes that shape the everyday experiences of Professionals of Color.

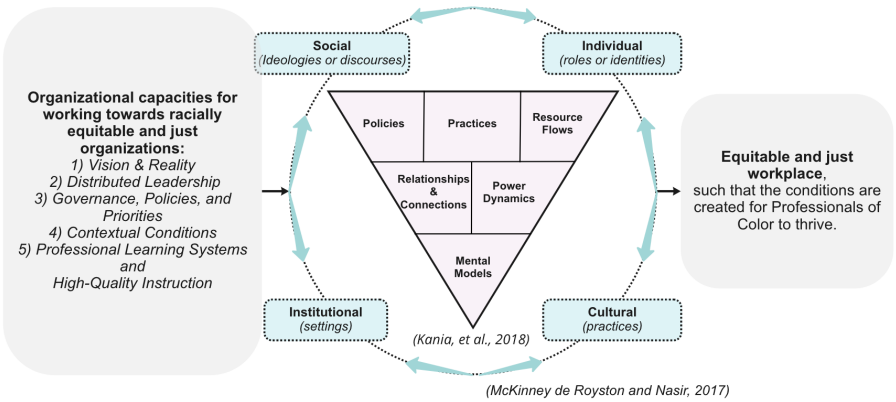

Figure 1: The Racialized Conditions of Systems Change Theoretical Approach

Implementation Plan

We will 1) prepare and support a Facilitation Team of 4-6 individuals from five organizations to lead and facilitate organization-wide discussions related to racial equity, setting a foundation for 2) leading organizational distributed leadership teams of 8-10 individuals through a replicable racial equity design process. Through this process, we will create a Racial Equity Transformation Tool Kit, comprised of the *Facilitator's Reflection Guide*, *Foundations of Racial Equity Guide*, and *Organization Systems Change Tools*. Concurrent evaluation and research efforts will both inform this model and synthesize learnings for the field. This work will be accomplished over five phases:

Phase 0: Planning & Organization Selection *(January 2024-December 2024)*. We will create and disseminate recruitment and application materials (webinars, website pages, & conference presentations, etc.). We will tap the Justice Outside and Lawrence Hall of Science networks for recruitment (over 400 organizations and over 6,000 individual subscribers total), along with national networks such as: the People of the Global Majority in the Outdoors, Nature, and Environment (PGM ONE) and North American Association of Environmental Education (NAAEE). We will directly recruit organizations that have expressed an interest in advancing equity and justice. Our partnership has demonstrated repeated success in recruiting for previous efforts, all of which received two to five times as many applications as available spots. The workshop series will launch in Year 2 to allow ample recruitment time.

Phase 0 includes an application process to select five organizations. This process will include individual and organization written applications and interviews to evaluate the readiness of organizations and of individuals on organization teams. Organization readiness criteria include: a) the formation of a Facilitation Team of 4-6 individuals, who generally represent the racial diversity of their staff and include at least one key decision-make; b) openness to examining and challenging organizational assumptions about race, equity and justice; c) ability to commit time and to balance existing organization priorities with the timeline for the workshop series and subsequent implementation; and d) ability to articulate the value of equity within the context of their broader organizational mission (Moyers, 2019). Individual readiness criteria include the ability to recognize and name personal racial and positional identities; the access to power and privilege that come from them; and interest in engaging in learning and self-reflection.

Phase 1: Foundation Building *(January 2025 - September 2025).* We will prepare the five Facilitation Teams to lead organization-wide discussions about racial equity and justice with their staff. This includes: 1) understanding key concepts related to racial equity (e.g., white supremacy culture, understanding impacts of power and privilege, recognizing and interrupting unconscious bias), and 2) exploring how to give and receive feedback; navigate unpracticed conversations; use Nonviolent Communication skills (Rosenberg, 2015); recognize and mitigate the impact of their personal racial and other biases; navigate power dynamics (particularly related to racial identities); and hold spaces for discussions that include discomfort, harm, and defensiveness (Sue, n.d.). Workshop topics will be informed by the Racialized Conditions of Systems Change theoretical approach so that Facilitation Teams can identify and discuss individual, cultural, social, and institutional racism.

Phase 1 includes: a three-day in-person workshop, seven monthly three-hour virtual workshops (that include self-reflection, peer mentorship, racial affinity spaces), six open office hours, and two virtual affinity spaces for Black, Indigenous, and other People of Color (BIPOC Affinity Space). BIPOC Affinity Spaces will be open to all anyone who identifies as a person of color who works or volunteers for the participating organizations. It will convene at least quarterly as a space to learn about and provide feedback on project activities, ask questions, share impact, build community, and center healing and solidarity. This space, facilitated by the project team, will lend credibility to each organization's efforts by providing accountability and opportunities for input and perspectives. If there is interest in meeting more frequently, the project team will provide the platform, and train interested participants to facilitate additional meetings. BIPOC participants will have access to a private Mighty Network group for regular, accessible communication and community-building.

Phase 2: Foundations of Racial Equity Organization-wide Discussions *(October 2025-September 2026).* Each Facilitation Team will lead Foundations of Racial Equity discussions across their organization, using the draft *Foundations of Racial Equity Guide*. We will scaffold the Facilitation Teams to gradually assume more independence through modeling, co-facilitating, and coaching. To build facilitator capacity, each Foundations of Racial Equity discussion will include a debrief of participant feedback. The project team will support Facilitation Teams to summarize, process, and act on feedback.

Phase 2 includes: 12 meetings per organization with two project team liaisons (four for organization-wide professional learning, eight for coaching), and two BIPOC Affinity Spaces.

Phase 3: Designing for Organization Systems Change *(October 2026-March 2028).* We will work with each organization to assemble a distributed/vertical leadership "Organization Systems Change Team" (OSC Team). OSC teams will include up to 10 individuals who strategically represent different spheres of influence: administrative and decision-making control over the mission, budget (e.g., executive director and/or board member); hiring, curriculum, instruction, professional learning (e.g., program director); managing instructional staff (e.g., coordinator or lead instructor); teaching (e.g., influential instructor); community engagement; hospitality; human resources; finances; and facilities. At least three members will be key decision-makers, including a board member. Each team will reflect the size, context,

governance structure, and racial demographics of their organization and the communities they serve or hope to serve.

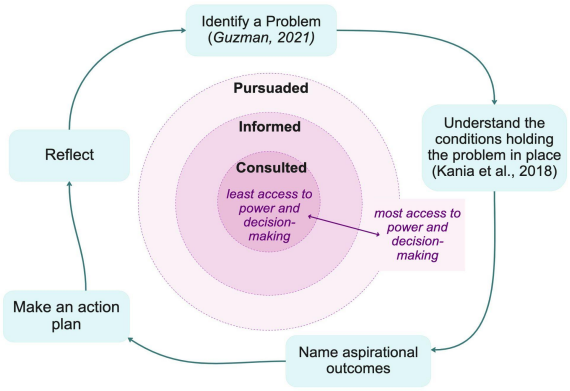

Figure 2. Designing for Organization Change

OSC Teams will engage in a 1.5-year design process to identify a problem to address, understand the conditions holding problems in place, name aspirational outcomes, implement strategies for change, reflect on successes and challenges, and restart the cycle (see Figure 2). Organizations will begin with a reflection on their organizational capacity to support them in identifying an important and strategic problem that is a barrier to racial equity. OSC Teams will describe their problem "through the lens of equity [so that it] is contextually nuanced, historically situated and articulated from the multiple vantage points of those who are most proximate to the problem and those who hold the power in the systems that create and perpetuate it" (Guzman, 2021, p. 6). Using Kania et al's (2018) Water of Systems Change Framework, OSC teams will seek to understand the conditions holding their problem in place, then name aspirational outcomes, and create an Action Plan that names and prioritizes time-bound strategies to achieve their outcomes. OSC Teams will then reflect and begin a new cycle. The project team will support OSC Teams to collect, understand, and act on the feedback they receive.

The design process includes "**ground truthing**" (Figure 2) to uplift the voices and experiences of the people in the organization most harmed by, and typically with the least access to, decision-making about the problem. OSC Teams will ground truth their problem statement, understanding of the conditions holding the problem in place, aspirational outcomes, and action plan. Ground truthing is adapted from the conceptualization of moving "margins to center" (hooks, 2000), "...to be in the margin is to be part of the whole but outside the main body" (p. ix). Through ground truthing, organizations will move margins to center by identifying who needs to be consulted (staff most impacted by the problem and whose experiences will deeply inform the plan to address it), informed (staff impacted by the problem or how it is addressed *and* who experience privilege (related to racial or positional identities) that mitigate harm), and persuaded (staff in positions of power and authority who will likely have to shift their ways of thinking to name and address the problem).

Phase 3 includes: an in-person 3-day workshop, 10 whole cohort meetings, six consultations and up to 5 hours of custom support per organization, and three BIPOC Affinity Space meetings. Whole cohort meetings include support for ground truthing and introduction of topics such as leadership vs authority, and structures to support power-sharing and time for discussion and reflection in job-alike and racial affinity spaces. We will determine specific custom support with each OSC team, based on their context and needs. OSC Teams will share lessons learned from their racial equity journey through a written narrative, video, or video series.

Phase 4: Analysis and Dissemination *(April 2028-December 2028).* We will finalize all components of the Racial Equity Transformation Tool Kit, and determine the best options for dissemination that mitigate the potential for harm (see Dissemination Plan, p. 13). The research and evaluation teams, with input from the programming team, will analyze data, publish findings, and disseminate learnings, further described in Research Design (p. 8) and Evaluation (p. 11).

Mighty Network. All participants will have access to Mighty Network, a professional networking platform, to share, track, and organize information and resources, and to communicate directly with each other and the WTRE team. It improves cohesion, professional sharing, and community throughout the project.

Racial Equity Transformation Tool Kit. This educative Tool Kit that will support users to put project findings into practice includes three components: 1) *Facilitator's Reflection Guide* that prepares individuals to facilitate discussions of racial equity by reflecting on personal bias, power, privilege, positionality, and other topics; 2) *Foundations of Racial Equity Guide* that provides agendas; professional learning materials and templates, and commonly needed facilitator moves to introduce foundations of racial equity concepts throughout an organization; and 3) Organization Systems Change Tools, that includes 3-6 guides and templates to create conditions for racial equity, such as revising mission and vision; creating an equity statement; creating systems for distributed leadership; and developing new structures for feedback. These tools will be designed as the project team develops programming, and refined based on participant and evaluation feedback.

Summary of Project Design Improvements. Based on prior evaluation findings, we are 1) eliminating the two-team (OSC and PoC) approach, while employing systems and structures to avoid burdening and tokening Professionals of Color to participate in systems change work; 2) preparing organization leaders to facilitate organization-wide discussions about the fundamentals of racial equity; 3) coaching organization leaders as they lead organization-wide discussions; and 4) decreasing the number of organizations in order to increase the amount of facilitation support each organization receives, allowing us to go deeper as we fine tune and publish more nuanced tools for use across the field. This multi-phase approach attends to the theoretical approach by creating a foundation of organization-wide individual understanding of racial equity, and a social racial discourse before attending to organizational change.

C. Research Design

This project will contribute to the field's understanding of the necessary and meaningful conditions and outcomes for Professionals of Color, that promote an equitable and just work environment. The research will aim to answer these questions: ***(RQ1)*** *What are the conditions necessary in OESE organizations to move towards a racially equitable and just work environment for Professionals of Color? (a) What does transformative change look like?* ***(RQ2)*** *What are meaningful indicators, for Professionals of Color, of a racially just and equitable work environment in OESE organizations?* ***(RQ3)*** *How do Professionals of Color make meaning of their experiences in the field-at-large? (a) What factors shape the experiences of Professionals of Color?*

Centering Race and Intersecting Systems of Power. To enact transformative systems change, we must critically examine how race and intersecting systems of oppression mediate everyday OESE experiences. To explore racially just work environments, it is imperative to attend to how systemic and institutional structures, ideologies, policies, and practices perpetuate the oppression and marginalization of People of Color (Bell, 1992; Harris, 1993; Ladson-Billings & Tate, 1995). We will draw on critical race theory (CRT) (Bell, 1992; Crenshaw et al., 1995; Ford, 1994; Harris, 1993; Matsuda, 1987; Peller, 1990; Tate IV, 1997) and intersectionality (Collins, 2000, 2019; Crenshaw, 1991) to attend to how racialized structures and intersecting systems of oppression shape the experiences of Professionals of Color in OESE organizations. An underlying premise of CRT is that structures exist and function to protect whiteness as property. Decuir and Dixson (2004) summarize that whiteness as property functions on three levels: 1) right to possession, 2) right to use, and 3) right to disposition. When we operationalize this in OESE organizations with a focus on the work environment, we seek to understand how policy and practices restrict access to equitable wages, leadership and management positions (right to possession); shape who has access to safe, resourced institutions (right to use), and shape the standards by which staff must conform (right to disposition). In education and social science research, systems, structures, epistemologies, and methodological approaches largely reflect white, Eurocentric narratives and values that privilege dominant ideologies (Perez Huber, 2009) and continue to marginalize, oppress and exclude communities of color (Delgado & Stefancic, 2017; Ladson-Billings, 1998). CRT provides a framework that "[deconstructs] oppressive structures and discourses, [reconstructs] human agency, and [constructs] equitable and socially just relations of power (Ladson-Billings, 1998, p. 9). Through counter-storytelling, CRT re-centers narratives that amplify the voices and lived experiences of communities of color to disrupt

the status quo (Delgado Bernal, 2002; Delgado & Stefancic, 2017). Intersectionality, grounded in Black Feminism, elucidates how theories that center race *or* gender neglect the nuanced experiences of Black women (Crenshaw, 1991; Collins, 2000, 2019). Identity politics frequently ignores or inflates intragroup differences. We will consider how intersectional systems of oppression undergird and are reproduced in the structures, systems, policies, practices, and values that shape the experiences of women of color. Our research will help to clarify for whom and in what ways is the work environment racially just.

Research and Evaluation Collaboration. The research and evaluation teams will work closely together to minimize the burden on participants, avoiding overlapping data collection activities, sharing data across teams, and engaging in collective meaning-making to afford more robust findings. Each team has a clear, distinct, and linked focus. Both teams will draw on methods and structures to support authentic engagement with Professionals of Color. We will establish a Research Evaluation Advisory Group (REAG), comprised of Professionals of Color from the prior and current WTEO and WTRE projects. The REAG will meet with the research and evaluation teams three to four times per year to review research and evaluation designs, approaches, and instruments, provide insights into the context of the OESE field, and contribute to sense-making of the findings.

Methodological Approach. We will use methodological approaches to center and uplift the voices and experiences of Professionals of Color and co-construct knowledge, in efforts to work against research practices shaped by colonialism that extracts knowledge from participants and leaves the power of meaning-making, and knowledge generation and validation solely to researchers (Smith, 2021). We will utilize pláticas, grounded in Chicana Femenista and Arabyya feminist research frameworks (Fierros and Bernal, 2016), to center the stories and knowledge production of participants. The five tenets of pláticas, which promote equitable and just research are: 1) center experiences, stories, and interpretations; 2) participants are co-constructors of knowledge; 3) prioritize everyday experiences; 4) conversations are a potential space for healing; and 5) the process is reciprocal (Flores Carmona et al., 2021).

While we will draw on a range of methods and data sources to answer our research questions, pláticas will be a critical lens and method in our study to emphasize listening and trust-building. We will take a participatory approach, being active and reflective in the space along with participants. We will continuously ask ourselves: whose voices are being heard and elevated? How are we centering lived experiences? How are we honoring how Professionals of Color make meaning of their own experiences in relation to systems change work?

Throughout data collection, we will hold 1:1 and group pláticas for Professionals of Color to share their experiences and engage in making meaning. We will always begin with community building and incorporate

Table 1. Research Design Overview

Research Question	Data Sources	Guiding Analytical Questions
(RQ1) What are the conditions necessary in OESE organizations to move towards a racially equitable and just work environment for Professionals of Color? (a) What does transformative change look like?	• Context building case sites (all 5 organizations) • Observations of WTRE programming and artifact analysis • Case study (3 organizations): observations, interviews with subset of staff, group- and one-on-one pláticas with Professionals of Color	How do organizational conditions evolve over time? How do conditions shape the experiences of Professionals of Color? How do race and power shape the organizational journey and experiences of Professionals of Color?
(RQ2) What are meaningful indicators, for Professionals of Color, of a racially just and equitable work environment in OESE organizations?	• Group pláticas with Professionals of Color across all 5 organizations	What indicators and/or outcomes do Professionals of Color identify? How do race and intersecting systems of oppression help us make sense of these outcomes? To what extent, and in what ways do these outcomes show up in the organization's approaches to racial justice and equity (e.g., alignment, contradictions, tensions)?
(RQ3) How do Professionals of Color make meaning of their experiences in the field-at-large? (a) What factors shape the experiences of Professionals of Color?	• Group pláticas with Professionals of Color across all 5 organizations • 1-on-1 pláticas with a subset of 10 Professionals of Color	What are the factors that shape the experiences of Professionals of Color? How do race and intersecting systems of oppression help us understand their experiences?

activities to promote healing and solidarity. A summary is in the adjacent Table 1.

Data Collection. To explore the conditions necessary to move towards transformative change in OESE organizations (RQ1), we will conduct site visits at the five participating organizations to build our understanding of the organizational and sociocultural contexts. We will draw on ethnographic methods (Le Compte & Schensul, 2010) to observe organizational meetings and programming, conduct in-situ interviews, review organization documents and artifacts (e.g., strategic plans), and invite staff to participate in one-on-one and group pláticas. We will explore how equity and justice show up at the organizational level and in everyday experiences and conditions (Rinaldo & Guhin, 2022), such as: structures and policies, resources allocated towards work around equity and justice, decision-making processes, and the guiding ideologies and mental models around equity and justice. We will document how race and power move through the institution (Vaught, 2017). We will take field notes and record analytic memos (Lareau, 2021) to reflect key themes and emergent questions which will have implications for future data collection. Site visits will inform the selection of case study sites (described below).

We will periodically observe WTRE programming and review organizational artifacts (e.g., problem statements, job descriptions, equity statements) for each organization to gain insight into how participants make meaning of the content and translate it into understanding the conditions of their organizations. Each year we will invite a subset of Professionals of Color from each organization to participate in a group plática to gain insight into perceptions of how conditions evolve over time and shape their experiences.

We will invite three organizations to participate in case studies (Le Compte & Schensul, 2010). Each case study will provide a richer understanding of how conditions shift over the course of the study and shape the experiences of Professionals of Color. At each case site, we will conduct a site visit in years 2 - 4. We will draw on ethnographic methods that include observations, in-situ interviews, and a review of organizational documents and artifacts. We will document the evolving conditions, and how race and power shape the approaches and processes within teams, e.g., how staff talk about race and justice, how power shows up in decision-making processes and everyday interactions, and whose voices are being centered and elevated. To support our understanding and interpretation, we will facilitate group pláticas with staff, and 6 – 8 one-on-one pláticas to gain a richer understanding of how staff make meaning of the organizations' journey to advance systems change. We will build in feedback loops for meaning-making to support organizational and staff reflection, learning, and actions towards advancing change.

To explore meaningful outcomes (RQ2), we will host a series of group pláticas over the course of the project. In year one, we will host a group plática with Professionals of Color who work in OESE to explore indicators and outcomes of a racially just and equitable work environment. Learnings from this initial group plática will inform the refinement of protocols for ongoing data collection in years 2 - 4, along with input from the REAG. Each subsequent year we will host a series of group pláticas with Professionals of Color in participating organizations, to explore outcomes associated with a racially just and equitable work environment. Data collected over the course of this study will result in a refined articulation of outcomes.

RQ3 will help us understand how Professionals of Color make meaning of their experiences in OESE, and understand how they experience belonging, resistance, joy, solidarity, healing, growth, and inspiration while navigating predominantly White spaces. We will invite Professionals of Color from participating organizations to share their stories in group pláticas to understand their experiences in their organizations and the field. These group pláticas will be held as a part of selected BIPOC Affinity Spaces, in coordination with the project team. We will also invite 10 individuals to engage in several one-on-one pláticas to gain a richer understanding of their experiences.

Data Analysis Approach. To answer our research questions, our analytical approach will draw on constructivist grounded theory (Charmaz, 2000) to gain a deep understanding of how organizational

conditions evolve over time and to elicit the narratives of Professionals of Color in OESE organizations (see Table 1). We recognize the "crisis of representation" (Denzin & Lincoln, 2011) – that we cannot hope to portray our participants exactly as they would portray themselves. Using constructivist grounded theory and approaches (Charmaz, 2000), we will support participants in the meaning-making process and strive to tell the story of "a world made real in the minds and through the words and actions of its members" (Charmaz, 2000, p. 523). We will engage the REAG to inform sensemaking and implications for ongoing data collection, analysis, and contributions to the field. Conducting member checks (Chase, 2017) at various time points will help us ensure that transcripts and interpretations reflect the perspectives and experiences of participants. We will host group pláticas and participant webinars to gather feedback and input on findings and implications for the field.

Analysis of data will employ an inductive and recursive approach in which data gathering, analysis, and theory development occur simultaneously (Charmaz, 2000). We will read through and code transcripts, artifacts, and observations using an In Vivo coding approach (Saldaña, 2013), which is "useful for marginalized voices" (p. 9) because it uses the language of participants. In comparing across participants and timepoints, we will establish categories for themes. These categories will emerge through the lens of our research questions (what Charmaz calls focused coding). We will use a constant comparative method (Charmaz, 2000) to observe themes across data sources and participants with regards to their views, situations, actions, accounts, and experiences. We will compare themes or ideas that emerge in different time points and situations. Emerging themes will be explored in subsequent data gathering.

We will draw on discourse analysis to help us understand and represent the pláticas participants. Interpreting meaning requires attention to how that meaning unfolds and how power shows up in interactions, and that meanings of utterances reside not only in what, but also in how, something is said (Baumann & Briggs, 1990; Jakobson, 1960; Wortham, 2001). The analytical framework is shaped out of the categories of themes of what is said, augmented by how it is said and the nature of the interactions involving discourse.

C. Evaluation

Informing Change will lead the evaluation to support ongoing program improvements and document learnings and progress toward objectives. The evaluation is focused on the WTRE model–its components, effectiveness, applicability, and replicability within the cohort of participating organizations. The focus is to understand "what it takes" to prepare people to lead discussions about racial equity at their organizations and to what extent the WTRE model facilitates transformational systems change at participating organizations. Recognizing that the project goals involve broader OESE field use of the developed materials, the evaluation will also focus on documenting a proposed evaluative approach to the model's future use. The following evaluation questions are aligned to the phases of the project: **(EQ1)** *What are the successes and challenges of recruiting and onboarding participating organizations?* **(EQ2)** *In what ways do members of the Facilitation Teams grow their understanding of concepts related to racial equity? What factors contribute to or hinder this process?* **(EQ3)** *What characteristics of Facilitation Teams, OSC teams, and organizations facilitate the dissemination and implementation of the WTRE curriculum?* **(EQ4)** *What progress do organizations make in addressing their selected problem?* **(EQ5)** *In what ways does the Racial Equity Transformation Tool Kit reflect key learnings from the project and how might subsequent evaluations assess the Tool Kit's uptake, relevance, and usefulness to organizations?* **(EQ6)** *What has the WTRE team learned about how to influence organizational transformation using the WTRE model?*

We will use a mixed methods approach to draw from a wide range of new and existing data from all collaborators and participants, including cross-sharing of data with the Research team. The evaluation adheres to the following values: 1) Partnership: we seek to learn from and with the project and research teams; 2) Human-centered design: we apply a human-centered design framework to our data collection

tools; 3) Participatory approaches: we ensure a participatory and transparent approach to our evaluation by engaging stakeholders through advisory group meetings, sense-making sessions, and other cycles of feedback during key project phases; 4) Minimizing data collection burden: we will synchronize data collection efforts with the Research team whenever possible, build data collection mechanisms into project programming, and utilize existing meetings or events to gather data.

To support the iterative improvement of program components and approaches, the evaluation team will actively participate in coordination and ideation meetings with the Program and Research teams, track and analyze participant feedback through the use of feedback forms, and facilitate rapid learning cycles that lean on data placemats and collective meaning-making at key junctions in the project's life cycle to provide formative feedback and stimulate continuous refinement. To promote project accountability, the evaluation team will guide the WTRE team through a reflection session at the end of each project year to review activities completed and progress made toward the goals of each project phase. The evaluation will remain nimble and adaptable to the project's emerging conditions.

Methods

We will conduct evaluation activities related to each of the project's phases, see Table 2.

Table 2. Evaluation Design Overview

Project Goals	Project Phase	Evaluation Question	Data Collection
1) Develop a model for organizations to continuously improve their capacity to make transformational systemic improvements for working toward equity and justice	Phase 0 - Phase 3	EQ1, EQ2, EQ4	• Application document review • Program team interviews • Facilitation team group conversations • Program team group conversations • Rapid feedback forms • Select site observations
2) Codify essential practitioner tools, resources, and professional learning experiences for efficient use in the field	Phase 1 - Phase 3	EQ3, EQ6	• Program team interviews • Facilitation team group conversations • OSC team group conversations • All-staff survey • Organization feedback forms • Organization custom support requests review • Select site observations
3) Publish research findings, insights, best practices, and approaches to racial equity transformation to advance the work of OESE researchers and organizations	Phase 4	EQ5	• Interviews with program team • Group conversations with select organization staff (not part of OSC or facilitation team) • Facilitation materials review

During Phase 0 we will review organization application materials and interview members of the WTRE team to understand (a) the context of each participating organization and (b) how organizational aspects that determine eligibility in the project affect the implementation of the model. This will allow the evaluation team to be grounded in their understanding of each organization's context and the relevance and applicability of the model within that context.

During Phase 1 the evaluation team will focus on how members of the Facilitation Teams grow their understanding of key concepts related to racial equity based on the materials developed during Phase 0. Evaluators will hold group discussions with the WTRE team and the Facilitation Teams, review rapid feedback forms from the Facilitation Teams after program sessions and observe select program sessions. The evaluators will document the characteristics of the Facilitation Teams, the Program Team, and the factors that contribute to Facilitation Teams' preparedness to bring content back to their organizations.

In Phases 2 and 3, the evaluation will examine the challenges and successes of implementing the WTRE material and the characteristics that influence implementation at each organization by holding group conversations with Facilitation Teams and OSC teams. The evaluation team will closely monitor the Facilitation Team custom support requests, the OSC feedback forms, and conduct select organization observations to understand which model elements (tool kit, curricula, custom support, cohort) facilitate organizational readiness to take action. The evaluation team will gather feedback from organization staff not participating in WTRE through an all-staff survey to gauge staff experience of the WTRE materials and with their OSC teams, and to set a baseline for additional staff conversations in Phase 4.

During Phase 4, the evaluation will host conversations with organization staff to look at the extent to which organizations made progress on their selected problems. These conversations will dig deeper into themes surfaced in the Phase 3 all-staff survey, and will be informed by the analysis of data from previous phases. The evaluation team will work closely with the Program and Research teams to inform the components and dissemination of the Racial Equity Transformation Tool Kit and explore potential areas of inquiry for future evaluations to understand the effectiveness of the model in the field as it is disseminated and adopted by other organizations. This phase will be informed by interviews with the Program Team, learnings from the prior years of evaluation, and a review of the program materials to be disseminated.

D. Dissemination Plan

We will share and disseminate findings in ways that feature and center participants' voices, including in co-presenting at conferences and co-authoring publications.

Dissemination of professional learning materials. STEM instructional and professional learning materials can typically be used, without causing harm, by educators with varying degrees of expertise. Conducting professional learning about racial equity and justice, however, even with high-quality, educative professional learning materials, requires specialized and advanced expertise in order to not cause harm. The extent to which the Racial Equity Transformation Tool Kit will be publicly available will be guided by research and evaluation findings. Decisions will be made to support high-quality transformative learning that mitigates the potential of harm to Professionals of Color in the field. Possible scenarios for dissemination: *Scenario 1:* The materials are sufficiently scaffolded and educative that most facilitators can use them without risk of causing harm, and will be widely available. *Scenario 2:* The materials require an abbreviated professional learning course that underscores keys to success along with potential pitfalls and thus, will be available to either individuals or organization teams who participate in a course from Lawrence Hall of Science and/or Justice Outside. *Scenario 3:* The materials require intensive professional learning and custom support and, as such, will be disseminated solely through participation in a comprehensive workshop series. We anticipate that different components might require different degrees of scaffolding. For example, the Foundations of Racial Equity Guide might require intensive professional learning, while the Facilitator's Reflection Guide may be disseminated broadly.

Dissemination channels. We will check project findings and invite participants to co-disseminate them through Mighty Network. We will reach additional OESE practitioners and researchers through: 1) Lawrence Hall of Science and Justice Outside networks (over 400 organizations and over 6,000 individual subscribers total); 2) "practitioner briefs" published by the Lawrence Hall of Science that focus on practical strategies and approaches; 3) conference presentations (e.g. People of the Global Majority in the Outdoors, Nature, and Environment (PGM ONE); North American Association of Environmental Education (NAAEE); NAAEE's State Affiliate network and groups; American Educational Research Association; American Evaluation Association; and 4) publication of findings in peer-reviewed journals (e.g. Journal of Environmental Education or Environmental Education Research).

E. Project Leadership

I. Partnership History and Capacity

This Racial Equity in STEM proposal requires significant organizational change management expertise, design and development expertise, and an institutional infrastructure with the capacity to engage in large-scale efforts. The Lawrence Hall of Science at the University of California, Berkeley (the Lawrence) will be the lead institution, in partnership with Justice Outside and Informing Change. Justice Outside and the Lawrence have been partners since 2017 when we received a Pisces Foundation grant to design and develop tools, resources, and professional learning to build the capacity of OESE organizations to foster equitable work environments. Our partnership has resulted in multiple publications (Romero, Foreman,

Strang, Rodriguez et al., 2019; Romero et al., 2022), including three (Gonzalez et al., 2021; Hernandez et al., 2020; Romero, Foreman, Strang, & Maybury et al., 2019) co-authored by Professionals of Color in the field, that provide high-quality examples of what it looks like to center racial equity in hiring, workplace culture, and crisis management (i.e., the Covid-19 pandemic). These publications highlight one of our key operating principles of ensuring that Professionals of Color are not just research subjects, they are central to the research design and sense-making itself. Informing Change joined this partnership in 2020 as an external evaluator on our NSF AISL Working Towards Racial Equity Project.

The Lawrence has a 55-year track record of designing effective materials and programs that translate research about learning into practical tools for educators and education leaders and take them to scale through dissemination to vast audiences. Through these tools and accompanying professional learning opportunities, the Lawrence supports school systems and informal science education institutions to build capacity for improving the quality and quantity of science learning they provide to their audiences, for the purpose of advancing equity and opportunity. The Lawrence is a leader in formal and informal STEM learning from preschool to college throughout the U.S. and internationally. **Justice Outside** advances racial justice and equity in the outdoor and environmental movement. They shift resources to, build power with, and center the voices and leadership of, Black, Indigenous, and People of Color through grantmaking, organizational capacity building, leadership development, and a national conference. They have a large national network of individuals and Black, Indigenous, and People of Color-led organizations, with regional hubs in the Pacific Northwest, Southwest, Delaware River Watershed, and North and South Carolina. **Informing Change** is a strategic learning firm based in Berkeley, CA. They have 20 years of experience supporting local, regional, and national nonprofit and philanthropic organizations to improve their effectiveness and build cultures of learning and continuous improvement. They believe that generating actionable insight in pursuit of equity is the highest and best purpose for strategy development, learning, and evaluation. Through their work, they help organizations build a better understanding of how to best make the change they want to see.

The project team has 1) deep expertise and reliable networks within the communities of outdoor, informal, and formal science education, 2) successful experience designing professional learning for outdoor, informal and formal science educators, 3) deep understanding of the unique challenges and significant opportunities in outdoor science education, and 4) the experience, infrastructure, and track record for designing and managing large-scale design, research, and evaluation efforts together.

II. Senior Personnel

Jedda Foreman, PI and Project Director, will oversee project strategy, activities, deliverables, timelines, and budget, and will be a lead author of the Working Towards Racial Equity model and the Racial Equity Transformation Tool Kit. She is the Director of the Advancing Environmental Learning Initiative at Lawrence Hall of Science. **Craig Strang**, Co-PI, will be a lead author of the Working Towards Racial Equity model and the Racial Equity Transformation Tool Kit and collaborate as a lead professional learning designer. Strang is the former Associate Director of Lawrence Hall of Science at the University of California, Berkeley. He co-chairs the California Environmental Literacy Initiative. He served on the Advisory Committee for the National Science Foundation Geosciences Directorate, and on the National Academy of Sciences, Panel Reviewing the National Oceanic & Atmospheric Administration Education Programs. **Valeria Romero**, Co-PI, Research Specialist will oversee the research component of this Project. Ms. Romero is a Senior Research Lead at the Lawrence Hall of Science, where she has led and supported over 25 research and evaluation studies of education programs. Her recent work focuses on examining the intersection of race, power and STEM education. She is currently Co-PI of two NSF-funded projects and is a Co-Chair of the Lawrence's Equity Leadership Team. Concurrently, she is a Ph.D. Candidate at the University of California, Davis. **Laura Rodriguez**, Co-PI and PI of the Justice Outside subaward, is the Chief Program Officer for Justice Outside. She has over 14 years of experience centered

on supporting communities in gaining access to healthcare, social services, education, and the outdoors. **Dr. Michael Arnold**, Director at Informing Change, will serve as the project director for the evaluation. Michael has over 15 years of experience conducting research and program evaluation, with a particular focus on social and structural determinants of health and programs serving communities of color, LGBTQ individuals, and youth, partnering with a range of clients in health, social services, employment, policy advocacy, the arts, and beyond. Arnold holds a PhD and MSW in social welfare and an MPH in epidemiology from the University of California, Berkeley.

III. Key Personnel

Advisory Board. Advisors will provide expertise on 1) the state and landscape of outdoor science education nationally; 2) equity and justice; and 3) research and evaluation. **Celeste Royer** (Director of Equity and Inclusion, Ten Strands), **Jody Donovan** (Principal and Senior Consultant, Rocky Mountain Consulting), **Déana Scipio (**Director of Education for Environment and Community Graduate Program, IslandWood), and **Dr. Autumn Saxton-Ross**, (Director, Mid-Atlantic Region, NatureBridge) all currently work or have recently worked in leadership positions in OESE across the country. Royer, Sexton-Ross, and Scipio are all Professionals of Color who have participated in earlier iterations of this project and have experience leading efforts to promote equity within their organizations. **Judy Brauss** (Executive Director, North American Association for Environmental Education) understands the national OESE landscape and the regional and state-wide landscapes through the NAAEE state-wide affiliate program. **Dr. Patricia D Quijada** (Professor of Education, University of California, Davis) and **Dr. Bernadette Chi** (Independent Consultant) have extensive experience leading culturally-responsive research and evaluation efforts that center the voices and experiences of Professionals of Color.

Partners.The five OESE organizations that participate in Phases 1-3 are the participating organization partners. As described above, all project activities will be co-designed and co-implemented with Justice Outside, and Informing Change will be the external evaluator.

IV. Project leadership by and in authentic partnership with individuals and communities who experience inequities caused by systemic racism

Multiple members of the project leadership team (Arnold, Rodriguez, and Romero) identify as people of color. PI Rodriguez has experienced inequities caused by systemic racism in the OESE field, specifically. The majority of project personnel (including programming, research, and evaluation teams) identify as People of Color. Additionally, our project team has created multiple mechanisms for additional leadership and partnership, including the BIPOC Affinity Spaces, Research and Evaluation Advisory Group, and project Advisory Board. Through these structures, Professionals of Color will have opportunities to provide input, share impacts, and co-design significant aspects of the program, research, and evaluation.

V. Results from prior NSF support

DRL 2005829: 1,999,323 (9/1/2020-8/31/2023). Strang, Romero, and Foreman are Co-PIs of Working Toward Equitable Organizations: Building Capacity for Leadership of Color in Outdoor and Environmental Science Education. Intellectual Merit: This project contributes to innovative approaches to building the capacity of OESE program leaders and Professionals of Color to work towards equitable workplaces. The research component aims to understand, through surveys and case studies, for whom and under what conditions organizations are able to make equitable institutional change. The project evaluation, using survey data feedback forms, supports ongoing improvements and enhancements to the design and implementation of the professional learning model. Broader Impacts: The project directly impacts 20 OESE nationwide, 150 organization leaders, and 65 Professionals of Color. Publications: So far, this project has resulted in five conference presentations.

Laura Rodriguez does not have prior NSF experience as a PI.

Working Toward Racial Equity:
Building Capacity to Institutionalize Equity in Outdoor and Environmental Science Education

Submitted to: Racial Equity in STEM Education, NSF 22-634

Submitted by: Jedda Foreman, Valeria Romero, Craig Strang, Laura Rodriguez

Lawrence Hall of Science & Justice Outside

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Submitted/PI: Jedda Foreman /Proposal No: 2315277

SUMMARY PROPOSAL BUDGET

YEAR 1

FOR NSF USE ONLY		
PROPOSAL NO.	DURATION (months)	
	Proposed	Granted
2315277		
AWARD NO.		

ORGANIZATION: University of California-Berkeley

PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR: Jedda Foreman

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-months CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. Jedda Foreman - Principal Inv	3.0			35,965	
2. Valeria Romero	2.4			25,244	
3. Craig Strang	1.8			37,656	
4.					
5.					
6. ( ) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	0.0			0	
7. (3) TOTAL SENIOR PERSONNEL (1 - 6)	7.2			98,865	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (0) POST DOCTORAL SCHOLARS	0.0			0	
2. (5) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	17.4			123,846	
3. (0) GRADUATE STUDENTS				0	
4. (1) UNDERGRADUATE STUDENTS				1,382	
5. (0) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				0	
6. (0) OTHER				0	
TOTAL SALARIES AND WAGES (A + B)				224,093	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				86,265	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				310,358	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
TOTAL EQUIPMENT				0	
E. TRAVEL 1. DOMESTIC (INCL. U.S. POSSESSIONS)				22,895	
2. INTERNATIONAL				0	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ 0					
2. TRAVEL 0					
3. SUBSISTENCE 0					
4. OTHER 0					
TOTAL NUMBER OF PARTICIPANTS (0) TOTAL PARTICIPANT COSTS				0	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				6,000	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				0	
3. CONSULTANT SERVICES				0	
4. COMPUTER SERVICES				0	
5. SUBAWARDS				115,599	
6. OTHER				145,533	
TOTAL OTHER DIRECT COSTS				267,132	
H. TOTAL DIRECT COSTS (A THROUGH G)				600,385	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) Modified Total Direct Costs (Rate: 40.0, Base:509786)					
TOTAL INDIRECT COSTS (F&A)				203,914	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				804,299	
K. FEE				0	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				804,299	

M. COST SHARING PROPOSED LEVEL $ 0 AGREED LEVEL IF DIFFERENT $

PI/PD NAME: Jedda Foreman

ORG. REP. NAME*: Eb Thorpe

FOR NSF USE ONLY		
INDIRECT COST RATE VERIFICATION		
Date Checked	Date Of Rate Sheet	Initials - ORG

*ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET

Submitted/PI: Jedda Foreman /Proposal No: 2315277

SUMMARY PROPOSAL BUDGET

YEAR 2

ORGANIZATION	FOR NSF USE ONLY: PROPOSAL NO.	DURATION (months) Proposed	Granted
University of California-Berkeley	2315277		
PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR: Jedda Foreman	AWARD NO.		

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-months CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. Jedda Foreman - Principal Inv	3.0			37,044	
2. Valeria Romero	2.4			26,128	
3. Craig Strang	1.8			38,409	
4.					
5.					
6. ( ) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	0.0			0	
7. (3) TOTAL SENIOR PERSONNEL (1 - 6)	7.2			101,581	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (0) POST DOCTORAL SCHOLARS	0.0			0	
2. (5) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	17.4			131,212	
3. (0) GRADUATE STUDENTS				0	
4. (1) UNDERGRADUATE STUDENTS				1,416	
5. (0) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				0	
6. (0) OTHER				0	
TOTAL SALARIES AND WAGES (A + B)				234,209	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				90,070	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				324,279	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
TOTAL EQUIPMENT				0	
E. TRAVEL 1. DOMESTIC (INCL. U.S. POSSESSIONS)				21,354	
2. INTERNATIONAL				0	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ 0					
2. TRAVEL 51,250					
3. SUBSISTENCE 0					
4. OTHER 12,000					
TOTAL NUMBER OF PARTICIPANTS (30) TOTAL PARTICIPANT COSTS				63,250	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				1,000	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				0	
3. CONSULTANT SERVICES				0	
4. COMPUTER SERVICES				0	
5. SUBAWARDS				110,512	
6. OTHER				170,049	
TOTAL OTHER DIRECT COSTS				281,561	
H. TOTAL DIRECT COSTS (A THROUGH G)				690,444	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) Modified Total Direct Costs (Rate: 40.0, Base:516682)					
TOTAL INDIRECT COSTS (F&A)				206,673	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				897,117	
K. FEE				0	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				897,117	

M. COST SHARING PROPOSED LEVEL $ 0 AGREED LEVEL IF DIFFERENT $

PI/PD NAME	FOR NSF USE ONLY: INDIRECT COST RATE VERIFICATION		
Jedda Foreman	Date Checked	Date Of Rate Sheet	Initials - ORG
ORG. REP. NAME* Eb Thorpe			

*ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET

Submitted/PI: Jedda Foreman /Proposal No: 2315277

SUMMARY PROPOSAL BUDGET

YEAR 3

ORGANIZATION	FOR NSF USE ONLY: PROPOSAL NO.	DURATION (months) Proposed	Granted
University of California-Berkeley	2315277		
PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR: Jedda Foreman	AWARD NO.		

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-months CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. Jedda Foreman - Principal Inv	3.0			41,589	
2. Valeria Romero	2.4			33,803	
3. Craig Strang	2.4			54,848	
4.					
5.					
6. ( ) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	0.0			0	
7. (3) TOTAL SENIOR PERSONNEL (1 - 6)	7.8			130,240	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (0) POST DOCTORAL SCHOLARS	0.0			0	
2. (5) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	17.4			135,611	
3. (0) GRADUATE STUDENTS				0	
4. (1) UNDERGRADUATE STUDENTS				1,452	
5. (0) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				0	
6. (0) OTHER				0	
TOTAL SALARIES AND WAGES (A + B)				267,303	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				102,358	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				369,661	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
TOTAL EQUIPMENT				0	
E. TRAVEL 1. DOMESTIC (INCL. U.S. POSSESSIONS)				24,704	
2. INTERNATIONAL				0	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ 0					
2. TRAVEL 0					
3. SUBSISTENCE 0					
4. OTHER 0					
TOTAL NUMBER OF PARTICIPANTS (0) TOTAL PARTICIPANT COSTS				0	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				1,000	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				0	
3. CONSULTANT SERVICES				0	
4. COMPUTER SERVICES				0	
5. SUBAWARDS				137,731	
6. OTHER				182,688	
TOTAL OTHER DIRECT COSTS				321,419	
H. TOTAL DIRECT COSTS (A THROUGH G)				715,784	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) Modified Total Direct Costs (Rate: 40.0, Base:578053)					
TOTAL INDIRECT COSTS (F&A)				231,221	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				947,005	
K. FEE				0	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				947,005	

M. COST SHARING PROPOSED LEVEL $ 0 AGREED LEVEL IF DIFFERENT $

PI/PD NAME	FOR NSF USE ONLY: INDIRECT COST RATE VERIFICATION		
Jedda Foreman	Date Checked	Date Of Rate Sheet	Initials - ORG
ORG. REP. NAME* Eb Thorpe			

*ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET

Submitted/PI: Jedda Foreman /Proposal No: 2315277

SUMMARY PROPOSAL BUDGET

YEAR 4

ORGANIZATION	FOR NSF USE ONLY: PROPOSAL NO.	DURATION (months) Proposed	Granted
University of California-Berkeley	2315277		
PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR: Jedda Foreman	AWARD NO.		

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-months CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. Jedda Foreman - Principal Inv	3.0			42,836	
2. Valeria Romero	3.0			34,986	
3. Craig Strang	2.4			55,945	
4.					
5.					
6. ( ) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	0.0			0	
7. (3) TOTAL SENIOR PERSONNEL (1 - 6)	8.4			133,767	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (0) POST DOCTORAL SCHOLARS	0.0			0	
2. (5) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	19.2			157,071	
3. (0) GRADUATE STUDENTS				0	
4. (1) UNDERGRADUATE STUDENTS				1,488	
5. (0) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				0	
6. (0) OTHER				0	
TOTAL SALARIES AND WAGES (A + B)				292,326	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				112,445	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				404,771	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
TOTAL EQUIPMENT				0	
E. TRAVEL 1. DOMESTIC (INCL. U.S. POSSESSIONS)				15,929	
2. INTERNATIONAL				0	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ 0					
2. TRAVEL 82,750					
3. SUBSISTENCE 0					
4. OTHER 12,500					
TOTAL NUMBER OF PARTICIPANTS (50) TOTAL PARTICIPANT COSTS				95,250	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				1,000	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				10,000	
3. CONSULTANT SERVICES				0	
4. COMPUTER SERVICES				0	
5. SUBAWARDS				174,097	
6. OTHER				185,474	
TOTAL OTHER DIRECT COSTS				370,571	
H. TOTAL DIRECT COSTS (A THROUGH G)				886,521	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) Modified Total Direct Costs (Rate: 40.0, Base:617174)					
TOTAL INDIRECT COSTS (F&A)				246,870	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				1,133,391	
K. FEE				0	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				1,133,391	

M. COST SHARING PROPOSED LEVEL $ 0 AGREED LEVEL IF DIFFERENT $

PI/PD NAME	FOR NSF USE ONLY: INDIRECT COST RATE VERIFICATION		
Jedda Foreman	Date Checked	Date Of Rate Sheet	Initials - ORG
ORG. REP. NAME* Eb Thorpe			

*ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET

Submitted/PI: Jedda Foreman /Proposal No: 2315277

SUMMARY PROPOSAL BUDGET

YEAR 5

FOR NSF USE ONLY		
PROPOSAL NO.	DURATION (months)	
	Proposed	Granted
2315277		
AWARD NO.		

ORGANIZATION: University of California-Berkeley

PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR: Jedda Foreman

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-months CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. Jedda Foreman - Principal Inv	3.0			48,092	
2. Valeria Romero	3.0			36,210	
3. Craig Strang	1.2			29,958	
4.					
5.					
6. ( ) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	0.0			0	
7. (3) TOTAL SENIOR PERSONNEL (1 - 6)	7.2			114,260	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (0) POST DOCTORAL SCHOLARS	0.0			0	
2. (5) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	18.0			149,135	
3. (0) GRADUATE STUDENTS				0	
4. (1) UNDERGRADUATE STUDENTS				1,525	
5. (0) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				0	
6. (0) OTHER				0	
TOTAL SALARIES AND WAGES (A + B)				264,920	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				103,439	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				368,359	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
TOTAL EQUIPMENT				0	
E. TRAVEL 1. DOMESTIC (INCL. U.S. POSSESSIONS)				21,262	
2. INTERNATIONAL				0	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ 0					
2. TRAVEL 21,270					
3. SUBSISTENCE 0					
4. OTHER 0					
TOTAL NUMBER OF PARTICIPANTS (10) TOTAL PARTICIPANT COSTS				21,270	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				1,000	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				10,000	
3. CONSULTANT SERVICES				0	
4. COMPUTER SERVICES				0	
5. SUBAWARDS				144,991	
6. OTHER				152,918	
TOTAL OTHER DIRECT COSTS				308,909	
H. TOTAL DIRECT COSTS (A THROUGH G)				719,800	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) Modified Total Direct Costs (Rate: 40.0, Base:553539)					
TOTAL INDIRECT COSTS (F&A)				221,416	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				941,216	
K. FEE				0	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				941,216	

M. COST SHARING PROPOSED LEVEL $ 0 AGREED LEVEL IF DIFFERENT $

PI/PD NAME: Jedda Foreman

ORG. REP. NAME*: Eb Thorpe

FOR NSF USE ONLY		
INDIRECT COST RATE VERIFICATION		
Date Checked	Date Of Rate Sheet	Initials - ORG

*ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET

Submitted/PI: Jedda Foreman /Proposal No: 2315277

SUMMARY PROPOSAL BUDGET

Cumulative

ORGANIZATION	FOR NSF USE ONLY: PROPOSAL NO.	DURATION (months) Proposed	Granted
University of California-Berkeley	2315277		
PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR: Jedda Foreman	AWARD NO.		

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-months CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. Jedda Foreman - Principal Inv	15.0			205,526	
2. Valeria Romero	13.2			156,371	
3. Craig Strang	9.6			216,816	
4.					
5.					
6. ( ) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)					
7. (3) TOTAL SENIOR PERSONNEL (1 - 6)	37.8			578,713	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (0) POST DOCTORAL SCHOLARS	0.0			0	
2. (25) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	89.39999999999999			696,875	
3. (0) GRADUATE STUDENTS				0	
4. (5) UNDERGRADUATE STUDENTS				7,263	
5. (0) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				0	
6. (0) OTHER				0	
TOTAL SALARIES AND WAGES (A + B)				1,282,851	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				494,577	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				1,777,428	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
TOTAL EQUIPMENT				0	
E. TRAVEL 1. DOMESTIC (INCL. U.S. POSSESSIONS)				106,144	
2. INTERNATIONAL				0	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ 0					
2. TRAVEL 155,270					
3. SUBSISTENCE 0					
4. OTHER 24,500					
TOTAL NUMBER OF PARTICIPANTS (90) TOTAL PARTICIPANT COSTS				179,770	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				10,000	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				20,000	
3. CONSULTANT SERVICES				0	
4. COMPUTER SERVICES				0	
5. SUBAWARDS				682,930	
6. OTHER				836,662	
TOTAL OTHER DIRECT COSTS				1,549,592	
H. TOTAL DIRECT COSTS (A THROUGH G)				3,612,934	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE)					
TOTAL INDIRECT COSTS (F&A)				1,110,094	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				4,723,028	
K. FEE				0	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				4,723,028	

M. COST SHARING PROPOSED LEVEL $ 0 AGREED LEVEL IF DIFFERENT $

PI/PD NAME	FOR NSF USE ONLY: INDIRECT COST RATE VERIFICATION		
Jedda Foreman	Date Checked	Date Of Rate Sheet	Initials - ORG
ORG. REP. NAME* Eb Thorpe			

*ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET

Submitted/PI: Jedda Foreman /Proposal No: 2315277

Budget Justification

A. ***Senior Personnel****:*
PI **Jedda Foreman** will provide leadership and oversight at 25% FTE in each grant year. Responsibilities also oversee project strategy, activities, deliverables, timelines, and budget, and will be a lead author of the Working Towards Racial Equity model and the Racial Equity Transformation Tool Kit. She will also be the lead contact for Laura Rodriguez, Co-PI from Justice Outside.
Co-PI **Craig Strang** will be a lead author of the Working Towards Racial Equity model and the Racial Equity Transformation Tool Kit and collaborate as a lead professional learning designer at 15% FTE in Yrs 1–2, 20% FTE in Yrs 2–4, and 10% FTE in Yrs 5.
Co-PI **Valeria Romero** will lead and oversee all research activities at 20% FTE in Yrs 1–2 and 25% FTE in Yrs 3–5. She will co-author all research findings. She will also be the lead contact for Michael Arnold, subaward PI at Informing Change.

In accordance with the PAPPG (Chapter II.C.2.g.(i))), the salary compensation requested in the proposal budget for the following senior personnel exceeds two months of salary compensation per year: Jedda Foreman, Valeria Romero, and Craig Strang (Yrs 3 and 4 only). The proposed levels of effort for this project are appropriate for the scope of work and are required in order to fulfill the objectives of the project within the proposed performance period. In addition, these investigators do not hold faculty appointments and are not core funded. Thus, their respective salaries are dependent on extramural funds. The University of California, Berkeley's definition of a "year" (effective April 1, 2018) for budgeting and management of senior personnel compensation is the fiscal year (July 1 to June 30).

B. Other Personnel:
B.2 Other Professionals: Additional project staff bring expertise in professional learning and organizational capacity building (Calhoun) and research (Sanchez, Grindstaff, and Young): **Corinne Calhoun**, Coordinator, will lead planning meetings, communicate with participants, collaborate on programmatic workshop design and implementation, and be a lead author of the Racial Equity Transformation Tool Kit at 35% FTE in Yrs 1-4 and 25% FTE in Yr 5 for a total of $191,256. **Alex Sanchez**, research coordinator, will oversee research coordination, and support study design and implementation including instrument development, data collection and sense-making at 25% FTE in Yrs 1–3 and 30% FTE in Yrs 4–5 for a total of $104,322. **Kelly Grindstaff**, research associate, brings expertise in qualitative studies and analysis. She will support research project management and contribute to study design and implementation including data collection, analysis, and dissemination at 25% FTE in Yrs 1–3 and 30% FTE in Yrs 4–5 for a total of $136,019. **Aujanée Young**, research analyst, will contribute to research activities including instrument development, data collection, and sense-making at 20% FTE in Yrs 1–3 and 25% FTE in Yrs 4–5 for a total of $86,375. **TBD**, project manager, will coordinate project logistics including individual and team calendars, in-person meetings with participants, and resource tracking and organization at 40% FTE in all Yrs for a total of $178,902.
B.4 Undergraduate Student: An undergraduate student will provide support with research data processing and transcription in Yrs 1–5, estimated at 80 hours/year (3.8% FTE). Rate is estimated at $17.50/hour based on UC policy for student employees.

Salaries are based on December 2022 actual salaries and are projected to include an annual cost-of-living adjustment (and merit, if applicable) effective each year.

C. ***Fringe Benefits***: The University of California, Berkeley Composite Fringe Benefit Rates (CFBR) have been reviewed and federally approved by the Department of Health and Human Services (DHHS) for use by all fund sources through FY21. Rates beyond June 30, 2021 are estimates and are provided for planning purposes only. Future CFBR rates are subject to review and approval by DHHS

on an annual or bi-annual basis. Fringe benefits are assessed as a percentage of the respective employee's salary. The benefit rates are as follows:

	Proposed		Projections for Planning Purposes	
CFBR Rate Group	**FY23**	**FY24**	**FY25**	**FY26**
Academic	35.4%	34.4%	34.4%	34.4%
Staff	42.8%	42.8%	42.8%	42.8%
Students (Graduate and Undergraduate)	2.8%	2.3%	2.3%	2.3%

For more information, please see: https://spo.berkeley.edu/policy/benefits/benefits.html

D. ***Equipment*****:** N/A

E. ***Travel*****:** Domestic: Cost estimates are based on past similar charges and current prices via ConnexUC, a web portal with access to University of California's Systemwide Travel Program offering comprehensive discounted rates and benefits for all those affiliated with UC. Cost estimates follow the UC Travel Regulations, Policy G-28 (see: https://policy.ucop.edu/doc/3420365/BFB-G-28). A travel budget of $106,144 (Yr 1: $22,895; Yr 2: $21,354; Yr 3: $24,704; Yr 4: $15,929; Yr 5: $21,262) is requested for project staff to attend:

1. $25,224 is requested for 2 people to attend one trip each Yrs 1-4 (3-days/2-nights) and 4 people to attend 1 trip each in Yr 5 for conferences. Funds will be used to send different Lawrence project team members across different roles to these conferences to support capacity building. Costs for Justice Outside conference attendance are included in G.6ix. Conferences will focus on recruiting participants in Yr 1 and dissemination in Yrs 2-5 at practitioner or research conferences, such as People of the Global Majority in the Outdoors, Nature, and Environment, North American Association of Environmental Education, likely held at similar previous conference venues such as Tucson, Arizona or Saco, Maine. The amount includes conference registration fees ($400/person), airfare ($650 RT/person), meals ($79/day/person), lodging ($275/night/person), ground transportation ($150/person) and airport parking and mileage ($30/day/person, mileage to/from airport $50/person) for a total of $2,522.40 per person per conference.

2. $10,362 is requested for one 3-day/2-night PI meeting in or near Washington DC in project Yrs 1, 3, and 5. We will send one member of the PI team plus one community member each time. The amount includes airfare ($650 RT/person), meals ($79/day/person), lodging ($270/night/person), airport parking and mileage $30/day/person, mileage to/from airport $50/person) and ground transportation ($150/person), for a total of for a subtotal of $1,577 per person per meeting.

3. $18,438 is requested for one in-person cross-organization collaborative meeting (3 days/2 nights) in each of Yrs 1, 3, and 5 for Lawrence project staff (8 persons) to engage in project planning with partner organizations, Justice Outside and Informing Change. Meeting foci include programmatic, research, and evaluation alignment for phases 1 and 2 in Yr 1; responding to participant feedback, data analysis, and alignment of activities for Yr 3; and sensemaking and dissemination in Yr 5. All of our project team members work remotely across the greater SF Bay Area, so the in-person meeting will be held at a central offsite location such as Marconi Conference Center in Point Reyes, CA. Costs for attendance of Justice Outside staff are included in G.6x. The amount includes mileage ($31.25/person), meals ($79/day/person), and lodging ($250/night/person), for a total of $2,304 per/person.

4. $12,500 is requested for Lawrence project staff (8 persons) to attend Phase 1 and Phase 3 in-person participant workshops (4 days/3 nights) in Yrs 2 and 4. The in-person workshops will be held at an offsite location such as Walker Creek Ranch and Conference Center in Petaluma, CA, which can accommodate a large number of attendees, and provides opportunities for environmental learning-specific program activities. Costs for attendance of Justice Outside staff are included in G.6xi. The amount includes mileage ($31.25/person), room and board ($250/night/person) for a subtotal of

$1,562.50 per person per workshop.

5. $36,166 is requested for research case site visits (3 days/2 nights) for 1 person (co-PI/research coordinator/analyst). A research team member will visit five participating organizations in Yr 1; three of the five organizations twice in Yrs 2 –3, and those same three organizations once in Yr 4. The amount includes airfare ($650 RT/person), meals ($79/day/person), lodging ($250/night/person), airport parking and mileage ($30/day/person, mileage to/from airport $50/person and ground transportation, which may include a rental car in cases of remote site locations, budgeted at $250. Travel expenses for case site visits will total $9,041 in Yr 1; $10,850 each Yr in Yrs 2 and 3; and $5,425 in Yr 4.

F. Participant Support Costs: We will work with five OESE organizations. In Phase 1, a total of 30 people (teams of 6 people per organization) and in Phase 3, a total of 50 people (teams of 10 people). As part of the recruitment and selection process, organizations will be advised that attending in-person workshops is an organizational commitment; we will provide full room and board and travel.

F.1 Stipends: No stipends are included because participation is part of their job.

F.2 Travel:
1. Travel to support participant attendance at the in-person workshop (30 participants in Yr 2 and 50 participants in Yr 4) are budgeted. Airfare for each participant is estimated at $700/person and room and board at $250 per person/night. Funds for a shuttle to transport participants from airport to the conference site is budgeted at $4000, as well as additional lodging funds of $250 per night for an estimated 15 persons in Yr 2 and 25 persons in Yr 4 who will have to stay an extra night in a hotel due to travel times. The total cost is $134,000 ($51,250 in Yr 2 and $82,750 in Yr 4).
2. Travel to support 10 participants' engagement in project dissemination (as co-presenters, conference panelists) in Yr 5 is budgeted. Estimated costs include $650 airfare per person, $79 per diem, $275 lodging per person, $150 ground transportation, $50 airport mileage/person, $30 per person per day for airport parking, and $400 conference registration per person for a subtotal of $2,127 per person per conference. Total cost is $21,270.

F.4 Other:

a. **Participant Hardware** is included for participants' technological needs (e.g., tablet, Chromebook, webcam, hot spot) to support equitable participation in all virtual programming components in Phases 1 – 3, in response to a reality within OESE organizations, where not all staff have computers or other technology equipment if it is not directly tied to their job. Total cost is $12,500 ($7,500 in Yr 2 @ $500 up to 15 participants; $5,000 in Yr 4 @ $500 up to 10 participants).
b. **Participant Materials and supplies** for in-person workshops, such as handouts, notebooks, and writing supplies, are estimated at $150 per person per workshop for a total of $12,000.

G. Other Direct Costs

G.1 Materials and supplies

a. Computer equipment at $5,000 in Yr 1, includes two computers for project communications and facilitation of virtual workshop. These purchases are in-line with UC Berkeley computer purchasing policy that "computers used to accomplish the technical scope maybe charged directly to sponsored awards provided they can be specifically identified to and benefit the project."
b. Additional supplies at $1,000 per year for printing, copying, and other workshop supplies.

G.2 Publication cost, documentation, and dissemination: $20,000 for Article Publishing Charges ($10,000 in each Yrs 4 and 5) is included to submit research, evaluation, and practitioner findings to journals. This is based on an estimated $3,000 per article plus taxes for two to three journals. Possible academic journals and current APCs (excluding taxes) include Applied Environmental Education and

Communication (APC: $3,175), Environmental Education (APC: $4,130), The Journal of Environmental Education (APC: $2,970), and International Research in Geographical and Environmental Education (APC: $3,175).

G.3 Consultant Services: n/a

G.4 Computer Services: n/a

G.5 Subawards: To support Informing Change in the amount of $682,930 to support the work under the guidance of Michael Arnold, as per the work and tasks as described in the project description. Please see the separate subaward budget and budget justification for a detailed breakdown of costs. Informing Change was selected as a partner in this work due to our history of partnership as well as their expertise in and focus on culturally responsive and equitable evaluation practices.

G.6 Other:

i. Subscriptions at $17,277 are included to carry out project and research activities: Mighty network at $99/month for unlimited participants for a total of $1,188 in Yrs 2–5 included provide an online communication platform among participants and facilitators; Descript for $300/year in Yrs 1–5 for data analysis; Dedoose in Yrs 1–5 for $12.95/month/per person for 4 researchers ($621/year); Calendly (calendar management software) at $12 per person per month (11 team members) for a total of $1,584 in Yrs1–5 to streamline scheduling internally and with participating organizations.

ii. Coaching at $6,600 in Yrs 2–5 for external leadership coaching sessions for project team, particularly members of color who will bear an additional emotional burden in doing work related to racial equity. Coaching is estimated at $300/hour for up to 2.75 hours of coaching for up 8 team members per year (including Justice Outside and Informing Change).

iii. Honoraria will be provided for three types of project advisors:

a. Seven project advisors to provide guidance on design and implementation of project for an estimated 8 hours of service to the project: Celeste Royer, Jody Donovan, Déana Scipio, Autumn Saxton-Ross, Judy Braus, Patricia D Quijada, and Bernadette Chi. Honoraria will be $1,600 for 6 advisors, and $1,500 for 1 advisor due to UC Policy.

b. Five Racial Equity Transformation Toolkit Peer Reviewers, to provide feedback on components of the toolkit, approximately 10 hours of service to the project. Peer reviewers to be recruited, in Yrs 3–5 for $1000 per reviewer per year.

c. Six Research Evaluation Advisory Group members to provide feedback on research and evaluation at various stages. Rate is estimated at $200/hour/person for an estimated 12 hours in year 1 ($2400 per member) and 9 hours in each of Yrs 2–4 ($1800 per member).

iv. Toolkit document editing and layout costs are included at $5,000 per year in each of Yrs 3–5 for document editing, layout, and creation of graphics for Racial Equity Transformation Tool Kit, conferences, and papers. This amount is based on previous work with Editcetera, who contracts with our marketing department to support Lawrence Papers publications. Total is $15,000.

v. Working lunch for daylong focus groups with research participants at $300 per site visit ($15/person@ 20 people/site) for five site visits in Yr 5 and three site visits in Yrs 2–4 for total of $4,200.

vi. Five types of research incentives are included; they are based on $50/hour and will be tracked with our business office, using UC Berkeley's Cash Card Incentive Systems, to ensure incentives are provided and received for each data collection activity, as follows:

a. Case site data collection: $75/person for 15 people at 5 sites in Yr 1 and 20 people at 3 sites in each of Yrs 2–4. Participation ranges from 5 to 10 hours over the study. Total is $19,125.

b. Professionals of color focus group conversations: $75/person for 30 people in each of Yrs 1–4. Participation ranges from 2 hours and up to 10 hours. Total is $9,000.

c. Site liaison to support with case study data collection is included at $400 site for 3 sites in each of Yrs 2–4 for approximately five hours of work per liaison at $100/hour for total of $3,600.

d. Survey: $20/person (100 people, 30 min each time) in each of Yrs 1–5, for total of $10,000.

e. Ten focal professionals of color for one-hour interview at $75/person Yrs 2–4. Total is $2,250.

vii. $2,500/organization for a team coordinator to liaison between WTRE team and their organization, including uploading organization documentation, ensuring team attendance, and scheduling liaison and coaching meetings. Costs estimated for an annual effort of approximately 25 hours at $100/hour.

viii. A service contract to Justice Outside in the amount of $527,083 to support the work under the guidance of Laura Rodriguez as per the work and tasks as described in the project description. The intent is for Justice Outside to be issued a subaward (post-award), however, due to a registration issue with SAM.gov, the budget amount is placed here instead of G.5. Justice Outside was selected as a partner in this work due to our history of partnership and co-design of the project model as well as Justice Outside's national network and experience centering the voices of professionals of color within the OESE field. Justice Outside's budget includes: 1) time for PI **Laura Rodriguez**, who will provide leadership, oversight, and consult on all programmatic and research design elements, at 10% FTE in years 1–4 and 15% FTE in year 5. Her responsibilities include reviewing research protocols and co-authoring publications. She will work collaboratively with Jedda Foreman, Craig Strang, and Valeria Romero from the Lawrence Hall of Science as well as Michael Arnold from Informing Change, the project's external evaluator; 2) time for **a Training and Support Lead**, at 25% year 1, 35% in years 2–4, and 25% in year 5, who will be responsible for planning and implementing all programmatic elements, including designing and leading in-person and virtual workshops, offering custom support to individual organizations, and authoring publications; 3) time for a **Training and Support Specialist**, who will be responsible for leading and supporting in-person and virtual workshops, at 20% year 1, 25% in years 2–4, and 15% in year 5; 4) fringe benefits, assessed as a percentage of the respective employee's salary at a rate of 20%; and 5) Indirect costs, calculated at a *de minimis* indirect cost rate recovery of 10% of modified total direct costs.

Intentionally, Justice Outside's budget includes funding for effort related to programmatic design and implementation as well input into research and evaluation design. It does not include funding for effort associated with project management or coordination, or funds for participant support, materials, travel, or other direct costs. This is by design to reduce the administrative burden on Justice Outside's smaller team.

ix. $25,524 is requested for 2 Justice Outside people to attend 1 trips annually in Yrs 1-4 (3-day/2-night) and 2 people to attend 1 trip in Yr 5, for conferences. Description of expense included in E1.

x. $6,915 is requested for one in-person cross-organization collaborative meeting in each of Yrs 1, 3, and 5 for project staff at Justice Outside (3 persons) to engage in project planning, reflection, and sense-making. Description included in E3.

xi. $4,688 is requested for project staff at Justice Outside (3 persons) to attend Phase 1 and Phase 3 in-person participant workshops (3 days/3 nights) in Yrs 2 and 4. Description included in E4.

H. Indirect Costs: Indirect Costs are requested at $1,110,094 Indirect costs are based on University negotiated rates with the Department of Health and Human Services and are applied at Other Sponsored Activities, On-campus rate at 40% as of 7/1/2022 until amended.

Indirect costs are calculated using the modified total direct cost (MDTC) formula as per the approved rate agreement dated October 24, 2019. Modified total direct costs, consisting of all direct salaries and wages, applicable fringe benefits, materials, supplies, services, travel and up to the first $25,000 of each subaward (regardless of the period of performance of the subawards under the award). Modified total direct costs shall exclude equipment, capital expenditures, charges for patient care, student tuition remission, rental costs of off-site facilities, scholarships, and fellowships, participant support costs and the portion of each subaward in excess of $25,000. For more information,
see: https://spo.berkeley.edu/policy/fa.html. The rates after July 1, 2022 are provisional and subject to change based upon our updated federally negotiated indirect cost rate agreement.

Submitted/PI: Jedda Foreman /Proposal No: 2315277

SUMMARY PROPOSAL BUDGET

YEAR 1

ORGANIZATION	FOR NSF USE ONLY: PROPOSAL NO.	DURATION (months) Proposed	Granted
BTW CONSULTANTS, INC.	2315277		
PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR: Jedda Foreman	AWARD NO.		

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-months CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. Michael Arnold	0.72			32,500	
2.					
3.					
4.					
5.					
6. ( ) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	0.0			0	
7. (1) TOTAL SENIOR PERSONNEL (1 - 6)	0.72			32,500	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (0) POST DOCTORAL SCHOLARS	0.0			0	
2. (5) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	4.0			71,855	
3. (0) GRADUATE STUDENTS				0	
4. (0) UNDERGRADUATE STUDENTS				0	
5. (0) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				0	
6. (0) OTHER				0	
TOTAL SALARIES AND WAGES (A + B)				104,355	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				0	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				104,355	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
TOTAL EQUIPMENT				0	
E. TRAVEL 1. DOMESTIC (INCL. U.S. POSSESSIONS)				150	
2. INTERNATIONAL				0	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ 0					
2. TRAVEL 0					
3. SUBSISTENCE 0					
4. OTHER 0					
TOTAL NUMBER OF PARTICIPANTS (0) TOTAL PARTICIPANT COSTS				0	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				0	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				0	
3. CONSULTANT SERVICES				0	
4. COMPUTER SERVICES				0	
5. SUBAWARDS				0	
6. OTHER				585	
TOTAL OTHER DIRECT COSTS				585	
H. TOTAL DIRECT COSTS (A THROUGH G)				105,090	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) Modified Total Direct Costs (Rate: 10.0, Base:105090)					
TOTAL INDIRECT COSTS (F&A)				10,509	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				115,599	
K. FEE				0	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				115,599	

M. COST SHARING PROPOSED LEVEL $ 0 AGREED LEVEL IF DIFFERENT $

PI/PD NAME	FOR NSF USE ONLY: INDIRECT COST RATE VERIFICATION		
Jedda Foreman	Date Checked	Date Of Rate Sheet	Initials - ORG
ORG. REP. NAME* Eb Thorpe			

*ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET

Submitted/PI: Jedda Foreman /Proposal No: 2315277

SUMMARY PROPOSAL BUDGET

YEAR 2

ORGANIZATION	FOR NSF USE ONLY		
BTW CONSULTANTS, INC.	PROPOSAL NO. 2315277	DURATION (months) Proposed	Granted
PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR Jedda Foreman	AWARD NO.		

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-months CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. Michael Arnold	0.6			29,700	
2.					
3.					
4.					
5.					
6. ( ) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	0.0			0	
7. (1) TOTAL SENIOR PERSONNEL (1 - 6)	0.6			29,700	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (0) POST DOCTORAL SCHOLARS	0.0			0	
2. (5) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	3.0			66,945	
3. (0) GRADUATE STUDENTS				0	
4. (0) UNDERGRADUATE STUDENTS				0	
5. (0) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				0	
6. (0) OTHER				0	
TOTAL SALARIES AND WAGES (A + B)				96,645	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				0	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				96,645	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
TOTAL EQUIPMENT				0	
E. TRAVEL 1. DOMESTIC (INCL. U.S. POSSESSIONS)				150	
2. INTERNATIONAL				0	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ 0					
2. TRAVEL 0					
3. SUBSISTENCE 0					
4. OTHER 0					
TOTAL NUMBER OF PARTICIPANTS (0) TOTAL PARTICIPANT COSTS				0	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				0	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				0	
3. CONSULTANT SERVICES				0	
4. COMPUTER SERVICES				0	
5. SUBAWARDS				0	
6. OTHER				3,670	
TOTAL OTHER DIRECT COSTS				3,670	
H. TOTAL DIRECT COSTS (A THROUGH G)				100,465	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) Modified Total Direct Costs (Rate: 10.0, Base:100465)					
TOTAL INDIRECT COSTS (F&A)				10,047	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				110,512	
K. FEE				0	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				110,512	

M. COST SHARING PROPOSED LEVEL $ 0 AGREED LEVEL IF DIFFERENT $

PI/PD NAME	FOR NSF USE ONLY		
Jedda Foreman	INDIRECT COST RATE VERIFICATION		
ORG. REP. NAME* Eb Thorpe	Date Checked	Date Of Rate Sheet	Initials - ORG

*ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET

Submitted/PI: Jedda Foreman /Proposal No: 2315277

SUMMARY PROPOSAL BUDGET

YEAR 3

ORGANIZATION	FOR NSF USE ONLY: PROPOSAL NO.	DURATION (months) Proposed	Granted
BTW CONSULTANTS, INC.	2315277		
PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR: Jedda Foreman	AWARD NO.		

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-months CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. Michael Arnold	0.67			33,660	
2.					
3.					
4.					
5.					
6. ( ) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	0.0			0	
7. (1) TOTAL SENIOR PERSONNEL (1 - 6)	0.67			33,660	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (0) POST DOCTORAL SCHOLARS	0.0			0	
2. (5) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	4.25			81,665	
3. (0) GRADUATE STUDENTS				0	
4. (0) UNDERGRADUATE STUDENTS				0	
5. (0) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				0	
6. (0) OTHER				0	
TOTAL SALARIES AND WAGES (A + B)				115,325	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				0	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				115,325	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
TOTAL EQUIPMENT				0	
E. TRAVEL 1. DOMESTIC (INCL. U.S. POSSESSIONS)				6,410	
2. INTERNATIONAL				0	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ 0					
2. TRAVEL 0					
3. SUBSISTENCE 0					
4. OTHER 0					
TOTAL NUMBER OF PARTICIPANTS (0) TOTAL PARTICIPANT COSTS				0	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				0	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				0	
3. CONSULTANT SERVICES				0	
4. COMPUTER SERVICES				0	
5. SUBAWARDS				0	
6. OTHER				3,475	
TOTAL OTHER DIRECT COSTS				3,475	
H. TOTAL DIRECT COSTS (A THROUGH G)				125,210	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) Modified Total Direct Costs (Rate: 10.0, Base:125210)					
TOTAL INDIRECT COSTS (F&A)				12,521	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				137,731	
K. FEE				0	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				137,731	

M. COST SHARING PROPOSED LEVEL $ 0 AGREED LEVEL IF DIFFERENT $

PI/PD NAME	FOR NSF USE ONLY: INDIRECT COST RATE VERIFICATION		
Jedda Foreman	Date Checked	Date Of Rate Sheet	Initials - ORG
ORG. REP. NAME* Eb Thorpe			

*ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET

Submitted/PI: Jedda Foreman /Proposal No: 2315277

SUMMARY PROPOSAL BUDGET

YEAR 4

FOR NSF USE ONLY		
PROPOSAL NO.	DURATION (months)	
	Proposed	Granted
AWARD NO.		

ORGANIZATION: BTW CONSULTANTS, INC.

PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR: Jedda Foreman

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-months CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. Michael Arnold	0.8			42,000	
2.					
3.					
4.					
5.					
6. ( ) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	0.0			0	
7. (1) TOTAL SENIOR PERSONNEL (1 - 6)	0.8			42,000	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (0) POST DOCTORAL SCHOLARS	0.0			0	
2. (5) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	4.8			112,535	
3. (0) GRADUATE STUDENTS				0	
4. (0) UNDERGRADUATE STUDENTS				0	
5. (0) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				0	
6. (0) OTHER				0	
TOTAL SALARIES AND WAGES (A + B)				154,535	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				0	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				154,535	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
TOTAL EQUIPMENT				0	
E. TRAVEL 1. DOMESTIC (INCL. U.S. POSSESSIONS)				150	
2. INTERNATIONAL				0	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ 0					
2. TRAVEL 0					
3. SUBSISTENCE 0					
4. OTHER 0					
TOTAL NUMBER OF PARTICIPANTS (0) TOTAL PARTICIPANT COSTS				0	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				0	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				0	
3. CONSULTANT SERVICES				0	
4. COMPUTER SERVICES				0	
5. SUBAWARDS				0	
6. OTHER				3,585	
TOTAL OTHER DIRECT COSTS				3,585	
H. TOTAL DIRECT COSTS (A THROUGH G)				158,270	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) Modified Total Direct Costs (Rate: 10.0, Base:158270)					
TOTAL INDIRECT COSTS (F&A)				15,827	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				174,097	
K. FEE				0	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				174,097	

M. COST SHARING PROPOSED LEVEL $ 0 AGREED LEVEL IF DIFFERENT $

PI/PD NAME: Jedda Foreman

ORG. REP. NAME*: Eb Thorpe

FOR NSF USE ONLY		
INDIRECT COST RATE VERIFICATION		
Date Checked	Date Of Rate Sheet	Initials - ORG

*ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET

Submitted/PI: Jedda Foreman /Proposal No: 2315277

SUMMARY PROPOSAL BUDGET

YEAR 5

FOR NSF USE ONLY		
PROPOSAL NO.	DURATION (months)	
	Proposed	Granted
AWARD NO.		

ORGANIZATION: BTW CONSULTANTS, INC.

PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR: Jedda Foreman

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-months CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. Michael Arnold	0.65			33,950	
2.					
3.					
4.					
5.					
6. ( ) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	0.0			0	
7. (1) TOTAL SENIOR PERSONNEL (1 - 6)	0.65			33,950	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (0) POST DOCTORAL SCHOLARS	0.0			0	
2. (5) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	4.0			79,150	
3. (0) GRADUATE STUDENTS				0	
4. (0) UNDERGRADUATE STUDENTS				0	
5. (0) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				0	
6. (0) OTHER				0	
TOTAL SALARIES AND WAGES (A + B)				113,100	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				0	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				113,100	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
TOTAL EQUIPMENT				0	
E. TRAVEL 1. DOMESTIC (INCL. U.S. POSSESSIONS)				14,540	
2. INTERNATIONAL				0	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ 0					
2. TRAVEL 0					
3. SUBSISTENCE 0					
4. OTHER 0					
TOTAL NUMBER OF PARTICIPANTS (0) TOTAL PARTICIPANT COSTS				0	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				0	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				0	
3. CONSULTANT SERVICES				0	
4. COMPUTER SERVICES				0	
5. SUBAWARDS				0	
6. OTHER				4,170	
TOTAL OTHER DIRECT COSTS				4,170	
H. TOTAL DIRECT COSTS (A THROUGH G)				131,810	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) Modified Total Direct Costs (Rate: 10.0, Base:131810)					
TOTAL INDIRECT COSTS (F&A)				13,181	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				144,991	
K. FEE				0	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				144,991	

M. COST SHARING PROPOSED LEVEL $ 0 AGREED LEVEL IF DIFFERENT $

PI/PD NAME: Jedda Foreman

ORG. REP. NAME*: Eb Thorpe

FOR NSF USE ONLY		
INDIRECT COST RATE VERIFICATION		
Date Checked	Date Of Rate Sheet	Initials - ORG

*ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET

Submitted/PI: Jedda Foreman /Proposal No: 2315277

SUMMARY PROPOSAL BUDGET

Cumulative

ORGANIZATION	FOR NSF USE ONLY: PROPOSAL NO.	DURATION (months) Proposed	Granted
BTW CONSULTANTS, INC.	2315277		
PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR: Jedda Foreman	AWARD NO.		

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-months CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. Michael Arnold	3.44			171,810	
2.					
3.					
4.					
5.					
6. ( ) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)					
7. (1) TOTAL SENIOR PERSONNEL (1 - 6)	3.44			171,810	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (0) POST DOCTORAL SCHOLARS	0.0			0	
2. (25) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	20.05			412,150	
3. (0) GRADUATE STUDENTS				0	
4. (0) UNDERGRADUATE STUDENTS				0	
5. (0) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				0	
6. (0) OTHER				0	
TOTAL SALARIES AND WAGES (A + B)				583,960	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				0	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				583,960	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
TOTAL EQUIPMENT				0	
E. TRAVEL 1. DOMESTIC (INCL. U.S. POSSESSIONS)				21,400	
2. INTERNATIONAL				0	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ 0					
2. TRAVEL 0					
3. SUBSISTENCE 0					
4. OTHER 0					
TOTAL NUMBER OF PARTICIPANTS (0) TOTAL PARTICIPANT COSTS				0	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				0	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				0	
3. CONSULTANT SERVICES				0	
4. COMPUTER SERVICES				0	
5. SUBAWARDS				0	
6. OTHER				15,485	
TOTAL OTHER DIRECT COSTS				15,485	
H. TOTAL DIRECT COSTS (A THROUGH G)				620,845	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE)					
TOTAL INDIRECT COSTS (F&A)				62,085	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				682,930	
K. FEE				0	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				682,930	

M. COST SHARING PROPOSED LEVEL $ 0 AGREED LEVEL IF DIFFERENT $

PI/PD NAME	FOR NSF USE ONLY: INDIRECT COST RATE VERIFICATION		
Jedda Foreman	Date Checked	Date Of Rate Sheet	Initials - ORG
ORG. REP. NAME* Eb Thorpe			

*ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET

Submitted/PI: Jedda Foreman /Proposal No: 2315277

Informing Change Subaward Budget Narrative

PROJECT PERIOD: JANUARY 1, 2024 TO DECEMBER 31, 2028

For inclusion in the University of California, Berkeley proposal: "Working Towards Equitable Environmental Science Organizations"

BUDGET JUSTIFICATION FOR INFORMING CHANGE

The proposed budget goes towards:

A. ***Senior Personnel:*** Dr. Michael P. Arnold (Director), Principal Investigator, who will provide leadership, oversight, and prepare data collection tools, conduct evaluation, research and analysis, at 6% FTE in Year 1, 5% FTE in Year 2, 6% FTE in Year 3, 7% in Year 4, and 5% in Year 5. Michael brings over 15 years of experience conducting research and program evaluation to support efforts that advance health equity, with a particular focus on social and structural determinants. Drawing on his background in advanced statistical methods in the fields of epidemiology and social science, as well as mixed methods evaluation to support clients and communities, his work emphasizes telling stories of impact and raising insights for strategic directions to advance racial and intersectional equity. Michael is part of the current AISL-funded WTRE project (#17-573) and has been involved since its inception in 2020.

B. Other Personnel:

B.6 Other Personnel

Inti Chomsky (Associate III), Lead Analyst, who will support data collection, conduct analysis, and contribute to reporting at 9% FTE in Year 1, 9% FTE in Year 2, 10% FTE in Year 3, 13% in Year 4, and 9% in Year 5. Inti has worked as an evaluator for 5 years at Informing Change, supporting mixed-methods evaluations across a range of equity-focused projects including health, housing, and education initiatives. Inti grew up in Mexico City and is fully bilingual in Spanish and English. Inti is part of the current AISL-funded WTRE project (#17-573) and has been involved since its inception in 2020.

TDB (Sr. Associate), Project Manager and Analyst, who will provide project management, prepare data collection tools, support evaluation, research, and analyses, and prepare reports, at 9% FTE in Year 1, 8% FTE in Year 2, 10% FTE in Year 3, 13% in Year 4, and 9% in Year 5.

Zoe Bell, Research Assistant, who will support data collection, conduct analysis, and contribute to reporting at 8% FTE in Year 1, 8% FTE in Year 2, 9% FTE in Year 3, 12% in Year 4, and 8% in Year 5. In her 2 years as a Research Assistant at Informing Change, Zoe has supported project teams with data collection, analysis, and administrative processes. Zoe has a B.A. in Psychology and primarily worked in community and social psychology labs prior to her time at Informing Change.

Johnny Du, Writer, who will support the writing, reporting, conference preparation, and dissemination processes at 1% FTE in Years 1 through 5. As Informing Change's in-house Writer/Editor, Johnny supports development and final production of key deliverable(s) and contributes to our business development and proposal functions. His prior professional background is primarily in writing and managing grants at various stops in the higher education and nonprofit sectors.

C. ***Fringe Benefits*****:** As a part of our standard business practice, fringe benefits are included in our hourly rates charged for services. In this budget, they have been included in requested salary. The fringe benefits included in the rate(s) are: benefits administration, medical, dental, unemployment, vision, and workers' compensation insurance, employees support programs, FICA and disability taxes, incentive award programs, and retirement benefits.

D. ***Equipment*****: No equipment will be purchased for the purpose of this grant.**

E. ***Travel*****: Domestic:** A **total travel budget of $21,400** is requested for staff to attend in-person conferences to disseminate findings and raise awareness of the project and to attend in-person program activities. The amount includes conference registration fees, mileage reimbursement, air transportation, per diem, and lodging. We include travel for multiple team members to provide our Research Assistants and Associates (in addition to the PI and Sr. Associate) opportunities for knowledge and skill growth, personal and professional network building, and opportunities to share their insights and learnings with external audiences.

All Travel costs are calculated using the following estimates:

Meals, per day	Hotel, per day	Ground Transportation	Airfare
$75	$200	$0.655/mile	$500

In-Person WTRE Meetings and Workshops: Transportation Only ($750)

A total $450 budget is requested for transportation to one cross-organizational collaborative meeting, $150 in each of Years 1, 3, and 5 at the Marconi Conference center in Point Reyes, CA. Mileage was calculated using the Federal Reimbursement Rate ($0.655 per mile) assuming an approximately 115-mile round trip for 2 Informing Change staff. Other associated costs are covered by the Lawrence Hall of Science budget.

A total $300 budget is requested for transportation to one in-person participants workshop, $150 in each of Years 2 and 4 at the Marconi Conference center in Point Reyes, CA. Mileage was calculated using the Federal Reimbursement Rate ($0.655 per mile) assuming an approximately 115-mile round trip for 2 Informing Change staff. Other associated costs are covered by the Lawrence Hall of Science budget.

In-Person Conferences: Transportation, Lodging, Registration ($20,650)

A total $20,650 budget is requested for conference attendance, $6,260 in Year 3 and $14,390 In Year 5. This includes include associated costs (meals ($75/day), lodging ($200/day), transportation ($500/flight), registration ($400/per person), for 3 days/2 nights) of attending one conference such as the People of the Global Majority in the Outdoors, Nature, and Environment (PGM ONE) or North American Association of Environmental Education (NAAEE) in each of Years 3 and 5 for 2 Informing Change staff (possibly the P.I. along with the Analyst or Lead Analyst in order to support building the capacity of the Analyst or Lead Analyst). These conferences focus specifically on sharing findings of projects related to the outdoor and environmental space. Additionally, we plan for 3 Informing

Change staff (P.I., Lead Analyst, Analyst or Research Assistant) to attend the American Evaluation Association Conference in Year 5 (2 days/1 night) in order to speak more broadly to practitioners in the evaluation field about this project's evaluation learnings.

Estimated costs per year, are as follows:

Year	Event Travel Expenses	Number of Staff	Costs per Event	Total
Year 1	Ground transportation for cross-org collaborative meeting	2 staff	$150	**$150**
Year 2	Ground transportation for participant workshop	2 staff	$150	**$150**
Year 3	Ground transportation for cross-org collaborative meeting	2 staff	$150	**$6,410**
	Conference attendance, 3day/2nt	2 staff	$6,260	
Year 4	Ground transportation for participant workshop	2 staff	$150	**$150**

Year 5	Ground transportation for cross-org collaborative meeting	2 staff	$150	**$14,540**
	Conference attendance, 3day/2nt	2 staff	$6,350	
	Conference attendance, 2day/1nt	3 staff	$8,040	
All YEARS				**$21,400**

F. Participant Support Costs: Not included in this application.

G. Other Direct Costs

G.6 Other: Transcription services are included for a total of $4,485.

Year 1 Transcriptions ($130/hour *4.5hrs based on 6 45-minute interviews)	**Year 2 Transcriptions ($130/hour * 9 hours based on 1 ~60 min FG and 5, 1.5hr FGs)**	**Year 3 Transcriptions ($130/hour * 7.5 hours based on 5 90-minute interviews)**	**Year 4 ($130/hour * 4.5 hours based on 3 90-minute interviews)**	**Year 5 ($130/hour * 9 hours based on 6 45-minute interviews and 3 90-minute focus groups)**
$585	$1,170	$975	$585	$1,170

Incentives for engaging with evaluation activities for a total of $11,000

We assume $100 incentive per person per engagement in focus groups or interviews. We expect to engage approximately 25 individuals in Years 2 and 3, and 30 individuals in Years 4 and 5. Participation will be 60 - 90 minutes. We track participation at the moment of attending the focus group and distribute incentives only to participants who participate in the focus group.

Year 1	Year 2	Year 3	Year 4	Year 5
$0	$2,500	$2,500	$3,000	$3,000

H. Indirect Costs: We have included a 10% de minimis rate in our application.

Working Toward Racial Equity: Building Capacity to Institutionalize Equity in Outdoor and Environmental Science Education

Facilities, Equipment, and Other Resources

The Lawrence Hall of Science's (the Lawrence) mission is to inspire and engage through science, discovery and learning in ways that advance equity and opportunity. The Lawrence is the public science center of the University of California, Berkeley, and an innovative leader in the field of science and mathematics education. As a national leader in the development of science and mathematics instructional materials, its approaches, programs, and tools are replicated, scaled up, and disseminated nationally in preK-12, college, and informal science education settings. The Lawrence Hall of Science also supports a network of teachers that test new, cutting-edge instructional materials in classrooms nationwide.

The public museum has a total of 30,000 square feet of programmatic spaces. This includes exhibition space, a planetarium/digital dome, an outdoor science park, a state-of-the-art auditorium that seats 275 people, and 10 teaching classrooms and laboratories that provide a venue for learning experiences. The building also has dedicated office space for project staff and volunteers in the building equipped with standard furnishing including networked computers, phones, printers, and high-speed internet connections. In addition, the Lawrence houses several large meeting rooms suitable for Advisory Board and other large group meetings.

The Lawrence Hall of Science employs a cloud-based file server, hosted and managed at the University of California Data Center, that provides all desktops and laptops with reliable shared storage for project information. A dedicated in-house backup facility exists for all project data stored on the cloud server, and backup is also provided by the Data Center. Many of the ongoing projects either have an online presence or deliver a significant amount of content over the Internet, so the technical staff members maintain web servers, web applications, and online file storage services hosted and managed by the University of California Data Center, and its approved commercial partners. The department has a total of 9 terabytes of managed storage. The Berkeley network gateway is connected to both the California educational network and the commodity Internet via redundant links. The museum also works with campus departments and third-party systems to provide an event calendaring system, registration for educational and professional development services, and a networked display control system.

The **Learning Group** at The Lawrence advances four Strategic Initiatives through research, design, development in ways that expand knowledge, affect practice, influence policy, and impact people nationally and globally. These Strategic Initiatives include:

- Advancing Science in K-12 Systems
- Advancing Environmental Learning
- Transforming Science and Society
- Transforming STEM Pathways

The Lawrence Hall of Science's **Advancing Environmental Learning Initiative** is a multidisciplinary team that aims to advance environmental learning in education systems while centering communities bearing the burdens of environmental injustice. In addition to designing, implementing, and studying learning experiences for youth, the team also offers a variety of outstanding inquiry-based science professional development options that exemplify sound teaching strategies and are researched to address the needs of all learners. The Lawrence Hall of Science connects with over 20,000 teachers annually—regionally, nationally, and even internationally through collaborations with partner sites, publishers, school districts from NYC to LA, and partners as distant as Japan and Jordan. In addition, the Lawrence Hall of Science's Research Strand is charged with providing evidence and insights to

foster high quality, equitable, and innovative science and mathematics learning experiences. This team rigorously investigates and evaluates learning opportunities to inform program refinement and to contribute to generalizable knowledge for field of STEM education.

Justice Outside, our programmatic design and implantation partner, has an office space in Oakland, CA. All staff have access to personal computers for working remotely, as well as conference rooms and private office space. Justice Outside has 24 full time staff.

Informing Change, our evaluation partner, has office space in Berkeley, CA. While in the office, staff have access to two conference rooms and tables, two additional rooms for taking video or phone calls, and whiteboards for collaboration, in addition to their respective assigned cubicles or offices. Informing Change has a staff of 17 employees (15 full-time, 2 part-time). This count includes administrative and operations staff (2 full-time) and proposed project team members (4 full-time). Proposed project staff are each assigned a laptop, which are available for use whether working remotely or in our office.

Submitted/PI: Jedda Foreman /Proposal No: 2315277

Effective 10/04/2021 **NSF BIOGRAPHICAL SKETCH** **OMB-3145-0058**

NAME: Jedda Foreman

POSITION TITLE & INSTITUTION: Dir.of Environmental Literacy Programs, The Lawrence Hall of Science

A. PROFESSIONAL PREPARATION - (see PAPPG Chapter II.C.2.f.(i)(a))

INSTITUTION	LOCATION	MAJOR/AREA OF STUDY	DEGREE (if applicable)	YEAR (YYYY)
Carleton College	Northfield, MN	Psychology/Education	B.A.	2008
California College of Arts	San Francisco, CA	Design Strategy	M.B.A.	2015

B. APPOINTMENTS - (see PAPPG Chapter II.C.2.f.(i)(b))

From - To	Position Title, Organization and Location
2022-present	Initative Director, Advancing Environmental Learning, The Lawrence Hall of Science, UC Berkeley. Berkeley, CA.
2019–2022	Director of Environmental Literacy Programs, The Lawrence Hall of Science, UC Berkeley. Berkeley, CA.
2017–present	Director, Advancing Equity and Inclusion in Environmental Education, The Lawrence Hall of Science, UC Berkeley. Berkeley, CA.
2015–present	Project Lead, The Lawrence Hall of Science in Partnership with ChangeScale, a collective impact backbone organization in San Francisco, CA.
2012–present	Project Manager, BEETLES: Better Environmental Education, Teaching, Learning & Expertise Sharing (NSF AISL grant #1612512), The Lawrence Hall of Science, UC Berkeley. Berkeley, CA
2011–2012	Program Manager, Quality of Life Foundation, San Francisco, CA.
2009–2019	Program Assistant and Field Instructor, Teton Science Schools, Kelly, WY.
2006–2008	Mentor-Education, Gender and Sexuality Center, Carleton College, Northfield, MN

C. PRODUCTS - (see PAPPG Chapter II.C.2.f.(i)(c)) Products Most Closely Related to the Proposed Project

Romero, V., Foreman, J., Strang, C., Rodriguez, L., Payan, R., Moore Bailey, K., & Olsen, S. (2022). Racial equity and inclusion in U.S.-based environmental education organizations: A critical examination of priorities and practices in the work environment. Journal of Outdoor and Environmental Education.

Foreman, J., Beals, K., Barakos, L., Lygren, E., and Strang, C. (2022). Guide for Outdoor Science Program and Organization Leaders. Lawrence Hall of Science, Berkeley, CA. Accessed at: http://beetlesproject.org.

Foreman, J., Strang, C., Rodriguez, L., Payan, R. (2020). Racial Equity in Outdoor Science and Environmental Education: Re-Establishing the Field with Intention. Lawrence Hall of Science, University of California, Berkeley; California.

Hernandez, B., Romero, V., Foreman, J., & Strang, C. (2020). Building Towards an Inclusive Organizational Culture: Insights and Lessons Learned from YES Nature to Neighborhoods: Practice Brief. Lawrence Hall of Science, University of California, Berkeley; California.

Romero, V., Foreman, J., Strang, C., Maybury, C., Pepito, E., & Rocca, C. (2019). Intentional hiring and recruitment through the lens of equity and inclusion: Insights and lessons learned from Crissy Field Center, Golden Gate National Parks Conservancy. Berkeley, CA.

Other Significant Products, Whether or Not Related to the Proposed Project

Foreman, J., Mitchel, B., Elkin, T., Pedemonte, S., Strang, C., & Lujan, V. (2021). An Approach to Walking Field Trips. National Outdoor Learning Library, Green Schoolyards America. https://www.greenschoolyards.org/walking-field-trips.

Collins, M., Pande, A. Strang, C., Foreman, J., & Dorph, R. (2021). Impacts from covid-19: resilient outdoor science programs need support as challenges persist. Lawrence Hall of Science, University of California, Berkeley; California.

Pedemonte, S., Lujan, V., Strang, C., & Foreman, J. (2021). Full In-person Instructional Plans. National Outdoor Learning Library, Green Schoolyards America. https://www.greenschoolyards.org/in-person-instructional-plans

Foreman, J., Pedemone, S., Strang, C., Jen, T., Totino, J., Snyder, J., Binding, M., (2021). Environmental Literacy Curriculum Connections. Lawrence Hall of Science, University of California, Berkeley; California. https://lawrencehallofscience.org/curriculum/environmental-literacy-curriculum/

Romero, V., Foreman, J., Strang, C., Rodriguez, L., Payan, R., & Moore Bailey, K. (2019). Equitable and inclusive work environments in environmental education: Perspectives from the field and implications for organizations. Lawrence Hall of Science, Berkeley, CA. Accessed at: http://beetlesproject.org.

D. SYNERGISTIC ACTIVITIES - (see PAPPG Chapter II.C.2.f.(i)(d))

• Advisory board member for “Beyond Birds: Using Audubon’s Guided Nature Experiences to Engage 18-25 Year-Olds with STEM and Climate-Science Content” a NSF-supported project of the National Audubon Society
• I am a member of the North American Association of Environmental Education professional association (2015-present)
• Many products listed above in section C are results of the BEETLES project and were developed in conjunction with other educators and scientists. They are in use in hundreds of informal organizations across the county and internationally.

Submitted/PI: Jedda Foreman /Proposal No: 2315277

Effective 10/04/2021 **NSF BIOGRAPHICAL SKETCH** **OMB-3145-0058**

NAME: Valeria Fike Romero

POSITION TITLE & INSTITUTION: Senior Research Lead, UCB

A. PROFESSIONAL PREPARATION - (see PAPPG Chapter II.C.2.f.(i)(a))

INSTITUTION	LOCATION	MAJOR/AREA OF STUDY	DEGREE (if applicable)	YEAR (YYYY)
Holy Names University	Oakland	Sociology and Psychology	B.A.	2005
Mills College	Oakland	Educational Leadership	M.A.	2010
UC Davis	Davis	Education	Ph.D.	2024

B. APPOINTMENTS - (see PAPPG Chapter II.C.2.f.(i)(b))

From - To	Position Title, Organization and Location
2011- Present	Senior Research Lead, Lawrence Hall of Science; University of California, Berkeley, Berkeley, CA
2010-2011	Resident Fellow, Chicana/Latino Student Development Office; University of California, Berkeley, Berkeley, CA
2010	Program Assistant, Division of Student Life; Mills College, Oakland, CA
2007-2009	Higher Education Fellow, The Greenlining Institute, Berkeley, CA
2007-2008	2007 – 2008 Lead Organizer, Students and Families for Tuition Relief Now, Berkeley, CA

Revised Proposal Budget Revision #1 for 2315277 Submitted On Wed Jul 19 13:16:46 EDT 2023 Electronic Signature

C. PRODUCTS - (see PAPPG Chapter II.C.2.f.(i)(c)) Products Most Closely Related to the Proposed Project

Romero, V.F, Foreman, J., Strang, C., Rodriguez, L., Payan, R., Moore-Bailey, K., & Olsen, S. (2022). Racial equity and inclusion in United States of America-based environmental education organizations: A critical examination of priorities and practices in the work environment. Journal of Outdoor and Environmental Education, 1-26.

Romero, V. F., Collins, M., Young, A., Laina, V., Dorph, R., Pande, A., Strang, C., & Foreman, J. (2022). Improving Outdoor Science Teaching and Learning: The Implementation of a Capacity-Building Model in Outdoor Science Programs. Berkeley, CA: The Lawrence Hall of Science, University of California, Berkeley

Romero, V., Laina, V., Pande, A., Chi, B., & Snow, J.Z., (2021). BEETLES: An evaluation of a capacity building model to support outdoor science programs. Berkeley, CA: The Lawrence Hall of Science, University of California, Berkeley.

Gonzalez, J., Arciniega, M., Romero, V., & Pande, A. (2021). Centering equity and inclusion in cultivating community. Berkeley, CA: The Lawrence Hall of Science, University of California, Berkeley. http://beetlesproject.org/resources/centering-equity/

Romero, V., Foreman, J., Strang, C., Maybury, C., Pepito, E., & Rocca, C. (2019). Intentional hiring and recruitment through the lens of equity and inclusion: Insights and lessons learned from Crissy Field Center, Golden Gate National Parks Conservancy. Berkeley, CA.

Other Significant Products, Whether or Not Related to the Proposed Project

Dorph, R., Romero, V.F., & Cannady, M. (2022). Informal science institution-designed efforts to broaden participation in STEM learning and career pathways. Poster presented at the American Educational Association Annual Conference, 2022, San Diego, CA.

Sanchez. A. & Romero, V.F. (2021). Teacher leadership: A Review of the Literature. Report submitted to the National Geographic Society. Berkeley, CA: The Lawrence Hall of Science, University of California, Berkeley.

Romero, V., Cuff, K., Cannady, M.A., Nava, R. & Dorph, R. (2019). Fostering Environmental Activism through Community-Based Research Investigations. Poster presented at the American Educational Research Association annual meeting, Toronto, Canada.

Trahan, L., Romero, V., & Blinderman, E. (2019). From the classroom to the floor: Applying language supports to new museum contexts. Journal of Museum Education, 44(4), 418-426.

Collins, M. A., Totino, J., Hartry, A., Pedroso, R., Romero, V., & Nava, R. (2019). Service learning as a lever to support STEM engagement for underrepresented youth. Journal of Experiential Education. 43(1). 55-70.

D. SYNERGISTIC ACTIVITIES - (see PAPPG Chapter II.C.2.f.(i)(d))

- Member: American Educational Research Association
- Peer Reviewer: Science Education
- Peer Reviewer: American Journal of Evaluation
- Co-Chair, Lawrence Hall of Science Equity Leadership Team
- JEDI Strand Lead, Lawrence Hall of Science

Submitted/PI: Jedda Foreman /Proposal No: 2315277

Effective 10/04/2021 **NSF BIOGRAPHICAL SKETCH** **OMB-3145-0058**

NAME: Craig Strang

POSITION TITLE & INSTITUTION: Coordinator of Public Programs, Lawrence Hall of Science, UC Berkeley

A. PROFESSIONAL PREPARATION - (see PAPPG Chapter II.C.2.f.(i)(a))

INSTITUTION	LOCATION	MAJOR/AREA OF STUDY	DEGREE (if applicable)	YEAR (YYYY)
University of California, Santa Cruz	Santa Cruz, California	Environmental Studies (emphasis in Natural History and Marine Science	BA	1984

B. APPOINTMENTS - (see PAPPG Chapter II.C.2.f.(i)(b))

From - To	Position Title, Organization and Location
2018 - present	Principal Investigator, Elizabeth and Robert Karplus Outdoor Nature Lab at the Lawrence Hall of Science, University of California, Berkeley
2014 - present	Co-Chair, Environmental Literacy Task Force (2014-15), Environmental Literacy Steering Committee (2015-18), California Environmental Literacy Initiative (2018-present), Responsible for development and statewide implementation of the California Blueprint for Environmental Literacy
2011 - present	Principal Investigator, BEETLES Project (Better Environmental Education Teaching, Learning & Expertise Sharing), Lawrence Hall of Science, Berkeley, California
2008 - present	Principal Investigator, BaySci (Bay Area Partnership for Science Education) builds capacity to improve science education in 30 California school districts, Lawrence Hall of Science
2002 - 2014	Director/PI, Center of Ocean Sciences Education Excellence--California, Lawrence Hall of Science, University of California, Berkeley
1991 - present	Founding Director, MARE (Marine Activities, Resources & Education) curriculum and professional development designed to promote literacy and language development among English learners, Lawrence Hall of Science, University of California, Berkeley
1996 - 2022	Associate Director; Executive Management Team; Director, Learning and Teaching Group at The Lawrence Hall of Science, University of California, Berkeley

C. PRODUCTS - (see PAPPG Chapter II.C.2.f.(i)(c)) Products Most Closely Related to the Proposed Project

1) Forman, Jedda; Payan, R., Rodriguez, L., Strang, C. (2020) Racial Equity in Outdoor Science and Environmental Education: Re-Establishing the Field with Intention. simultaneously published https://youthoutside.org/racial-equity-in-outdoor-science-and-environmental-education-re-establishing-the-field-with-intention/ and http://beetlesproject.org/racial-equity-outdoor-science-environmental-education-re-establishing-field-intention/, Berkeley, California.
2) Collins, M.A., Dorph, R., Foreman, J., Pande, A., Strang, C., & Young, A. (2020). A field at risk: The impact of COVID-19 on environmental and outdoor science education: Policy brief. Lawrence Hall of Science, University of California, Berkeley; California.
3) Romero, Valeria; Foreman, J., Strang, C., Rodriguez, L., Payan, R., Moore Bailey, K., (2019) Examining Equitable and Inclusive Work Environments in Environmental Education: Perspectives from the Field and Implications for Organizations. Berkeley, CA.
4) A Report by State Superintendent of Public Instruction Tom Torlakson ' s Environmental Literacy Task Force-2015. (2015). A Blueprint for Environmental Literacy: Educating Every California Student In, About, and For the Environment. Sacramento, California: California Department of Education. (Strang co-chaired the Task Force that developed the Blueprint.)
5) Lujan, Vanessa and Strang, C.; Addressing the Convergence of the NGSS and the Common Core. Dimensions: Bimonthly magazine of the Association of Science and Technology Centers, November/December 2014

Other Significant Products, Whether or Not Related to the Proposed Project

1) Fauville, Géraldine; Strang, C., Cannady, M., Chen, Y. (2018) Development of the International Ocean Literacy Survey: measuring knowledge around the world. Environmental Education Research, 12 March 2018.
2) Ocean Literacy: The Essential Principles of Ocean Sciences for Learners of All Ages Version 2, a brochure resulting from the 2-week On-Line Workshop on Ocean Literacy through Science Standards; published by National Oceanic and Atmospheric Administration; Published June 2005, revised March 2013, revised 2020.
3) Strang, C. (2010). Written Testimony to the House Appropriations Committee Subcommittee on Commerce, Justice and Science February 4, 2010 Regarding the Importance of Inquiry-based Science Education and the Role of Science Agencies in the Improvement of Science Education. Washington, DC: Congressional Record. Retrieved from http://appropriations.house.gov/Witness_testimony/CJS/2011_STEM_Ed_Hearing_2_Strang_Testimony.pdf.

D. SYNERGISTIC ACTIVITIES - (see PAPPG Chapter II.C.2.f.(i)(d))

* I serve as co-chair of the California Environmental Literacy Initiative, charged by the CA Superintendent of Public Instruction to develop and implement the Blueprint for Environmental Literacy, 2015-present
* I serve on the Board on Gulf Education and Engagement, Gulf Research Program Division, The National Academies of Science, Engineering and Medicine, 2020-present
* I am past-president of the National Marine Educators Association, and Advisory Board Member of Asia Marine Educators Association, and former Advisory Board Member of European Marine Science Educators Association
* National Science Foundation Geosciences Directorate Advisory Committee (AC-GEO), Chair, Education Subcommitte, 2008-2011.

Submitted/PI: Jedda Foreman /Proposal No: 2315277

Effective 10/04/2021 **NSF BIOGRAPHICAL SKETCH** **OMB-3145-0058**

NAME: Laura Rodriguez

POSITION TITLE & INSTITUTION: Chief Program Officer, Justice Outside

A. PROFESSIONAL PREPARATION - (see PAPPG Chapter II.C.2.f.(i)(a))

INSTITUTION	LOCATION	MAJOR/AREA OF STUDY	DEGREE (if applicable)	YEAR (YYYY)
University of California, Los Angeles	Los Angeles, CA	Psychology	BS	2004
University of California, Los Angeles	Los Angeles, CA	Chicana/o Studies	BA	2004

B. APPOINTMENTS - (see PAPPG Chapter II.C.2.f.(i)(b))

From - To	Position Title, Organization and Location
2021 - present	Chief Program Officer, Justice Outside, Oakland CA
2018-2021	Director of Programs, Justice Outside, Oakland CA
2014-2018	Program Officer, Justice Outside, Oakland CA
2011-2014	Program Manager (Long Term Care), SEIU UHW West & Joint Employer Education Fund, Oakland CA
2010-2011	Program Coordinator (Long Term Care), SEIU UHW West & Joint Employer Education Fund, Oakland CA
2009-2010	Implementation Specialist (Long Term Care), SEIU UHW West & Joint Employer Education Fund, Oakland CA
2005-2007	Career Counselor, SEIU UHW West & Joint Employer Education Fund, Los Angeles CA

C. PRODUCTS - (see PAPPG Chapter II.C.2.f.(i)(c)) Products Most Closely Related to the Proposed Project

Foreman, J., Payan, R., Rodriguez, L., & Strang, C. (2022) Racial Equity in Outdoor Science and Environmental Education: Re-Establishing the Field with Intention. Clearing Magazine. Special Focus Issue: Justice Equity and Diversity in Environmental Education. 9-11, 38. https://clearingmagazine.org/wp-content/uploads/2022/02/ClearingJEDIw22-Foreman-1.pdf

Romero, V., Foreman, J., Strang, C., Rodriguez, L., Payan, R., & Moore Bailey, K. (2019). Examining equitable and inclusive work environments in environmental education: Perspectives from the field and implications for organizations. Berkeley, CA. http://beetlesproject.org/cms/wp-content/uploads/2019/06/Examining-Equitable-and-Inclusive-Work-Environments-in-Environmental-Education.pdf

Romero, V. F., Foreman, J., Strang, C., Rodriguez, L., Payan, R., Bailey, K. M., & Olsen, S. (2022). Racial equity and inclusion in United States of America-based environmental education organizations: a critical examination of priorities and practices in the work environment. Journal of Outdoor and Environmental Education, 1-26. https://link.springer.com/article/10.1007/s42322-022-00099-w

Other Significant Products, Whether or Not Related to the Proposed Project

n/a

D. SYNERGISTIC ACTIVITIES - (see PAPPG Chapter II.C.2.f.(i)(d))

- Subawardee of and collaborator on current NSF-funded WTEO project in programmatic design, delivery, and facilitation

- Vice-President of the Board of Together Bay Area (2020)

- Member of the Planning Committee for the Regional Funder Convening (March 2020) of Blue Sky Funders Forum & Environmental Education Funders Collaborative

- Review Panelist for the Pisces Foundation Request For Proposals (2019)

Submitted/PI: Jedda Foreman /Proposal No: 2315277

Effective 10/04/2021 **NSF BIOGRAPHICAL SKETCH** **OMB-3145-0058**

NAME: Michael P. Arnold, PhD

POSITION TITLE & INSTITUTION: Director, Informing Change

A. PROFESSIONAL PREPARATION - (see PAPPG Chapter II.C.2.f.(i)(a))

INSTITUTION	LOCATION	MAJOR/AREA OF STUDY	DEGREE (if applicable)	YEAR (YYYY)
Truman State University	Kirksville, Missouri	Biolgy	BS	1995
University of California, Berkeley	Berkeley, California	Social Work Social Welfare Social Work AIDS Prevention Epidemiology	MSW PhD Post-doc MPH	2001 2004 2007-2009 2008

B. APPOINTMENTS - (see PAPPG Chapter II.C.2.f.(i)(b))

From - To	Position Title, Organization and Location
2016 - present	Director, Informing Change, Berkeley, California.
2015 - 2016	Senior Research Associate, Harder & Company, San Francisco, California.
2014 - 2015	Assistant Research Scientist, Center for Sexuality & Health Disparities (University of Michigan School of Public Health), Ann Arbor, Michigan.
2011 - 2014	Faculty Scientist, Fred Hutchinson Cancer Research Center (FHCRC), Seattle, Washington.
2009 - 2011	Director, Bridge HIV (San Francisco Department of Public Health), San Francisco, CA.
2007 - 2009	Research Fellow, Center for AIDS Prevention Studies (University of California, San Francisco), San Francisco, CA.
Misc.	Quantitative Research Analyst (as independent consultant) for: * Hatchuel Tabernik & Associates (Berkeley, California) * Public Profit (Oakland, California) * B3 Consults (San Francisco, California) * MyPath (San Francisco, California) * Persons Living w/ HIV Stigma Index Project (Detroiit, Michigan)

Revised Proposal Budget Revision #1 for 2315277 Submitted On Wed Jul 19 13:16:46 EDT 2023 Electronic Signature

C. PRODUCTS - (see PAPPG Chapter II.C.2.f.(i)(c)) Products Most Closely Related to the Proposed Project

Chomsky, I., Young, A., Bell, Z., Arnold, M.P. Equity Everywhere: Reflections from a culturally responsive and equitable evaluation of an equity-centered capacity- and field-building model. Presentation given at AEA annual conference, November 2022, New Orleans, LA.

Arnold, M.P., Rodriguez, L. Hannaman, M. (Forthcoming). Speaking Truths about, for, and to Power in Evaluations of Inclusive Leadership Initiatives. Presentation given at AEA annual conference, November 2018, Cleveland, OH.

Arnold, M.P., Rodriguez, S. (2018). An Evaluation of the Outdoor Educators Institute: Advancing Equity & Inclusion in the Outdoor Field. Informing Change. Berkeley, CA.

Arnold, M.P. (2018), Evaluating CLI's Impact: Individuals, Agencies, & Networks. Presentation given at CLI's Cohort 10 Graduation, June 2018, Los Angeles, CA.

Benton, A., Arnold, M., Skipper, S., Hampton, A., Alvarez, J., Taton-Murphy, L., Sprague, L., Minalga, B., Loveluck, J. The Research is the Intervention: Strengthening Networks of Persons Living with HIV though Participatory Action Research. Poster presentation offered at 21st International AIDS Conference, July 2016, Durban, South Africa.

Other Significant Products, Whether or Not Related to the Proposed Project

Arnold, M.P., Esparrago Lieu, T. (2018). Coding Corps Marin: An Equity Strategy for Marin's Tech Workforce. Informing Change. Berkeley, CA.

Arnold, M.P. (2017) Approaches to Learning in Challenging Moments: Roundtable Discussion. Presentation offered at AEA annual conference, November 2017, Chicago, IL.

Andrasik, M., Arnold, M. P., Mimiaga, M. J., Clad, R., Leickly, E., Ismail, R., Schwab, E., Chan, Y., Broder, G. Improving community engagement through capacity building among HIV Vaccine Trial Network clinical research site staff. Poster presentation offered at CDC National HIV Prevention Conference, 2015. Atlanta, GA.

San Francisco Children and Families Commission. (2015). First Steps 2014: A Data Report on the Status of San Francisco's Young Children. San Francisco, First 5 San Francisco.

Arnold, M. (2006). Work-Based Learning and Occupational Coursework in the California Community Colleges. Hatchuel Tabernik and Associated. Berkeley, CA.

D. SYNERGISTIC ACTIVITIES - (see PAPPG Chapter II.C.2.f.(i)(d))

• PI and lead evaluator for the evaluation component of current WTRE funded through AISL-NSF.

• Director of multiple evaluation and strategic planning projects, guiding programmatic and analytic direction. I design data collection tools that are creative in reach and aligned with field-wide standards and best practices to measure what cannot often be counted from the outset.

• Served as director of an evaluation of Justice Outside's Outdoor Educator Institute, a program focused on advancing equity and inclusion in the outdoor education field, and the director of an evaluation of Youth Outside's Rising Leaders Fellowship program. These evaluations surfaced program strengths, opportunities for improvement within the program, and field-wide challenges the program can address as part of the realities of the program's context.

• Recipient of the Eugene Cota-Robles Fellowship and the University of California, Berkeley (1999-2002), and received the Presidential Honor Award from Truman State University (1991-1995).

Other Personnel Biographical Information

Data Not Available

Effective 10/04/2021 NSF CURRENT AND PENDING SUPPORT OMB-3145-0058

*PI/co-PI/Senior Personnel Name: Foreman, Jedda

***Required fields**

Note: NSF has provided 15 project/proposal and 10 in-kind contribution entries for users to populate. Please leave any unused entries blank.

Project/Proposal Section:

Current and Pending Support includes all resources made available to an individual in support of and/or related to all of his/her research efforts, regardless of whether or not they have monetary value.[1] Information must be provided about all current and pending support, including this project, for ongoing projects, and for any proposals currently under consideration from whatever source, irrespective of whether such support is provided through the proposing organization or is provided directly to the individual. This includes, for example, Federal, State, local, foreign, public or private foundations, non-profit organizations, industrial or other commercial organizations, or internal funds allocated toward specific projects. Concurrent submission of a proposal to other organizations will not prejudice its review by NSF, if disclosed.[2]

[1] If the time commitment or dollar value is not readily ascertainable, reasonable estimates should be provided.
[2] The Biological Sciences Directorate exception to this policy is delineated in PAPPG Chapter II.D.2.

Projects/Proposals

1. *Project/Proposal Title :

*Status of Support : (•) Current ( ) Pending ( ) Submission Planned ( ) Transfer of Support

Proposal/Award Number (if available):

*Source of Support:

*Primary Place of Performance :

Project/Proposal Start Date (MM/YYYY) (if available) :

Project/Proposal End Date (MM/YYYY) (if available) :

*Total Award Amount (including Indirect Costs): $

*Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1.		4.	
2.		5.	
3.			

*Overall Objectives :

*Statement of
Potential Overlap :

Projects/Proposals

2. *Project/Proposal Title :

*Status of Support : ◉ Current ○ Pending ○ Submission Planned ○ Transfer of Support

Proposal/Award Number (if available):

*Source of Support:

*Primary Place of Performance :

Project/Proposal Start Date (MM/YYYY) (if available) :

Project/Proposal End Date (MM/YYYY) (if available) :

*Total Award Amount (including Indirect Costs): $

*Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1.		4.	
2.		5.	
3.			

*Overall Objectives :

*Statement of
Potential Overlap :

Projects/Proposals

3. *Project/Proposal Title : Connecting to Nature through Outdoor Science

*Status of Support : (•) Current ( ) Pending ( ) Submission Planned ( ) Transfer of Support

Proposal/Award Number (if available): 053517

*Source of Support: Woka Foundation

*Primary Place of Performance : University of California, Berkeley

Project/Proposal Start Date (MM/YYYY) (if available) : 06/2022

Project/Proposal End Date (MM/YYYY) (if available) : 05/2024

*Total Award Amount (including Indirect Costs): $ 249,216

*Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1. 2023	0.60	4.	
2. 2024	0.60	5.	
3.			

*Overall Objectives : Creates learning experiences for the Lawrence Hall of Science's Outdoor Nature Lab. These experiences will be pilot tested for national dissemination to nature centers and other nature destinations that are visited by the general public.

*Statement of Potential Overlap : There is no known overlap between this project and the proposed project in terms of scope, budget, or person-months planned.

Projects/Proposals

4. *Project/Proposal Title : Working Toward Racial Equity: Building Capacity to Institutionalize Equity in Outdoor and Environmental Science Education

*Status of Support : ○ Current ◉ Pending ○ Submission Planned ○ Transfer of Support

Proposal/Award Number (if available):

*Source of Support: National Science Foundation

*Primary Place of Performance : University of California, Berkeley

Project/Proposal Start Date (MM/YYYY) (if available) : 01/2024

Project/Proposal End Date (MM/YYYY) (if available) : 12/2028

*Total Award Amount (including Indirect Costs): $ 4,731,307

*Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1. 2024	3.00	4. 2027	3.00
2. 2025	3.00	5. 2028	3.00
3. 2026	3.00		

*Overall Objectives : Addresses debilitating racial inequities in the OESE field by increasing the capacity of organizations to build more racially just and equitable work environments through a multi-phase cohort-based professional learning approach as well as the creation of a Racial Equity Transformation Tool Kit.

*Statement of Potential Overlap : This project

Projects/Proposals

5. *Project/Proposal Title : Advancing Organization Transformation for Racial Equity in Environmental Education

*Status of Support : ○ Current ◉ Pending ○ Submission Planned ○ Transfer of Support

Proposal/Award Number (if available):

*Source of Support: Spencer Foundation (RPP)

*Primary Place of Performance : University of California, Berkeley

Project/Proposal Start Date (MM/YYYY) (if available) : 08/2023

Project/Proposal End Date (MM/YYYY) (if available) : 07/2026

*Total Award Amount (including Indirect Costs): $ 397,899

*Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1. 2024	0.60	4.	
2. 2025	0.60	5.	
3. 2026	1.20		

*Overall Objectives : Conducts a landscape assessment to understand the current state of racial equity and justice within the environmental education (EE) field across the United States.

*Statement of Potential Overlap : There is no known overlap between this project and the proposed project in terms of scope, budget, or person-months planned.

Projects/Proposals

6. *Project/Proposal Title : DTI: Indigenous Mixed Reality Science Experiences (IMRSE): Fostering Cultural and Science Identity through Youth Participatory Design of Mixed Reality Experiences

*Status of Support : ○ Current ◉ Pending ○ Submission Planned ○ Transfer of Support

Proposal/Award Number (if available): 2241805

*Source of Support: National Science Foundation

*Primary Place of Performance : University of California, Berkeley

Project/Proposal Start Date (MM/YYYY) (if available) : 09/2023

Project/Proposal End Date (MM/YYYY) (if available) : 08/2026

*Total Award Amount (including Indirect Costs): $ 1,292,298

*Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1. 2024	1.80	4.	
2. 2025	1.80	5.	
3. 2026	1.80		

*Overall Objectives : Develops and studies a model that strengthens Indigenous youths' capacity for, and disposition toward STEM pathways through the collaborative design of mixed reality Indigenous science experiences.

*Statement of Potential Overlap : There is no known overlap between this project and the proposed project in terms of scope, budget, or person-months planned.

Projects/Proposals

7. *Project/Proposal Title : Understanding the Impact of Outdoor Science and Environmental Learning Through Community-Driven Outcomes

*Status of Support : ○ Current ◉ Pending ○ Submission Planned ○ Transfer of Support

Proposal/Award Number (if available):

*Source of Support: National Science Foundation

*Primary Place of Performance : University of California, Berkeley

Project/Proposal Start Date (MM/YYYY) (if available) : 09/2023

Project/Proposal End Date (MM/YYYY) (if available) : 08/2027

*Total Award Amount (including Indirect Costs): $ 1,998,911

*Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1. 2024	2.40	4. 2027	2.40
2. 2025	1.80	5.	
3. 2026	1.80		

*Overall Objectives : Using community-driven, participatory methods and approaches, this project will develop conceptual understandings and measures of scientific and environmental literacy that center the voices and experiences of youth of color. In addition, we will use developed measures to examine the impact of outdoor science and environmental education experiences on youth, and in particular aim to understand how youth of color make meaning of their experiences.

*Statement of Potential Overlap : There is no known overlap between this project and the proposed project in terms of scope, budget, or person-months planned.

Effective 10/04/2021 NSF CURRENT AND PENDING SUPPORT OMB-3145-0058

*PI/co-PI/Senior Personnel Name: Romero, Valeria Fike

***Required fields**

Note: NSF has provided 15 project/proposal and 10 in-kind contribution entries for users to populate. Please leave any unused entries blank.

Project/Proposal Section:

Current and Pending Support includes all resources made available to an individual in support of and/or related to all of his/her research efforts, regardless of whether or not they have monetary value.[1] Information must be provided about all current and pending support, including this project, for ongoing projects, and for any proposals currently under consideration from whatever source, irrespective of whether such support is provided through the proposing organization or is provided directly to the individual. This includes, for example, Federal, State, local, foreign, public or private foundations, non-profit organizations, industrial or other commercial organizations, or internal funds allocated toward specific projects. Concurrent submission of a proposal to other organizations will not prejudice its review by NSF, if disclosed.[2]

[1] If the time commitment or dollar value is not readily ascertainable, reasonable estimates should be provided.
[2] The Biological Sciences Directorate exception to this policy is delineated in PAPPG Chapter II.D.2.

Projects/Proposals

1. *Project/Proposal Title :

*Status of Support : ◉ Current ○ Pending ○ Submission Planned ○ Transfer of Support

Proposal/Award Number (if available):

*Source of Support:

*Primary Place of Performance :

Project/Proposal Start Date (MM/YYYY) (if available) :

Project/Proposal End Date (MM/YYYY) (if available) :

*Total Award Amount (including Indirect Costs): $

*Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1.		4.	
2.		5.	
3.			

*Overall Objectives :

*Statement of
Potential Overlap :

Projects/Proposals

2. *Project/Proposal Title : Youth Engaged in STEM and Service (YESS)

*Status of Support : (•) Current ( ) Pending ( ) Submission Planned ( ) Transfer of Support

Proposal/Award Number (if available): 1949586

*Source of Support: National Science Foundation

*Primary Place of Performance : University of California, Berkeley

Project/Proposal Start Date (MM/YYYY) (if available) : 09/2020

Project/Proposal End Date (MM/YYYY) (if available) : 08/2024

*Total Award Amount (including Indirect Costs): $ 1,471,693

*Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1. 2021	1.80	4. 2024	1.80
2. 2022	1.80	5.	
3. 2023	1.80		

*Overall Objectives : Project team is co-designing and implementing two summer camp models that engage youth in project-based learning experiences through the lens of either (1) local relevance or (2) global service learning. The research examines the design, development and implementation of the summer camp models. In addition, the research draws on quasi-experimental mixed methods approach to examine the impact of camp experiences on youth's cognitive and social-emotional outcomes.

*Statement of Potential Overlap : There is no known overlap between this project and the proposed project in terms of scope, budget, or person-months planned.

Projects/Proposals

3. *Project/Proposal Title : Advancing Organization Transformation for Racial Equity in Environmental Education

*Status of Support : ○ Current ◉ Pending ○ Submission Planned ○ Transfer of Support

Proposal/Award Number (if available):

*Source of Support: Spencer Foundation (RPP)

*Primary Place of Performance : University of California, Berkeley

Project/Proposal Start Date (MM/YYYY) (if available) : 08/2023

Project/Proposal End Date (MM/YYYY) (if available) : 07/2026

*Total Award Amount (including Indirect Costs): $ 397,899

*Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1. 2024	1.40	4.	
2. 2025	1.40	5.	
3. 2026	1.40		

*Overall Objectives : Conducts a landscape assessment to understand the current state of racial equity and justice within the environmental education (EE) field across the United States.

*Statement of Potential Overlap : There is no known overlap between this project and the proposed project in terms of scope, budget, or person-months planned.

Projects/Proposals

4. *Project/Proposal Title : Calendar in the Sky: Learning Astronomy from Indigenous Mexican Cultures

*Status of Support : ○ Current ◉ Pending ○ Submission Planned ○ Transfer of Support

Proposal/Award Number (if available):

*Source of Support: Institute of Museum and Library Services

*Primary Place of Performance : University of California, Berkeley

Project/Proposal Start Date (MM/YYYY) (if available) : 09/2023

Project/Proposal End Date (MM/YYYY) (if available) : 08/2026

*Total Award Amount (including Indirect Costs): $ 1,394,140

*Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1. 2024	2.40	4.	
2. 2025	2.40	5.	
3. 2026	2.40		

*Overall Objectives : Calendar in the Sky will engage local communities in learning about astronomical traditions of Mexican & Central American cultures. We will work with local Mexican & Central American communities to co-design programming in the Planetarium at the Lawrence Hall of Science and in Festivals, outreach events held within community neighborhoods. Project activities will result in a series of learning guides and best practices about how to co-design astronomy-focused museum programming.

*Statement of Potential Overlap : There is no known overlap between this project and the proposed project in terms of scope, budget, or person-months planned.

Projects/Proposals

5. *Project/Proposal Title : DTI: Justice and Equity Centered Online Learning Design: Attending to ethics and collaboration in AI systems learning

*Status of Support : ○ Current ◉ Pending ○ Submission Planned ○ Transfer of Support

Proposal/Award Number (if available): 2241576

*Source of Support: National Science Foundation

*Primary Place of Performance : University of California, Berkeley

Project/Proposal Start Date (MM/YYYY) (if available) : 09/2023

Project/Proposal End Date (MM/YYYY) (if available) : 08/2026

*Total Award Amount (including Indirect Costs): $ 1,294,766

*Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1. 2024	2.40	4.	
2. 2025	2.40	5.	
3. 2026	2.40		

*Overall Objectives : Design, test, and iteratively revise TechHive:AI, a learning experience for high school aged youth that integrates AI technical learning with ethics principles.

*Statement of Potential Overlap : There is no known overlap between this project and the proposed project in terms of scope, budget, or person-months planned.

Projects/Proposals

6. *Project/Proposal Title : Understanding the Impact of Outdoor Science and Environmental Learning Through Community-Driven Outcomes

*Status of Support : ○ Current ◉ Pending ○ Submission Planned ○ Transfer of Support

Proposal/Award Number (if available):

*Source of Support: National Science Foundation

*Primary Place of Performance : University of California, Berkeley

Project/Proposal Start Date (MM/YYYY) (if available) : 01/2024

Project/Proposal End Date (MM/YYYY) (if available) : 12/2027

*Total Award Amount (including Indirect Costs): $ 1,998,891

*Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1. 2024	3.00	4. 2027	3.00
2. 2025	2.40	5.	
3. 2026	2.40		

*Overall Objectives : Using community-driven, participatory methods and approaches, this project will develop conceptual understandings and measures of scientific and environmental literacy that center the voices and experiences of youth of color. In addition, we will use developed measures to examine the impact of outdoor science and environmental education experiences on youth, and in particular aim to understand how youth of color make meaning of their experiences.

*Statement of Potential Overlap : There is no known overlap between this project and the proposed project in terms of scope, budget, or person-months planned.

Projects/Proposals

7. *Project/Proposal Title : Working Toward Racial Equity: Building Capacity to Institutionalize Equity in Outdoor and Environmental Science Education

*Status of Support : ○ Current ◉ Pending ○ Submission Planned ○ Transfer of Support

Proposal/Award Number (if available):

*Source of Support: National Science Foundation

*Primary Place of Performance : University of California, Berkeley

Project/Proposal Start Date (MM/YYYY) (if available) : 01/2024

Project/Proposal End Date (MM/YYYY) (if available) : 12/2028

*Total Award Amount (including Indirect Costs): $ 4,731,307

*Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1. 2024	2.40	4. 2027	2.40
2. 2025	2.40	5. 2028	2.40
3. 2026	2.40		

*Overall Objectives : Addresses debilitating racial inequities in the OESE field by increasing the capacity of organizations to build more racially just and equitable work environments through a multi-phase cohort-based professional learning approach as well as the creation of a Racial Equity Transformation Tool Kit.

*Statement of Potential Overlap : This proposal

Projects/Proposals

8. *Project/Proposal Title : Transforming Leadership Structures to Disrupt Systemic Racism by Elevating Staff of Color in Informal Science Education

*Status of Support : ○ Current ◉ Pending ○ Submission Planned ○ Transfer of Support

Proposal/Award Number (if available):

*Source of Support: National Science Foundation

*Primary Place of Performance : University of California, Berkeley

Project/Proposal Start Date (MM/YYYY) (if available) : 07/2023

Project/Proposal End Date (MM/YYYY) (if available) : 06/2028

*Total Award Amount (including Indirect Costs): $ 4,999,748

*Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1. 2024	3.00	4. 2027	3.00
2. 2025	3.00	5. 2028	3.00
3. 2026	3.00		

*Overall Objectives : This project will generate (1) a theoretical understanding of leadership that centers the voices and experiences of staff of color in informal science education, (2) learnings about what it takes to build organizational and individual capacities to examine, discern, and transform racialized systems, and (3) a case study that explores the ways in which a university-affiliated science institution can work to enact racially just notions and structures of leadership that elevates and supports Staff of Color.

*Statement of Potential Overlap : There is no known overlap between this project and the proposed project in terms of scope, budget, or person-months planned.

Effective 10/04/2021 **NSF CURRENT AND PENDING SUPPORT** **OMB-3145-0058**

*PI/co-PI/Senior Personnel Name: Craig Strang

***Required fields**

Note: NSF has provided 15 project/proposal and 10 in-kind contribution entries for users to populate. Please leave any unused entries blank.

Project/Proposal Section:

Current and Pending Support includes all resources made available to an individual in support of and/or related to all of his/her research efforts, regardless of whether or not they have monetary value.[1] Information must be provided about all current and pending support, including this project, for ongoing projects, and for any proposals currently under consideration from whatever source, irrespective of whether such support is provided through the proposing organization or is provided directly to the individual. This includes, for example, Federal, State, local, foreign, public or private foundations, non-profit organizations, industrial or other commercial organizations, or internal funds allocated toward specific projects. Concurrent submission of a proposal to other organizations will not prejudice its review by NSF, if disclosed.[2]

[1] If the time commitment or dollar value is not readily ascertainable, reasonable estimates should be provided.
[2] The Biological Sciences Directorate exception to this policy is delineated in PAPPG Chapter II.D.2.

Projects/Proposals

1. *Project/Proposal Title : Connecting to Nature through Outdoor Science

*Status of Support : (•) Current ( ) Pending ( ) Submission Planned ( ) Transfer of Support

Proposal/Award Number (if available): 053517

*Source of Support: Woka Foundation

*Primary Place of Performance : University of California, Berkeley

Project/Proposal Start Date (MM/YYYY) (if available) : 06/2022

Project/Proposal End Date (MM/YYYY) (if available) : 05/2024

*Total Award Amount (including Indirect Costs): $ 249,216

*Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1. 2023	0.60	4.	
2. 2024	0.60	5.	
3.			

*Overall Objectives : Creates learning experiences for the Lawrence Hall of Science's Outdoor Nature Lab. These experiences will be pilot tested for national dissemination to nature centers and other nature destinations that are visited by the general public.

*Statement of Potential Overlap : None

Projects/Proposals

2. *Project/Proposal Title : Understanding the Impact of Outdoor Science and Environmental Learning Experiences Through Community-Driven Outcomes

*Status of Support : ○ Current ◉ Pending ○ Submission Planned ○ Transfer of Support

Proposal/Award Number (if available):

*Source of Support: National Science Foundation

*Primary Place of Performance : University of California, Berkeley

Project/Proposal Start Date (MM/YYYY) (if available) : 09/2023

Project/Proposal End Date (MM/YYYY) (if available) : 08/2027

*Total Award Amount (including Indirect Costs): $ 1,998,991

*Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1. 2024	0.60	4. 2027	0.60
2. 2025	0.60	5. 2028	0.60
3. 2026	0.60		

*Overall Objectives : Using community-driven, participatory methods and approaches, this project will develop conceptual understandings and measures of scientific and environmental literacy that center the voices and experiences of youth of color. In addition, we will use developed measures to examine the impact of outdoor science and environmental education experiences on youth, and in particular aim to understand how youth of color make meaning of their experiences.

*Statement of Potential Overlap : None

Projects/Proposals

3. *Project/Proposal Title : Working Toward Racial Equity: Building Capacity to Institutionalize Equity in Outdoor and Environmental Science Education

*Status of Support : ○ Current ◉ Pending ○ Submission Planned ○ Transfer of Support

Proposal/Award Number (if available):

*Source of Support: National Science Foundation

*Primary Place of Performance : University of California, Berkeley

Project/Proposal Start Date (MM/YYYY) (if available) : 01/2024

Project/Proposal End Date (MM/YYYY) (if available) : 12/2028

*Total Award Amount (including Indirect Costs): $ 4,731,307

*Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1. 2024	1.80	4. 2027	2.40
2. 2025	1.80	5. 2028	1.20
3. 2026	2.40		

*Overall Objectives : Addresses debilitating racial inequities in the OESE field by increasing the capacity of organizations to build more racially just and equitable work environments through a multi-phase cohort-based professional learning approach as well as the creation of a Racial Equity Transformation Tool Kit.

*Statement of Potential Overlap : This proposal

Projects/Proposals

4. *Project/Proposal Title : Advancing Organization Transformation for Racial Equity in Environmental Education

*Status of Support : ○ Current ◉ Pending ○ Submission Planned ○ Transfer of Support

Proposal/Award Number (if available):

*Source of Support: Spencer Foundation (RPP)

*Primary Place of Performance : University of California, Berkeley

Project/Proposal Start Date (MM/YYYY) (if available) : 01/2024

Project/Proposal End Date (MM/YYYY) (if available) : 12/2026

*Total Award Amount (including Indirect Costs): $ 397,889

*Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1. 2024	0.60	4.	
2. 2025	0.60	5.	
3. 2026	0.60		

*Overall Objectives : Conducts a landscape assessment to understand the current state of racial equity and justice within the environmental education (EE) field across the United States.

*Statement of Potential Overlap : None

Effective 10/04/2021 **NSF CURRENT AND PENDING SUPPORT** **OMB-3145-0058**

*PI/co-PI/Senior Personnel Name: Laura Rodriguez

***Required fields**

Note: NSF has provided 15 project/proposal and 10 in-kind contribution entries for users to populate. Please leave any unused entries blank.

Project/Proposal Section:

Current and Pending Support includes all resources made available to an individual in support of and/or related to all of his/her research efforts, regardless of whether or not they have monetary value.[1] Information must be provided about all current and pending support, including this project, for ongoing projects, and for any proposals currently under consideration from whatever source, irrespective of whether such support is provided through the proposing organization or is provided directly to the individual. This includes, for example, Federal, State, local, foreign, public or private foundations, non-profit organizations, industrial or other commercial organizations, or internal funds allocated toward specific projects. Concurrent submission of a proposal to other organizations will not prejudice its review by NSF, if disclosed.[2]

[1] If the time commitment or dollar value is not readily ascertainable, reasonable estimates should be provided.
[2] The Biological Sciences Directorate exception to this policy is delineated in PAPPG Chapter II.D.2.

Projects/Proposals

1. *Project/Proposal Title :

*Status of Support : ◉ Current ○ Pending ○ Submission Planned ○ Transfer of Support

Proposal/Award Number (if available):

*Source of Support:

*Primary Place of Performance :

Project/Proposal Start Date (MM/YYYY) (if available) :

Project/Proposal End Date (MM/YYYY) (if available) :

*Total Award Amount (including Indirect Costs): $

*Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1.		4.	
2.		5.	
3.			

*Overall Objectives :

*Statement of
Potential Overlap :

Projects/Proposals

2. *Project/Proposal Title :

*Status of Support : ◉ Current ○ Pending ○ Submission Planned ○ Transfer of Support

Proposal/Award Number (if available):

*Source of Support:

*Primary Place of Performance :

Project/Proposal Start Date (MM/YYYY) (if available) :

Project/Proposal End Date (MM/YYYY) (if available) :

*Total Award Amount (including Indirect Costs): $

*Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1.		4.	
2.		5.	
3.			

*Overall Objectives :

*Statement of
Potential Overlap :

Projects/Proposals

3. *Project/Proposal Title : Advancing Organization Transformation for Racial Equity in Environmental Education

*Status of Support : ○ Current ◉ Pending ○ Submission Planned ○ Transfer of Support

Proposal/Award Number (if available):

*Source of Support: Spencer Foundation

*Primary Place of Performance : Berkeley, CA

Project/Proposal Start Date (MM/YYYY) (if available) : 08/2023

Project/Proposal End Date (MM/YYYY) (if available) : 07/2026

*Total Award Amount (including Indirect Costs): $ 71,917

*Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1. 2023	0.20	4.	
2. 2024	0.20	5.	
3. 2025	0.20		

*Overall Objectives : Conduct a landscape assessment of the current state of racial equity and justice within the EE field across the US. Create a snapshot of the current national conditions that hold systemic racism in place within the EE field in order to build partner and field-wide capacity for systems change and organizational transformation toward equity and justice. Publish a landscape report and articulate a new conceptual framework for recognizing transforming racial equity in the field.

*Statement of Potential Overlap : There is no known overlap between this project and the proposed project in terms of scope, budget, or person-months planned.

Projects/Proposals

4. *Project/Proposal Title : Working Toward Racial Equity: Building Capacity to Institutionalize Equity in Outdoor and Environmental Science Education

*Status of Support : ○ Current ◉ Pending ○ Submission Planned ○ Transfer of Support

Proposal/Award Number (if available):

*Source of Support: University of California Berkeley/ NSF

*Primary Place of Performance :

Project/Proposal Start Date (MM/YYYY) (if available) : 01/2024

Project/Proposal End Date (MM/YYYY) (if available) : 12/2028

*Total Award Amount (including Indirect Costs): $ 527,083

*Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1. 2024	1.80	4. 2027	1.80
2. 2025	1.80	5. 2028	1.80
3. 2026	1.80		

*Overall Objectives : Addresses debilitating racial inequities in the OESE field by increasing the capacity of organizations to build more racially just and equitable work environments through a multi-phase cohort-based professional learning approach as well as the creation of a Racial Equity Transformation Tool Kit.

*Statement of Potential Overlap : This project

Effective 10/04/2021 **NSF CURRENT AND PENDING SUPPORT** **OMB-3145-0058**

*PI/co-PI/Senior Personnel Name: Michael P. Arnold

***Required fields**

Note: NSF has provided 15 project/proposal and 10 in-kind contribution entries for users to populate. Please leave any unused entries blank.

Project/Proposal Section:

Current and Pending Support includes all resources made available to an individual in support of and/or related to all of his/her research efforts, regardless of whether or not they have monetary value.[1] Information must be provided about all current and pending support, including this project, for ongoing projects, and for any proposals currently under consideration from whatever source, irrespective of whether such support is provided through the proposing organization or is provided directly to the individual. This includes, for example, Federal, State, local, foreign, public or private foundations, non-profit organizations, industrial or other commercial organizations, or internal funds allocated toward specific projects. Concurrent submission of a proposal to other organizations will not prejudice its review by NSF, if disclosed.[2]

[1] If the time commitment or dollar value is not readily ascertainable, reasonable estimates should be provided.
[2] The Biological Sciences Directorate exception to this policy is delineated in PAPPG Chapter II.D.2.

Projects/Proposals

1. *Project/Proposal Title : YESS Summer Camp Evaluation

*Status of Support : (•) Current ( ) Pending ( ) Submission Planned ( ) Transfer of Support

Proposal/Award Number (if available):

*Source of Support: NSF/Lawrence Hall of Science (Subaward)

*Primary Place of Performance : Berkeley, CA

Project/Proposal Start Date (MM/YYYY) (if available) : 09/2020

Project/Proposal End Date (MM/YYYY) (if available) : 08/2024

*Total Award Amount (including Indirect Costs): $ 120,000

*Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1. 2020	0.13	4. 2023	0.41
2. 2021	0.41	5. 2024	0.28
3. 2022	0.41		

*Overall Objectives : Study of the efficacy of service-learning in STEM education (particularly as delivered in a camp format, to middle school age youth in Alameda, CA)

*Statement of Potential Overlap : None

Projects/Proposals

2. *Project/Proposal Title : Partnership for the Bay's Future Breakthrough Grant Evaluation

*Status of Support : (•) Current ( ) Pending ( ) Submission Planned ( ) Transfer of Support

Proposal/Award Number (if available):

*Source of Support: San Francisco Foundation Partnership for the Bay's Future

*Primary Place of Performance : Berkeley, CA

Project/Proposal Start Date (MM/YYYY) (if available) : 03/2022

Project/Proposal End Date (MM/YYYY) (if available) : 05/2024

*Total Award Amount (including Indirect Costs): $ 208,950

*Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1. 2022	0.20	4.	
2. 2023	0.24	5.	
3. 2024	0.10		

*Overall Objectives : Evaluation of the Breakthrough Grants, a program of the Partnership for the Bay's Future Policy Fund.

*Statement of Potential Overlap : None

Projects/Proposals

3. *Project/Proposal Title : Designing and implementing a bundled evaluation of two 2021 RWJF Healthy Children and Families' leadership authorizations, NEW and SPFL

*Status of Support : (•) Current ( ) Pending ( ) Submission Planned ( ) Transfer of Support

Proposal/Award Number (if available):

*Source of Support: Robert Wood Johnson Foundation

*Primary Place of Performance : Berkeley, CA

Project/Proposal Start Date (MM/YYYY) (if available) : 07/2022

Project/Proposal End Date (MM/YYYY) (if available) : 06/2025

*Total Award Amount (including Indirect Costs): $ 996,110

*Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1. 2022	0.47	4. 2025	0.92
2. 2023	1.85	5.	
3. 2024	1.85		

*Overall Objectives : Iterative and participatory approach to the design and implementation of a bundled evaluation of Healthy Children and Families' leadership programming and investments from 2021–2024. The evaluation will focus on the relationships built and work done through two distinct authorizations of the HCF team: New Economics for BIPOC Women, and Augmenting Parent & Family Leadership.

*Statement of Potential Overlap : None

Projects/Proposals

4. *Project/Proposal Title : Landscaping and Assessing the Field of Equitable Evaluation to Support Learning and Program Development

*Status of Support : (•) Current ( ) Pending ( ) Submission Planned ( ) Transfer of Support

Proposal/Award Number (if available):

*Source of Support: Engage R+D/Robert Wood Johnson Foundation (Subaward)

*Primary Place of Performance : Berkeley, CA

Project/Proposal Start Date (MM/YYYY) (if available) : 11/2022

Project/Proposal End Date (MM/YYYY) (if available) : 05/2025

*Total Award Amount (including Indirect Costs): $ 281,850

*Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1. 2022	0.11	4. 2025	0.55
2. 2023	1.31	5.	
3. 2024	1.31		

*Overall Objectives : The Research, Evaluation, and Learning (REL) unit at the Robert Wood Johnson Foundation (RWJF) has launched a body of work to advance the field of equitable evaluation (EE) and promote equity - with a focus on racial equity - in evaluation culture, processes, and practices in philanthropy. Engage R+D and Informing Change will serve as the learning and evaluation partner for this initiative.

*Statement of Potential Overlap : None.

Projects/Proposals

5. *Project/Proposal Title : Working Toward Racial Equity: Building Capacity to Institutionalize Equity in Outdoor and Environmental Science Education

*Status of Support : ○ Current ◉ Pending ○ Submission Planned ○ Transfer of Support

Proposal/Award Number (if available):

*Source of Support: NSF/Lawrence Hall of Science (Subaward)

*Primary Place of Performance : Berkeley, CA

Project/Proposal Start Date (MM/YYYY) (if available) : 01/2024

Project/Proposal End Date (MM/YYYY) (if available) : 12/2028

*Total Award Amount (including Indirect Costs): $ 675,425

*Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1. 2024	0.72	4. 2027	0.84
2. 2025	0.60	5. 2028	0.60
3. 2026	0.72		

*Overall Objectives : This project addresses debilitating racial inequities in the outdoor and environment science education field by increasing the capacity of organizations to build more racially just and equitable work environments.

Informing Change will lead the evaluation to support ongoing program improvements and document learnings and progress toward objectives.

*Statement of Potential Overlap : None

Table 1

1	Your Name:	Your Organizational Affiliation(s), last 12 mo	Last Active Date
	Foreman, Jedda	University of California, Berkeley	

Table 2

2	Name:	Type of Relationship	Optional (email, Department)	Last Active Date

Table 3

3	Advisor/Advisee Name:	Organizational Affiliation	Optional (email, Department)

Table 4

4	Name:	Organizational Affiliation	Optional (email, Department)	Last Active Date
C	Dorph, Rena	University of California, Berkeley		
A	Strang, Craig	University of California, Berkeley		
C	Lujan, Vanessa	University of California, Berkeley		
A	Olsen, Sarah	University of California, Berkeley		
C	Beals, Kevin	University of California, Berkeley		
A	Romero, Valeria	University of California, Berkeley		
A	Mitchell, Betsy	University of California, Berkeley		
C	Lygren, Emilie	University of California, Berkeley		
C	Pedemonte, Sarah	University of California, Berkeley		
A	Elkin, Terri	Alameda Unified School District		
C	Storksdieck, Martin	Oregon State University		
A	Rodriguez, Laura	Justice Outside		
A	Payan, Rena	Justice Outside		
A	Moore Bailey, Kim	Justice Outside		

Table 5

5	Name:	Organizational Affiliation	Journal/Collection	Last Active Date
B	John Quay	University of Melbourne		
E	Tonia Gray	Western Sydney University		

Table 1

1	Your Name:	Your Organizational Affiliation(s), last 12 mo	Last Active Date
	Romero, Valeria	University of California, Berkeley	

Table 2

2	Name:	Type of Relationship	Optional (email, Department)	Last Active Date
R	Kelly, Greg	Mentor	Pennsylvania State University	
R				
R				
R				

Table 3

3	Advisor/Advisee Name:	Organizational Affiliation	Optional (email, Department)
G	Patterson, Alexis	UC Davis	School of Education
G	Quijada, Patricia	UC Davis	School of Education
G	Martinez, Danny C.	UC Davis	School of Education
G	McAfee, Myosha	The Equitect	

Table 4

4	Name:	Organizational Affiliation	Optional (email, Department)	Last Active Date
A	Strang, Craig	University of California, Berkeley		
A	Foreman, Jedda	University of California, Berkeley		
A	Rodriguez, Laura	Justice Outside		
A	Collins, Melissa	University of California, Berkeley		
A	Olsen, Sarah	University of California, Berkeley		
A	Grindstaff, Kelly	University of California, Berkeley		
A	Cannady, Matthew	University of California, Berkeley		
C	Chi, Bernadette	Independent Consultant		
C	Dorph, Rena	University of California, Berkeley		
C	Hartry, Ardice	University of California, Berkeley		
C	Voussougi, Shirin	Northwestern University		
A	Young, Aujanee	University of California, Berkeley		
A	Sanchez, Alex	University of California, Berkeley		
C	Koo, Ben	University of California, Berkeley		
C	Mayfield, Karen	University of California, Berkeley		

C	Garibay, Cecila	Garibay Group		
C	Arnold, Michael	Informing Change		
A	Payan, Rena	Justice Outside		
A	Moore-Bailey, Kim	Justice Outside		
A	Laina, Vicky	University of California, Berkeley		
A	Pande, Aparajita	University of Chicago, Loyola		
A	Snow, Juna	Innovated Consulting		
A	Gonzalez, Jasmin	Adventures Cross Country Program		
A	Arciniega, Martha	Watsonville Wetlands Watch		
A	Maybury, Charity	Crissy Field Center		
A	Pepito, Ernesto	Crissy Field Center		
A	Rocca, Christy	Crissy Field Center		
A	Cuff, Kevin	University of California, Berkeley		
A	Nava, Rosalinda	University of California, Berkeley		
A	Trahan, Lisa	University of California, San Diego		
A	Blinderman, Ellen	Retired		
A	Totino, Joanna	University of California, Berkeley		
A	Pedroso, Rosio	Pedroso Consulting		
C				

Table 5

5	Name:	Organizational Affiliation	Journal/Collection	Last Active Date
B	George Julnes		American Journal of Evaluation	
B	Tonia Gray		International Journal of Environmental Education	
B	Sherry Southerland		Science Education	
B	John Settlage		Science Education	

Table 1

1	Your Name:	Your Organizational Affiliation(s), last 12 mo	Last Active Date
	Strang, Craig	University of California, Berkeley	

Table 2

2	Name:	Type of Relationship	Optional (email, Department)	Last Active Date

Table 3

3	Advisor/Advisee Name:	Organizational Affiliation	Optional (email, Department)

Table 4

4	Name:	Organizational Affiliation	Optional (email, Department)	Last Active Date
A	Pande, Aparajita	Northwestern University		
C	Dorph, Rena	University of California, Berkeley		
C	Hernandez, Blanca	YES Nature to Neighborhoods		
C	Cowe, Karen	Ten Strands		
C	Maybury, Charity	Crissiy Field Center		
C	Weiss, Emily	University of California, Berkeley		
C	Lujan, Vanessa	University of California, Berkeley		
A	Rodriguez, Laura	Youth Outside		
A	Payan, Rena	Youth Outside		
A	Moore Bailey, Kim	Youth Outside		
A	Foreman, Jedda	University of California, Berkeley		
A	Fauville, Geraldine	University of Gothenburg		
A	Cannady, Matthew	University of California, Berkeley		
A	Chen, Ying-Fang	Genentech		
A	Young, Aujanee	University of California, Berkeley		
A	Collins, Melissa	University of California, Berkeley		
A	Romero, Valeria	University of California, Berkeley		

C	Storksdieck, Martin	Oregon State University		

Table 5

5	Name:	Organizational Affiliation	Journal/Collection	Last Active Date

Table 1

1	Your Name:	Your Organizational Affiliation(s), last 12 mo	Last Active Date
	Rodriguez, Laura	Justice Outside	

Table 2

2	Name:	Type of Relationship	Optional (email, Department)	Last Active Date

Table 3

3	Advisor/Advisee Name:	Organizational Affiliation	Optional (email, Department)
G	Little, Judith Warren	University of California, Berkeley	
G	Noguera, Pedro	New York University	
G	Swidler, Ann	University of California, Berkeley	

Table 4

4	Name:	Organizational Affiliation	Optional (email, Department)	Last Active Date
A	Valeria Fike Romero	Lawrence Hall of Science, UC Berkeley	valeriafr@berkeley.edu	
A	Craig Strang	Lawrence Hall of Science, UC Berkeley	cstrang@berkeley.edu	
A	Jedda Foreman	Lawrence Hall of Science, UC Berkeley	jforeman@berkeley.edu	
A	Rena Payan	Justice Outside	rena@justiceoutside.org	
A	Kim Moore Bailey	Justice Outside	kim@justiceoutside.org	
A	Sarah Olsen	Lawrence Hall of Science, UC Berkeley	sarah.olsen@berkeley.edu	
A	Kelly Grindstaff	Lawrence Hall of Science, UC Berkeley	kelly.grindstaff@berkeley.edu	
A	Michael Arnold	Informing Change	marnold@informingchange.com	
A	Inti Chomsky	Informing Change	ichomsky@informingchange.com	
A	Aujanee Young	Lawrence Hall of Science, UC Berkeley	aujaneeyoung@berkeley.edu	
A	Zoe Bell	Informing Change	zbell@informingchange.com	

Table 5

5	Name:	Organizational Affiliation	Journal/Collection	Last Active Date

Table 1

1	Your Name:	Your Organizational Affiliation(s), last 12 mo	Last Active Date
	Arnold, Michael P.	Informing Change	

Table 2

2	Name:	Type of Relationship	Optional (email, Department)	Last Active Date
R	None			

Table 3

3	Advisor/Advisee Name:	Organizational Affiliation	Optional (email, Department)
G	Chow, Julian	University of California, Berkeley	Department of Social Welfare
T	Organista, Kurt	University of California, Berkeley	Department of Social Welfare
T	Duerr-Berrick, Jill	University of California, Berkeley	Department of Social Welfare

Table 4

4	Name:	Organizational Affiliation	Optional (email, Department)	Last Active Date
A	Chomsky, Inti	Informing Change	ichomsky@informingchange.com	
A	Bell, Zoe	Informing Change	zbell@informingchange.com	
A	Young, Aujanee	Lawrence Hall of Science, UC Berkeley	aujaneeyoung@berkeley.edu	
A	Rodriguez, Laura	Justice Outside	laura@justiceoutside.org	
A	Kee, Chad	WhitworthKee Consulting	ckee@whitworthkee.com	
A	Garcia, Moctezuma	San Jose State University	moctezuma.garcia@sjsu.edu	
A	Oliva, Michelle	EduDream	michelle@edudream.org	
A	Losey, London	Change Matrix	llosey@changematrix.org	
A	Lieu, Theresa Esperrago	College Futures Foundation (current)		
A	Blackmur, Natalie	Freelance Consultant (current)		
A	Solórzano, Brenda	Headwaters Foundation	brendas@headwatersmt.org	
A	Wang Kong, Carolyn	Asian Pacific Fund (current)		
A	Wunsch, Bobbie	Pacific Health Consulting		
A	Mutha, Sunita	Healthforce Center, UC San Francisco		
A	Hilliard, Tracy	MPHI		
C	Rosga, AnnJanette	Informing Change	arosga@informingchange.com	

Table 5

5	Name:	Organizational Affiliation	Journal/Collection	Last Active Date
B	None			
E	None			

Data Management Plan

Data Description. The proposed project will include human subjects data consisting of (1) field notes obtained through observations at participating organizations, in-situ interviews, WTRE project activities, pláticas and case site visits, (2) group and one-one-one pláticas which will audio-recorded, transcribed and stored in electronic files (MP3, MS Word), and (3) artifacts obtained through project activities and case site visits.

Responsibility. The principal investigators (PIs) will have overall responsibility for data management and dissemination over the course of the research project and will monitor compliance with the plan. In the case that a PI leaves UC Berkeley, the data will remain with UC Berkeley and another appointed and approved PI will take over the project and be able to access to the data.

Data Storage. All data collected through the research project will be transferred securely to long-term storage on the UC Berkeley campus. Any paper data will be stored in locked cabinets in locked offices, and electronic data will be stored in encrypted files on a password-protected server that is only accessible to researchers. Human subject consent forms will be signed and collected electronically through a secure online survey program such as Berkeley Qualtrics and stored in an encrypted password-protected Microsoft Excel file, . accessible only to the PIs and designated research staff.

Confidentiality. Since these data will be from human subjects, approval for human subjects research will be obtained through UC Berkeley's institutional review board. To answer our research questions, it will be necessary to link data over time. Thus, each participant will be assigned an arbitrary code so their story can be tracked over time. One file or key that contains the correspondence between participant names and codes will be kept in an encrypted password-protected file. Only members of the research and evaluation teams will have access to participants' identities. These personnel must have access to participant names, addresses, and telephone numbers in order to perform their duties (i.e., maintaining follow-up contact with participants, setting up compensation for their time, etc). All such staff members will be required to pass the CITI course and have current CITI certification and agree not to reveal the names of study participants to anyone outside the research team.

Sharing of Data and Products. Upon completion of the project, members of the research team will have access to the data for at least five years. During this time, the team will (1) analyze data to address specific aims; and (2) conceptualize, present, write and publish the study findings. If requested, access to the de-identified data will be provided by contacting the PI. Data will, in principle, be available for access and sharing as soon as is reasonably possible, normally not longer than one year after finalization of clean research files.

Data collected by the research and evaluation teams may be shared across institutions, as appropriate. In all cases data will be encrypted and password protected before sharing. Passwords will be shared verbally or with a secure platform such as LastPass. Both institutions will enact measures to protect the confidentiality and privacy of participants.

Instruments will be shared with each of the informal learning contexts for which they have been specifically developed. Information regarding our final instruments will be shared through our websites, journal publications and industry conferences. The instrument itself will be shared with informal learning environments through evaluation efforts and the evaluation community.

The data acquired and preserved in the context of this proposal will be further governed by the University of California's policies pertaining to intellectual property, record retention, and data management. We do not anticipate that significant intellectual property issues involved with these data will arise. Reports or publications resulting from the project will be submitted to NSF and be made available through research conferences and journals.

Dissemination of products. The proposed project will disseminate research findings through multiple channels including journal articles, conferences, websites, and online communities to share what we have developed and lessons learned. Products will be made available on websites such as the Lawrence Hall of Science website. Products will be made available on online community websites, as appropriate. Educational products developed through this grant as well as derivative products will become property of the Regents of the University of California.

Evaluation Data Management Plan

Data Description. The proposed project will include human subjects data consisting of (1) survey data collected electronically through an online survey program like Alchemer and stored in electronic files (Microsoft Excel, SPSS, R), (2) group conversations and individual interview data which will audio-recorded, transcribed and stored in electronic files (MP3, MS Word) (3) rapid feedback forms, (4) field notes obtained through observations of project activities, interviews, group conversations and case site visits, and (5) artifacts obtained through project activities and case site visits.

Responsibility. The principal investigators (PIs) at Informing Change will have overall responsibility for data management and dissemination over the course of the evaluation and will monitor compliance with the plan. In the case that a PI leaves Informing Change, the data will remain with Informing Change and another appointed and approved team member will gain access to the data.

Data Storage. All data collected through the evaluation aspect of the project will be securely stored in the securely locked Informing Change offices. Paper data will be stored in locked cabinets in locked offices, and electronic data will be stored in encrypted files on a password-protected server that is only accessible to evaluators.

Confidentiality. Whenever possible, data will be collected anonymously. Informing Change will follow the same measures to maintain confidentiality as described for the research above.

Submitted/PI: Jedda Foreman /Proposal No: 2315277

Working Toward Racial Equity:
Building Capacity to Institutionalize Equity in Outdoor and Environmental Science Education

Supplementary Documents

Table of Contents

Working Toward Racial Equity:
Building Capacity to Institutionalize Equity in Outdoor and Environmental Science Education

Submitted to: Racial Equity in STEM Education; NSF 22-634
Submitted by: Jedda Foreman; Valeria Romero; Craig Strang; Laura Rodriguez
Lawrence Hall of Science

List of Project Personnel

---

1. Jedda Foreman; The Lawrence Hall of Science; PI
2. Craig Strang; The Lawrence Hall of Science; co-PI
3. Valeria Romero; The Lawrence Hall of Science; co-PI (Research Team)
4. Laura Rodriguez; Justice Outside; co-PI/Subawardee
5. Corinne Calhoun; The Lawrence Hall of Science; Project Coordinator
6. TBD; The Lawrence Hall of Science; Project Manager
7. Alex Sanchez; The Lawrence Hall of Science; Research Coordinator
8. Kelly Grindstaff; The Lawrence Hall of Science; Research Associate
9. Aujanee Young; The Lawrence Hall of Science; Research Analyst
10. TBD; Justice Outside; Professional Learning Lead Specialist
11. TBD; Justice Outside; Professional Learning Specialist
12. Kim Moore Bailey; Justice Outside; letter of collaboration writer
13. Gail Comacho; Informing Change; letter of collaboration writer
14. Dr. Michael Arnold; Informing Change; Subaward PI
15. Inti Chomsky; Informing Change; Analyst
16. Zoe Bell; Informing Change; Evaluation Assistant
17. TBD; Informing Change; Lead Analyst and Project Manager
18. Johnny Du; Informing Change; Writer
19. Autumn Saxton-Ross; National Recreation and Parks Association; Advisor
20. Bernadette Chi; Independent Consultant; Advisor
21. Celeste Royer; Ten Strands; Advisor
22. Jody Donovan; Rocky Mountain Consulting; Advisor
23. Judy Braus; North American Association for Environmental Education; Advisor
24. Déana Scipio; IslandWood; Advisor
25. Patricia D. Quijada; University of California; Davis; Advisor

December 8, 2022

Jedda Foreman
Lawrence Hall of Science
University of California
Berkeley, CA 94720-5200

If the proposal submitted by Jedda Foreman entitled *Working Toward Racial Equity: Building Capacity to Institutionalize Equity in Outdoor and Environmental Science Education* is selected for funding by NSF, it is my intent to collaborate as detailed in the Project Description.

ABOUT JUSTICE OUTSIDE

Justice Outside is a woman of color-led nonprofit organization that advances racial justice and equity in the outdoor and environmental movement. We shift resources to, build power with, and center the voices and leadership of Black, Indigenous, and People of Color because the health of current and future generations demands it.

Justice Outside is a national leader in the critical work of creating a more inclusive and equitable environmental movement. We are unique in that we empower those we support to take immediate action and apply learnings in the moment. We seek to strengthen individual, organizational, and field-wide capacity to leverage resources and create inclusive environments that authentically welcome and engage all people in relevant ways. At Justice Outside, we believe that lasting diversity results when equity and inclusion are practiced consistently and intentionally.

Kim Moore Bailey
President & CEO

DocuSigned by:
Kim Moore Bailey
82CBD1F7ECDD4E0...

INFORMING CHANGE

December 21, 2022

Jedda Foreman
Lawrence Hall of Science
University of California
Berkeley, CA 94720-5200

Dear Jedda,

If the proposal submitted by Jedda Foreman, Valeria Romero, Craig Strang, et al. entitled **Working Toward Racial Equity: Building Capacity to Institutionalize Equity in Outdoor and Environmental Science Education** is selected for funding by NSF, it is our company's intent to collaborate and/or commit resources as detailed in the Project Description or the Facilities, Equipment or Other Resources section of the proposal.

Gail Camacho
Chief Operating Officer

Michael P. Arnold
Director

NATIONAL
RECREATION AND PARK
ASSOCIATION

22377 Belmont Ridge Road
Ashburn, VA 20148
1 800 626 NRPA (6772)
P 703 858 0784
F 703 858 0794
nrpa.org

December 19, 2022

Jedda Foreman
Lawrence Hall of Science
University of California
Berkeley, CA 94720-5200

If the proposal submitted by Melissa Collins entitled *Working Toward Racial Equity: Building Capacity to Institutionalize Equity in Outdoor and Environmental Science Education* is selected for funding by NSF, it is my intent to collaborate as an advisor. As a member of the Advisory Board, I will participate in yearly meetings, as well as periodic reviews of various project components, protocols, and publications.

Regarding my qualification to serve as an advisor, I have worked at the intersection of health, equity and green space for over 20 years. Currently as the VP for Education and Chief Equity Officer for the National Recreation and Parks Association (NRPA), I lead a team that creates in person and online learning opportunities for over 60,000 members within our 3 pillars of health and wellness, conservation and equity. My work at NRPA is based off the belief that *"difference meets on the playground"* where we center race equity as a way to prepare our professionals for the present and the future. Serving as an advisor would not only provide me with the opportunity to share my experience but to also learn with others working in this space.

Sincerely,

Autumn Saxton-Ross, PhD
VP of Education & Chief Equity Officer

BERNADETTE CHI, PH.D. ***CONSULTANT***

1463 Mountain Boulevard, Oakland, CA 94611 bchiconsulting@gmail.com 510-693-6981

December 9, 2022

Jedda Foreman
Lawrence Hall of Science
University of California
Berkeley, CA 94720-5200

If the proposal submitted by Dr. Melissa Collins entitled *Working Toward Racial Equity: Building Capacity to Institutionalize Equity in Outdoor and Environmental Science Education* is selected for funding by NSF, it is my intent to collaborate as an advisor. As a member of the Advisory Board, I will participate in yearly meetings, as well as periodic reviews of various project components, protocols, and publications.

Regarding my qualification to serve as an advisor, I have conducted educational evaluation and research studies over the last 25 years of science and civic education projects and initiatives in both formal and informal settings. I have a particular interest and passion to expand access to outdoor and environmental science educational opportunities for youth and communities typically underrepresented in those fields.

Sincerely,

Bernadette Chi, PhD
Independent Consultant

Celeste Royer
337 Henrietta Avenue
Los Osos, CA 93402
805-748-6404
celesteroyer1984@gmail.com

December 15, 2022

Jedda Foreman
Lawrence Hall of Science
University of California
Berkeley, CA 94720-5200

Dear Jedda:

If the proposal submitted by Melissa Collins entitled *Working Toward Racial Equity: Building Capacity to Institutionalize Equity in Outdoor and Environmental Science Education* is selected for funding by NSF, it is my intent to collaborate as an advisor. As a member of the Advisory Board, I will participate in yearly meetings, as well as periodic reviews of various project components, protocols, and publications.

Regarding my qualification to serve as an advisor, I have over 35 years of experience in outdoor and environmental education. In the programs I managed, I implemented many professional learning sessions for staff related to equity, inclusion, and cultural relevance including participation in the Working Toward Equitable Organizations pilot project. I currently work as the Director of Equity and Inclusion at Ten Strands where my work focuses on centering equity as we advance environmental literacy in California. I also serve as the Vice Chair of the Justice Outside Board of Directors, an organization whose mission is to advance racial justice and equity in the outdoors.

Sincerely,

Celeste Royer

ROCKY MOUNTAIN CONSULTING

December 15, 2022

Jedda Foreman
Lawrence Hall of Science
University of California
Berkeley, CA 94720-5200

Dear Jedda,

If the proposal submitted by Melissa Collins entitled *Working Toward Racial Equity: Building Capacity to Institutionalize Equity in Outdoor and Environmental Science Education* is selected for funding by NSF, it is my intent to collaborate as an advisor. As a member of the Advisory Board, I will participate in yearly meetings, as well as periodic reviews of various project components, protocols, and publications.

Regarding my qualification to serve as an advisor, in my role of Chief Operations Officer at Teton Science Schools I was accountable for the smooth function of internal operations and program delivery, and I led the DEI initiative for outdoor, experiential learning programs that served 15,000 participants each year. As a leader in the Jackson Hole DEI Collective, I led the design and implementation of community-based programming to support equity and belonging in our region. This work included the design and delivery of robust community and organizational learning opportunities as well as emergent services, such as debrief facilitation for a multi-entity collaboration that had harmful community impacts. Currently I am a Principal and Senior Consultant for Rocky Mountain Consulting, working with organizations and entities to create affirming and productive cultures and further their diversity, equity and belonging initiatives.

If my expertise is a match, I would welcome the opportunity to continue to support this next iteration of the WTRE project.

Sincerely,

Jody Donovan
Principal & Senior Consultant
Rocky Mountain Consulting

naaee
North American Association
for Environmental Education

December 17, 2022

Jedda Foreman
Lawrence Hall of Science
University of California
Berkeley, CA 94720-5200

If the proposal submitted by Jedda Foreman entitled *Working Toward Racial Equity: Building Capacity to Institutionalize Equity in Outdoor and Environmental Science Education* is selected for funding by NSF, it is my intent to collaborate as an advisor. As a member of the Advisory Board, I will participate in yearly meetings, as well as periodic reviews of various project components, protocols, and publications.

With respect to my qualifications, I am currently the Executive Director of the North American Association of Environmental Education, and in that role, oversee all the work of the Association in advancing environmental literacy and civic engagement and creating a more diverse and equitable movement. Prior to coming to NAAEE, I was the Senior Vice President of Education and Centers at the National Audubon Society and also led the education programs at World Wildlife Fund, the U.S. Peace Corps, and the National Wildlife Federation. I have been working in the field of environmental education, conservation, and outdoor education for more than three decades. Building a more just, equitable, and inclusive movement is integral to everything we do.

Sincerely,

Judy Braus
Executive Director

ISLANDWOOD™

January 5, 2023

Jedda Foreman
Lawrence Hall of Science
University of California
Berkeley, CA 94720-5200

If the proposal submitted by Jedda Foreman entitled *Working Toward Racial Equity: Building Capacity to Institutionalize Equity in Outdoor and Environmental Science Education* is selected for funding by NSF, it is my intent to collaborate as an advisor. As a member of the Advisory Board, I will participate in yearly meetings, as well as periodic reviews of various project components, protocols, and publications.

Regarding my qualification to serve as an advisor, I am a professional of color within the field of Environmental Education as well as a design-based researcher and scholar of broadening participation for and with BIPOC folks in environmental education. My work at IslandWood as the Director of the Education for Environment and Community program places me at the intersection of justice-centered practitioner education, higher education to prepare future teachers for more just worlds, and leveraging research to develop theory about how people learn in environmental education teaching and learning contexts. The resources from the Lawrence Hall of Science team have already been transformative for our organization and as a member of the second cohort of the Working Towards Race Equity Program I feel that I bring a special cross-section of interrelated skills to an advisory role on this project.

Sincerely,

Déana Scipio

Déana Scipio, PhD
Director of Graduate Education Programs
Pronouns: she/her/hers
IslandWood | 4450 Blakely Ave NE, Bainbridge Island, WA 98110
o: 206-855-4304
www.islandwood.org

UNIVERSITY OF CALIFORNIA, DAVIS

BERKELEY • DAVIS • IRVINE • LOS ANGELES • MERCED • RIVERSIDE • SAN DIEGO • SAN FRANCISCO SANTA BARBARA • SANTA CRUZ

SCHOOL OF EDUCATION
ONE SHIELDS AVENUE
DAVIS, CALIFORNIA 95616-8686

December 15, 2022

Jedda Foreman
Lawrence Hall of Science
University of California
Berkeley, CA 94720-5200

If the proposal submitted by Melissa Collins entitled *Working Toward Racial Equity: Building Capacity to Institutionalize Equity in Outdoor and Environmental Science Education* is selected for funding by NSF, I intend to collaborate as an advisor. As a member of the Advisory Board, I will participate in yearly meetings and periodic reviews of various project components, protocols, and publications.

Regarding my qualifications to serve as an advisor, I bring over twenty years of working as an educational leader and faculty member leading programs and research centered on equity, access, and persistence of students in P-20 educational systems. As a faculty member, I investigate students' educational pathways in k-12 and postsecondary alignment, equity, and access to higher education, particularly for Latinx/Indigenous and Native American students and communities. My research expertise centers on critically examining the intersection of race, place, and colonization in rural areas, Indigenous knowledge systems, family-community-school partnerships, and qualitative methodologies, including critical community participatory action research. My research also explores the impact of institutional policies and leadership practices aimed at reducing educational inequities in educational organizations.

I look forward to serving on the advisory board and supporting the *Working Toward Racial Equity: Building Capacity to Institutionalize Equity in Outdoor and Environmental Science Education* Project.

Sincerely,

Patricia D. Quijada

Patricia. D. Quijada, PhD
Associate Professor
Educational Policy and School Organization
School of Education

List of Suggested Reviewers

Data Not Available

List of Reviewers Not to Include

Data Not Available

EXHIBIT D

NATIONAL SCIENCE FOUNDATION

Award Notice

Award Number (FAIN): 2315277
Managing Division Abbreviation: DRL **Amendment Number:** 000

RECIPIENT INFORMATION

Recipient (Legal Business Name): REGENTS OF THE UNIVERSITY OF CALIFORNIA, THE
Recipient Address: 1608 4TH ST STE 201 BERKELEY, CA 94710-1749
Official Recipient Email Address: spoawards@berkeley.edu
Unique Entity Identifier (UEI): GS3YEVSS12N6

AMENDMENT INFORMATION

Amendment Type: New Project
Amendment Date: 09/13/2023
Amendment Number: 000
Proposal Number: 2315277
Amendment Description:

The National Science Foundation hereby awards a Continuing Grant for support of the project described in the proposal referenced above as modified by revised budget dated 07/19/2023.

PIs are required to submit the final Summative Evaluation of or other knowledge-building product(s) from the project for posting to the web site http://www.informalscience.org (or other sites designated by AISL) as part of submission of the Final Report. Final reports will not be approved before the summative evaluation/knowledge-building products are posted for the project. As a condition of this award, the grantee agrees to work with an NSF third-party evaluator for the purpose of program evaluation.

Broadcasts and all other materials produced as a part of this project, including digital media and World Wide Web pages, must include a clear indication of the source of support and must include the NSF logo all in a manner to be approved by NSF. NSF credits normally should be included at both the heads and tails of both broadcast and non-broadcast programs and placed on the cover of cover of publications. All promotional materials for the project produced under the control of the grantee must include NSF funding credit. All television programs must have closed captions encoded on the master and broadcast with closed captions.

No work with human subjects, including recruitment, may be conducted under this protocol or grant until IRB approval has been obtained.

Funds provided for participant support may not be diverted by the awardee to other categories of expense without the prior written approval of the cognizant NSF Program Officer. Since participant support cost is not a normal account classification, the awardee organization must be able to separately

identify participant support costs. It is highly recommended that separate accounts, sub-accounts, sub-task, or sub-ledgers be established to accumulate these costs. The awardee should have written policies and procedures to segregate participant support costs.

The Foundation authorizes the awardee to enter into the proposed subaward arrangement. The subaward agreement should contain appropriate provisions in accordance with the award terms and conditions in effect at the time of this award amendment, and contain any special conditions included in this award.

Costs of entertainment, amusement, diversion and social activities, and any costs directly associated with such activities (such as meals, lodging, rentals, transportation and gratuities) are unallowable. When certain meals are an integral and necessary part of a conference or meeting (i.e., working meals where business is transacted), grant funds may be used for such meals. Grant funds may also be used to furnish a reasonable amount of coffee or soft drinks for conference or meeting participants and attendees during coffee breaks.

No NSF funds may be spent on meals or coffee breaks for intramural meetings of an organization or any of its components, including, but not limited to, laboratories, departments and centers.

Fiscal Year 2023 and 2024 budgets have been combined in this award. It is still the grantee's responsibility to submit an annual project report in accordance with the award terms and conditions.

AWARD INFORMATION

Award Number (FAIN): 2315277
Award Instrument: Continuing Grant
Award Date: 09/13/2023
Award Period of Performance: Start Date: 01/01/2024 End Date: 12/31/2028
Project Title: Building Capacity to Institutionalize Equity in Outdoor and Environmental Science Education
Managing Division Abbreviation: DRL
Research and Development Award: Yes
Funding Opportunity: NSF 22-634 Racial Equity in STEM Education
Assistance Listing Number(s) and Name(s): 47.076 Education and Human Resources (Predominant source of funding for SEFA reporting)

FUNDING INFORMATION

Amount Obligated by this Amendment: $1,701,416
Total Intended Award Amount: $4,723,028
Total Approved Cost Share or Matching Amount: $0
Total Amount Obligated to Date: $1,701,416
Expenditure Limitation: Not Applicable

Contingent on the availability of funds and scientific progress of the project, NSF expects to continue support at approximately the following level:

Fiscal Year	Increment Amount
2025	$947,005

2026	$1,133,391
2027	$941,216

PROJECT PERSONNEL

Principal Investigator: Jedda Foreman
Email: jforeman@berkeley.edu
Organization: REGENTS OF THE UNIVERSITY OF CALIFORNIA, THE

co-Principal Investigator: Craig Strang
Email: cstrang@berkeley.edu
Organization: REGENTS OF THE UNIVERSITY OF CALIFORNIA, THE

co-Principal Investigator: Valeria Romero
Email: valeriafr@berkeley.edu
Organization: REGENTS OF THE UNIVERSITY OF CALIFORNIA, THE

NSF CONTACT INFORMATION

Managing Grants Official (Primary Contact)
Name: Denise M. Martin
Email: dmartin@nsf.gov
Phone: (703) 292-4808

Awarding Official
Name: Denise M. Martin
Email: dmartin@nsf.gov

Managing Program Officer
Name: Ellen L McCallie
Email: emccalli@nsf.gov
Phone: (703) 292-5115

GENERAL TERMS AND CONDITIONS

This is awarded pursuant to the authority of the National Science Foundation Act of 1950, as amended (42 U.S.C. 1861-75) and is subject to Research Terms and Conditions (RTCs) dated 11/12/2020, and NSF Agency Specific Requirements, dated 01/30/2023, available at https://www.nsf.gov/awards/managing/rtc.jsp.

This institution is a signatory to the Federal Demonstration Partnership (FDP) Phase VI Agreement which requires active institutional participation in new or ongoing FDP demonstrations and pilots.

This award is made in accordance with the provisions of NSF Solicitation: NSF 22-634 Racial Equity in STEM Education.

EXHIBIT E

COVER SHEET FOR PROPOSAL TO THE NATIONAL SCIENCE FOUNDATION

PROGRAM ANNOUNCEMENT/SOLICITATION NO./ DUE DATE
NSF 22-585 08/12/2022

☐ Special Exception to Deadline Date Policy

FOR NSF USE ONLY
NSF PROPOSAL NUMBER
2241805

FOR CONSIDERATION BY NSF ORGANIZATION UNIT(S) (Indicate the most specific unit known, i.e. program, division, etc.)
DRL - ITEST-Inov Tech Exp Stu & Teac

DATE RECEIVED	NUMBER OF COPIES	DIVISION ASSIGNED	FUND CODE	UEI(Unique Entity Identifier)	FILE LOCATION
08/12/2022	1	11090000 DRL	7227	GS3YEVSS12N6	

EMPLOYER IDENTIFICATION NUMBER (EIN) OR TAXPAYER IDENTIFICATION NUMBER (TIN)
946002123

SHOW PREVIOUS AWARD NO. IF THIS IS
☐ A RENEWAL
☐ AN ACCOMPLISHMENT- BASED RENEWAL

IS THIS PROPOSAL BEING SUBMITTED TO ANOTHER FEDERAL AGENCY? YES ☐ NO ☒ IF YES, LIST ACRONYM(S)

NAME OF ORGANIZATION TO WHICH AWARD SHOULD BE MADE
REGENTS OF THE UNIVERSITY OF CALIFORNIA, THE

AWARDEE ORGANIZATION CODE (IF KNOWN)

ADDRESS OF AWARDEE ORGANIZATION, INCLUDING 9 DIGIT ZIP CODE
1608 4TH ST STE 201
BERKELEY,CA 94710-1749 US

NAME OF PRIMARY PLACE OF PERF
University of California-Berkeley

ADDRESS OF PRIMARY PLACE OF PERF, INCLUDING 9 DIGIT ZIP CODE
1608 4TH ST STE 201,
BERKELEY,CA 94710-1749 US

IS AWARDEE ORGANIZATION (Check All That Apply)
☐ SMALL BUSINESS
☐ FOR-PROFIT ORGANIZATION
☐ MINORITY BUSINESS
☐ WOMAN-OWNED BUSINESS

☐ IF THIS IS A PRELIMINARY PROPOSAL THEN CHECK HERE

TITLE OF PROPOSED PROJECT
DTI: Indigenous Mixed Reality Science Experiences (IMRSE): Fostering Cultural and Science Identity through Youth Participatory Design of Mixed Reality Experiences

SHOW LETTER OF INTENT ID IF APPLICABLE

REQUESTED AMOUNT	PROPOSED DURATION (1-60 MONTHS)	REQUESTED STARTING DATE	SHOW RELATED PRELIMINARY PROPOSAL NO. IF APPLICABLE
$ 1,292,298	36 months	09/01/2023	

THIS PROPOSAL INCLUDES ANY OF THE ITEMS LISTED BELOW

☒ TYPE OF PROPOSAL **Research**
☒ COLLABORATIVE STATUS **Collaborative from one organization**
☐ BEGINNING INVESTIGATOR
☐ DISCLOSURE OF LOBBYING ACTIVITIES
☐ PROPRIETARY & PRIVILEGED INFORMATION
☐ HISTORIC PLACES
☐ LIVE VERTEBRATE ANIMALS IACUC App. Date
PHS AnimalWelfareAssurance Number

☒ HUMAN SUBJECTS Human Subjects Assurance Number
Exemption Subsection or IRB App. Date **pending**
☐ FUNDING OF INT'L BRANCH CAMPUS OF U.S IHE
☐ FUNDING OF FOREIGN ORGANIZATION OR FOREIGN INDIVIDUAL
☐ INTERNATIONAL ACTIVITIES: COUNTRY/COUNTRIES INVOLVED
☐ POTENTIAL LIFE SCIENCES DUAL USE RESEARCH OF CONCERN
☐ OFF-CAMPUS OR OFF-SITE RESEARCH

PI/PD DEPARTMENT
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CERTIFICATION PAGE

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Certification Regarding Responsible and Ethical Conduct of Research (RECR)
(This Certification applies to proposals submitted on or after July 31, 2023, and is not applicable to proposals for conferences, symposia, and workshops.)
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By electronically signing the certification pages, the Authorized Organizational Representative is certifying that the organization will be or is in compliance with all aspects of the United States Government Policy for Institutional Oversight of Life Sciences Dual Use Research of Concern.

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Submitted/PI: Ari Krakowski /Proposal No: 2241805

Overview

We, the University of California, Berkeley (UC Berkeley) and mak-'amham, an Ohlone cultural institution that empowers Ohlone people with a rich cultural identity, propose a three-year ITEST Developing and Testing Innovations project to address the ongoing marginalization of Indigenous communities from informal science learning spaces by developing and studying a model that strengthens Indigenous youths' capacity for, and disposition toward STEM pathways. Drawing on a set of design principles that emerged from an existing partnership between the Lawrence and mak-'amham, the project will engage 20 Ohlone youth (ages 10-16) in iterative cycles of participatory design and prototyping to create immersive Indigenous Science exhibit experiences for the Lawrence Hall of Science (the Lawrence) using mixed reality technologies. In centering Indigenous perspectives within science and technology learning experiences and highlighting connections between Indigenous cultural identities and contemporary STEM career pathways, our proposed project aims to reframe STEM learning to increase Indigenous youth's rightful presence (defined by a sense of belonging and shifting institutional power; Calabrese Barton & Tan, 2020) to foster positive affective shifts toward STEM that can improve prospects for a more diverse STEM workforce. The project's research will advance understanding of design practices that contribute to rightful presence for Indigenous youth, and investigate the impact of the participatory design model on youths' STEM learning, science identity, and interest in STEM careers. The project will generate insights to inform a professional learning model that supports informal science educators to facilitate Indigenous-centered learning experiences.

Intellectual Merit

The proposed project aims to contribute to building knowledge useful in broadening participation in STEM among Indigenous youth. This project will develop an evidence-based model for community-engaged, technology-rich STEM learning that position Indigenous youth to feel a rightful presence in informal science learning spaces, and a greater sense of belonging in STEM fields. Implementation of the project will provide insights about how youth-led design of informal Indigenous Science learning experiences can leverage cutting-edge technology to promote STEM learning and center Indigenous knowledge. Proposed research will be guided by the following questions: RQ1) *What are the outcomes of youth participation in the design of mixed reality exhibits? a) How do youth develop a sense of belonging, science identity, and STEM career interest and in what ways do these make visible and amplify their rightful presence in Informal Science Education spaces? b) How do youth deepen and construct new STEM knowledge through Indigenous Science-based Participatory Design?* RQ2) *How can a participatory design model be developed in ways that center Indigenous Science and contribute to Indigenous rightful presence in informal science education?* RQ3) *How can informal science educators be supported to make sense of and center Indigenous Science?* The project research will contribute to the field's understanding of the role that youth participatory design can play in broadening participation in informal science education by building evidence for how to foster equitable, inclusive and culturally relevant learning environments.

Broader Impacts

This project will expand the capacity for integration of Indigenous Science epistemologies in informal science learning settings, supporting increased rightful presence amongst Indigenous peoples, and increased exposure to and expanded understanding of Indigenous scientific and cultural knowledge amongst non-Indigenous people. In addition, the project will increase informal science educator capacity for facilitating learner experiences in ways that center Indigenous Science. Further, insights derived through developing and researching the Indigenous Science youth participatory design model will support its replication and principled adaptation in other museums and informal science education contexts. Understanding how organizations support rightful presence for marginalized populations is applicable beyond informal science education. This project has the potential to inform partnerships, organizational transformation, and capacity-building that broaden participation within and beyond STEM fields, thus helping to support and sustain a more diverse workforce.

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Submitted/PI: Ari Krakowski /Proposal No: 2241805

Developing and Testing Innovations:

Indigenous Mixed Reality Science Experiences (IMRSE): Fostering Cultural and Science Identity through Youth Participatory Design of Mixed Reality Experiences

I. Project overview, rationale, and importance

We, the University of California, Berkeley (UC Berkeley) and mak-'amham, an Ohlone cultural institution that empowers Ohlone people with a rich cultural identity, propose a three-year ITEST Developing and Testing Innovations project to address the ongoing marginalization of Indigenous communities from informal science learning spaces by developing and studying a model that strengthens Indigenous youths' capacity for, and disposition toward STEM pathways. Drawing on a set of design principles that emerged from an existing partnership between the Lawrence and mak-'amham, the project will engage 20 Ohlone youth (ages 10-16) in iterative cycles of participatory design and prototyping to create Indigenous Mixed Reality Science Experiences (IMRSE) exhibits for the Lawrence Hall of Science (the Lawrence) using immersive technologies. In centering Indigenous perspectives within science and technology learning experiences and highlighting connections between Indigenous cultural identities and contemporary STEM career pathways, our proposed project aims to reframe STEM learning to increase Indigenous youths' *rightful presence* (defined by a sense of belonging and shifting institutional power; Calabrese Barton & Tan, 2020) to foster positive affective shifts toward STEM that can improve prospects for a more diverse STEM workforce. The project's research will advance understanding of design practices that contribute to rightful presence for Indigenous youth, and investigate the impact of the participatory design model on youths' STEM learning, science identity, and interest in STEM careers. The project will generate insights to inform a professional learning model that supports informal science educators to facilitate Indigenous-centered learning experiences.

Addressing diversity, access, equity, and inclusion in K-12 learning environments

"*They took the bus up to the Lawrence Hall of Science in the Berkeley Hills, where there was a double fountain, which they knew would be practically untouched because only rich people or monitored kids on field trips went to that place.*" (Orange, 2018). UC Berkeley is located on the territory of xučyun, the ancestral and unceded land of the Chochenyo-speaking Ohlone people. This land was and continues to be of great importance to the Muwekma Ohlone Tribe, who live and have lived along the shore and hills of the East Bay for many centuries. UC Berkeley, since its inception, has had a complex and troubled relationship with Indigenous people. Among many issues, UC Berkeley holds more Indigenous American human remains (over 9,000) and more sacred objects (over 13,000) than any other institution in the U.S (Garrett, et al., 2019). mak-'amham and other Indigenous groups have been involved in a painful, decades-long process with UC Berkeley to return those materials to the communities from which they were stolen. For the Lawrence, specifically, as explicated by Indigenous author Tommy Orange's character Orvil Red Feather in the novel *There, There*, quoted above, local Indigenous communities do not (yet) perceive this place as one that embodies their rightful presence.

The need to confront centuries of marginalization and harm is not unique to UC Berkeley and the Lawrence. "Designed spaces" for informal science education (ISE) such as science centers and museums can promote science cognitive learning and positive affective engagement with science in free-choice environments (Falk & Dierking, 2000; Falk & Storksdieck, 2005; NRC, 2009; Stocklmayer et al., 2010), complementing and extending more constrained school-based opportunities for science learning (Reiss et al., 2016; Russell et al., 2013). However, rather than serving to democratize science learning (NRC, 2009), numerous studies have documented that science museums and other ISE institutions disproportionately serve White and middle- to upper-class audiences (Dawson, 2014a, Feinstein & Meshoulam, 2014). Further studies have shown that ISE institutions are perceived by communities historically and chronically marginalized in science as socially exclusive, unwelcoming, and culturally irrelevant (Archer et al., 2016; Ash & Lombana, 2013;

Dawson, 2014a; b; Rahm & Ash, 2008; Rahm, 2008), even for youth who are interested in science (Godec et al., 2022). Thus, merely increasing access to ISE for nondominant communities is insufficient to promote equitable, affirming, and just engagement with informal science learning opportunities (Dewitt & Archer, 2017; Feinstein, 2017). Needed are asset-based approaches to ISE design that center the cultural norms and epistemologies of nondominant communities (Bang and Medin, 2010; Medin & Bang, 2014) and transform power dynamics that shape "Whose science? When, what, and science towards which ends? What counts and who gets to decide?" (Vakil & Ayers, 2019, p. 451), critical components of rightful presence.

Indigenous Science. Over the past 300 years, settler colonialism has positioned Indigenous ways of knowing "as outside the boundaries or incompatible with the positivistic scientific paradigm used in STEM education at historically White institutions and workplace contexts" (Page-Reeves et al., 2019, p. 179). Indigenous knowledge continues to be marginalized in STEM and in settings of higher education (Anthony-Stevens & Matsaw, 2020). It is therefore not surprising that Indigenous Americans are the least represented population in science fields (Chow-Garcia et al., 2022). Despite this, Indigenous scholars in STEM fields demonstrate how Indigenous ways of thinking explore the interconnected nature of science and Indigenous identity in ways that work to sustain and empower Indigenous peoples (e.g., Page-Reeves et al., 2019).

Indigenous scholars have characterized Indigenous Science as a framework of epistemologies and methodologies drawn from Indigenous peoples' understanding of the natural world (Aikenhead & Ogawa, 2007; Brayboy & Castagno, 2008; Cajete, 2000). Core to Indigenous Science knowledge frameworks are place-based, situated, and sociocultural ways of knowing; close observation of cyclical patterns within natural systems and their perceptible indicators; and a focus on balance and interdependence within natural systems (Cajete, 2000; Haynes Writer & Valdez, 2021; Medin & Bang, 2014). Indigenous Science education approaches are characterized by knowledge-sharing through relational community engagement and oral storytelling, where elders play a key role as knowledge keepers, and — alongside plants, animals, and other components of the natural world — teachers (Haynes Writer & Valdez, 2021; Williams & Snively, 2016). While important distinctions between Indigenous and Western science have been extensively discussed, many Indigenous scholars assert that positioning Indigenous and Western science as contrasting narratives creates a "false dichotomy" (Aikenhead & Ogawa, 2007) that reduces both to caricature (Medin & Bang, 2014). Centering Indigenous Science within informal science learning contexts can therefore advance more expansive and transformative models of science that position Indigenous youth and families to feel a rightful presence in ISE spaces, and a greater sense of belonging in STEM fields.

Opportunity for transformational design. The Lawrence's new Outdoor Nature Lab (ONL) presented a novel opportunity to demonstrate the synergy between Indigenous and STEM knowledge within an ISE environment through collaboration, engagement, and design with the Ohlone community, part of an effort to move beyond land acknowledgments (Stewart-Ambo & Yang, 2021) and towards a recognition of multiple epistemologies and the centering of Indigenous Science knowledge. Currently, mak-'amham and the Lawrence are working together to ensure that Ohlone people can freely access the Lawrence and ONL and that the ONL embodies the culture, history, and current reality of the Ohlone people, including collaborating on the design of the ONL's physical space, exhibit materials, and the development of visitor experiences.

The motivation for developing mixed reality experiences arose during conversations between the Lawrence and mak-'amham during the ONL's ideation and development. From ONL observation decks, visitors can see present and historic Ohlone landmarks (e.g., the Berkeley shellmound), multiple ecological and geological features that are important in Ohlone traditions and stories, and the lands and waters of at least seven additional Indigenous nations. mak-'amham leadership conveyed their desire for visitors to experience the continuity, richness, and relevance of Ohlone knowledge. We saw the potential for immersive, multisensory IMRSE experiences to bring Indigenous Science concepts to life in ONL exhibits and invited Co-PI Kimiko Ryokai, an expert in human-computer interaction design, to join our collaboration.

Rightful presence through mixed reality (MR). MR refers to environments in which physical reality and computer-generated content are combined in a way that enables human-computer interaction with and among real-world and virtual objects (Milgram & Kishino, 1994). MR experiences hold the potential to "reveal place-based content, including hidden histories and alternative narratives," making them unique tools for sharing cultural heritage, and in particular Indigenous ways of knowing (Bekele et al., 2018; McMahon, Almond, et al., 2019; Park et al., 2022). Yet, little effort has been made (if at all in the US) to leverage MR to sustain and share Indigenous knowledge and expertise, and such platforms have yet to be designed with Indigenous collaborators in ways that prioritize Indigenous knowledge stewardship and representation (McMahon, Almond, et al., 2019).

In addition, MR presents opportunities for youth participatory design that invite Ohlone youth to build STEM knowledge grounded in their cultural identity. This project also answers the call from prior research to develop educator pedagogical practices in ISE that can support youths' rightful presence (Calabrese Barton et al., 2021). Rightful presence exposes the limitations of "inclusion" as equity and posits that a legitimate sense of belonging requires an acknowledgment of injustice and the reauthoring of rights such that power shifts from the host institution to learners (Calabrese Barton & Tan, 2020). We aim to center and celebrate Ohlone youths' cultural identity through active and authentic participation in the proposed design, engineering, and research processes involved in the creation of state-of-the-art MR museum exhibit experiences at the Lawrence, thus allowing youth participants to develop STEM identities that build from their current identities (Coenraad et al., 2019).

II. Research and Development Design

The goal of this project is to develop and study a model that cultivates Indigenous youths' rightful presence and activation toward STEM pathways through a participatory design process of 3-5 IMRSE exhibits. The model will engage a cohort of 20 Ohlone youth (ages 10-16) in the participatory design process and an additional 50 Indigenous youth (ages 10-16) and at least 50 public visitors in pilot testing. Research activities will examine the impact of IMRSE exhibit participatory design on youths' STEM learning, science identity, and interest in STEM careers, and advance understanding of how the participatory design model can center Indigenous epistemologies and support Indigenous rightful presence in ISE spaces. The research will also generate insights into how to support informal science educators in facilitating Indigenous-centered learning experiences.

a. Theoretical Framework

Rightful Presence. Recent discourse around equity-centered learning has called for shifts that go beyond expanding access to learning opportunities "for all" toward *rightful presence* (Calabrese Barton & Tan, 2020). Rightful presence (Calabrese Barton & Tan, 2018; 2019; 2020) is a justice-centered conceptualization of equity that re-authors rights to shape learning in ways that make present the lives of youth who have been "made missing" through racialization and colonialization in STEM learning (Bang & Medin, 2010; Nasir & Vakil, 2017). The rightful presence framework values the cultural knowledge and experience youth bring to STEM learning and positions youth as legitimate core contributors to a learning community "because of who one is (not who one should be)" (Calabrese Barton & Tan, 2019). As such, rightful presence can shift power dynamics in ISE institutions by disrupting "guest/host relationalities" (e.g., Shirazi, 2018) in which minoritized youth are treated as guests in a host ISE community (Calabrese Barton et al., 2020), leaving dominant colonialist and racialized hierarchies intact (Martin, 2019).

Sense of Belonging, Science Identity Formation, and STEM Career Development. Scholars have investigated how students personally relate to science, a concept known as science identity (Carlone & Johnson, 2007; Tytler, 2014). Science identity research is concerned with how students' various social identities interact with their sense of belonging in science, and the concept of science identity has been used to explain the representation (or lack of representation) of particular ethnic, cultural, and gender identity groups in science fields (Chang et al., 2014; Chemers

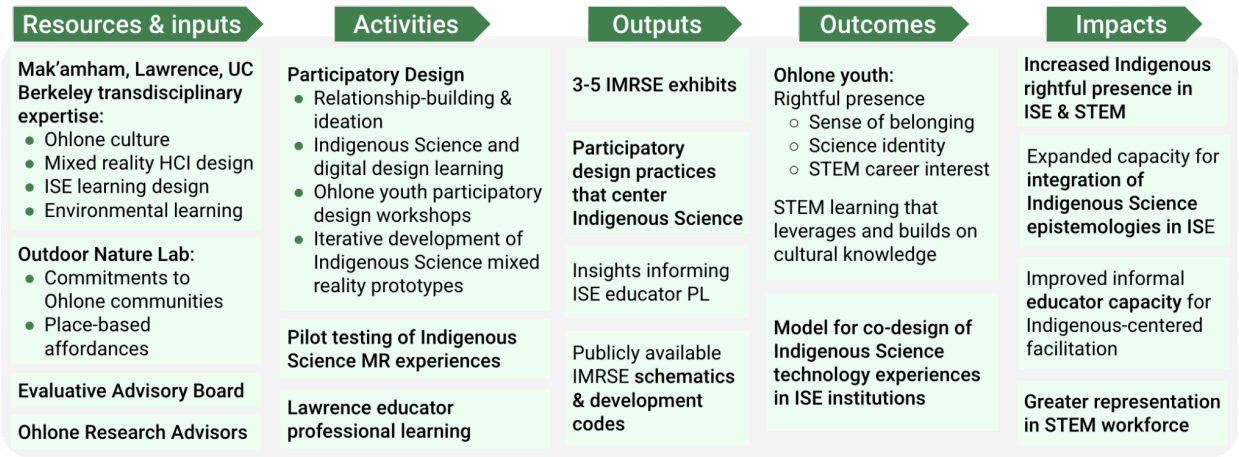
et al., 2011; Herrera et al., 2012). Research suggests that a strong science identity is particularly beneficial for minoritized students because it bolsters belonging in science (Chen et al., 2021) and can increase the likelihood a student will pursue a science degree or career (Chemers et al., 2011; Estrada et al., 2011; Estrada et al., 2016; Hernandez et al., 2013; Robinson et al., 2018).

A nascent but growing body of work suggests that Indigenous students' science identities, sense of belonging in science, and persistence in STEM professional pathways are motivated by connection with their Indigenous identities (Chow-Garcia et al., 2022; McMahon, Griese, & Kenyon, 2019; Page Reeves et al., 2019; Turner et al., 2022). As such, Indigenous youth must be engaged in STEM learning opportunities that draw on their lived experiences and cultural wisdom to support the development of science identity (Bang & Medin, 2010). Indigenous youth benefit particularly from science learning environments that are designed to support culturally relevant meanings and interpretations of science (Alkholy, et al., 2017; Bang & Medin 2010; Smith et al., 2014). This small but powerful body of work suggests that increasing Indigenous representation in science requires more than assimilation: STEM learning environments must transform to be inclusive of diverse knowledge and cultural practices.

Taken together, Chow-Garcia and Calabrese Barton's work suggest that structuring learning around the goal of rightful presence offers a promising lever to broaden participation. Centering Indigenous Science within informal science learning contexts can advance more expansive and transformative models of science that position Indigenous youth to feel a rightful presence in ISE spaces, and a greater sense of belonging in and identification with STEM fields. Our project addresses the underrepresentation of Indigenous professionals in STEM careers by building an understanding of culturally grounded learning models that can advance the educational and career development of Indigenous youth (Chow-Garcia et al., 2022; Turner et al., 2022).

Logic Model. A core premise of this project is that by centering and celebrating Ohlone youth cultural identity through STEM learning and technology-rich participatory design, youth will enact STEM identities that build from their current identity. Thus, we hypothesize that youth engagement in project activities will make visible and amplify their rightful presence in STEM through (1) positive shifts in youth sense of belonging and concomitant ISE institutional shifts in power; and (2) formation of science identity and increased STEM career interest grounded in youths' cultural identity. We also anticipate that youth will deepen and construct new knowledge of STEM content and practices (related to both science learning and digital technology design) in ways that support epistemological integration with Indigenous knowledge. Project activities will also generate a model for ISE institutions to center Indigenous epistemologies in STEM learning through the articulation of participatory design practices and insights to inform educator professional learning approaches.

Figure 1: Project Logic Model



b. Broader Impacts

This project will expand the capacity for integration of Indigenous Science epistemologies in informal science learning settings, supporting increased rightful presence amongst Indigenous peoples, and increased exposure to and expanded understanding of Indigenous scientific and cultural knowledge amongst non-Indigenous people. In addition, the project will increase informal science educator capacity for facilitating learner experiences in ways that center Indigenous Science. Further, insights derived through developing and researching the Indigenous Science youth participatory design model will support its replication and principled adaptation in other museums and informal science education contexts. Understanding how organizations support rightful presence for marginalized populations is applicable beyond informal science education. This project has the potential to inform partnerships, organizational transformation, and capacity-building that broaden participation within and beyond STEM fields, thus helping to support and sustain a more diverse workforce.

c. Research-informed instructional approaches for asset-based and culturally relevant learning

Learning Design Principles. The following three learning design principles, developed through the existing Lawrence and mak'-amham partnership, will guide the design of all project activities. These design principles seek to disrupt dominant power relations in ISE environments (e.g., Archer et al., 2016; Dawson, 2014b) and are supported by research on how people learn (National Research Council, 2009; 2010) and research on equitable practices in informal STEM settings (Archer et al., 2021; YESTEM Project Team, 2021). These design principles also allow scaffolding to support differentiated learning of Indigenous Science and digital design concepts and practices such that learning is responsive to youths' prior knowledge, interests, and lived experiences.

1) **Indigenous-centered**: all activities will: (a) center the dignity, beauty, and complexity of Ohlone people today and throughout time (avoiding marginalization, romanticization, and tokenization); (b) communicate the current presence of Ohlone people and the clear, unbroken connection between the current Ohlone community and old-time culture, knowledge, and traditions; (c) emphasize compatibility between Ohlone knowledge and Western science epistemologies, such that Ohlone knowledge is reframed from folklore/mythology to relevant, reliable, and solutionary; and (d) make Chochenyo language visible and audible.
2) **Nature-centered:** all activities will: (a) seek to enhance connection to the outdoors and place-based knowledge through their own first-hand experiences; and (b) foster respect and understanding of human place and interconnectedness in the world, in alignment with Ohlone values.
3) **Learner-centered:** learners will have the opportunity to connect new ideas to their lived experiences and prior knowledge; discover and engage with ideas and objects that interest them; make sense of their experiences and phenomena; build an understanding of concepts; apply what they have learned to new contexts; and reflect on what experiences helped them to learn.

Using participatory design to create age-appropriate Indigenous-led MR exhibits. This project will engage youth ages 10-16, an age range identified by mak-'amham as optimal for youth recruitment from the Ohlone community, as well as a range that is well-suited for engagement with Indigenous Science conceptual learning and digital technology learning. The decision to focus project activities on 10–16-year-old youth is also partly based on the desire to create a more culturally affirming STEM learning environment for youth who may not have previously identified with STEM in school-based learning experiences.

Participatory design challenges widely accepted paradigms of technology design by positioning users of technology as knowledge-bearers whose expertise should be brought to bear in its design (Muller, 2007; Schuler & Namioka, 1993). Participatory design approaches that position youth as central collaborators play a significant role in learning and interaction design research, particularly in

the design of technology-rich learning innovations (Druin, 2002). Drawing upon 20 years of including youth as designers and co-designers (e.g., DiSalvo et al., 2017; Druin, 2002; Iversen et al., 2017; Kim et al., 2019), youth co-construction of learning innovations can promote youth agency within the design process that can lead to positive shifts in cognitive and affective outcomes (Bonsignore et al., 2013; Iversen et al., 2017). Through this participatory design process, the co-construction of MR exhibits offers a particularly powerful opportunity for this project as it is suitable for a wider age range of youth (as opposed to Virtual Reality technologies), and speaks specifically to the desires of mak-'amham leaders to create immersive experiences that can bring Indigenous Science knowledge to life in the exhibits.

Guided by the learning design principles above, the project team will structure the participatory design process in conjunction with pedagogical approaches that support differentiated youth engagement with science and technology concepts that emerge as focal to the design of the MR prototypes. We will draw on the collective prior work, expertise, and collaboration of the project team (i.e., in Indigenous Science, digital technology learning and teaching) and draw on pedagogical approaches from our prior work to scaffold developmentally appropriate engagement with the technology and science concepts and practices.

Additional considerations. In addition to the learning design principles named above, project activities will be guided by the following considerations: (1) Indigenous ownership of teaching and knowledge sharing protocols; (2) access to and control of data storage and ownership; and (3) ongoing care, maintenance, and consent for the use of materials and exhibits. These considerations will support project activities to avoid misinformation (including in the form of marginalization or tokenization), the commodification of Ohlone knowledge and practice, or undermining of Ohlone protocols or values (McMahon, Almond, et al., 2019).

d. Project Activities

Project activities will occur over three iterative phases. Throughout all of the phases, we will document our process, challenges encountered, and lessons learned. We will also dedicate time during monthly planning meetings to reflect on the partnership between UC Berkeley and mak-'amham as well as between UC Berkeley and the Ohlone community to ensure that there are effective communication strategies and feedback mechanisms in place to support project success. Preliminary work has informed the design of project phases and activities.

Preliminary work. While the specific IMRSE exhibit components developed through the project will be determined through the youth participatory design process, our preliminary work provides a foundation for integrating Indigenous Science concepts and digital technology design. In preliminary meetings, Ohlone cultural leadership identified possible Indigenous Science content areas to ground the participatory design of MR prototypes, such as:

(1) present-day and historical geospatial mapping of Indigenous cultural landmarks, territories, languages, and land relationships, leveraging the expansive view of the Bay Area from the ONL;
(2) Indigenous knowledge of plant and animal species, interactions between living organisms and the soil, air, and water, and land management practices such as controlled burns; and
(3) knowledge of Indigenous horticulture, including gathering, cultivation, preservation, and preparation of food and medicinal plants.

Initial concepting work, illustrated below, identified opportunities for IMRSE exhibits that could bring these Indigenous Science concepts to life and thus serve as possible digital technology modalities for youth participatory design.

Figure 2: Initial concept illustrations from preliminary work

See-through augmented reality (AR) using mobile displays (e.g., tablet, smartphone) as a lens to learn about Indigenous Science in nature

Spatial AR (tripod-mounted display) as a window to interact with Indigenous scientific and cultural map-based data visualizations

Projection mapping to engage with Indigenous environmental scientific knowledge and land stewardship practices

Tangible user interfaces that invite visitors to physically interact with physical cultural artifacts and Ohlone engineering concepts

Phase 1: Relationship building, ideation, and initial content creation. *(September 2023-August 2024)*. The first part of this phase will focus on deepening relationships with Ohlone community members to inform IMRSE content ideation, recruiting Ohlone youth, and convening the Ohlone Research Advisory Committee (recruitment will be led by mak-'amham, see more information on pp. 8-9). During this process, the project team will begin ideation to explore possible Indigenous Science topics that could serve as science learning content foci alongside digital design content. Project staff will engage in site visits (e.g., to the Berkeley Shellmound, Chochenyo language programs, UC Berkeley's Indigenous Community Learning Garden) and develop initial content themes as possible contexts for IMRSE exhibit design that can make visible Ohlone science and cultural knowledge within learning experiences. For example, an understanding of oak tree growth cycles and processing of acorns to prepare Ohlone foods such as acorn bread can serve as a possible context for understanding science content related to botany, chemistry, and land stewardship as well as digital design of MR experiences that manifest Chochenyo terminology and narratives of seasonal cycles, and gathering, drying, and processing acorns into flour (Evans-Brown, 2021). Project staff will also identify local artists and cultural resources to support the development of visual and media assets for use in MR prototypes.

In the second part of this phase, we will conduct two participatory design workshops and a one-week participatory design summer intensive in order to begin ideation and initial content creation. The design team will consist of Ohlone youth, Lawrence learning designers, a Human-Computer Interaction (HCI) graduate student, and the workshop leads: Ohlone cultural leaders (PI Medina and mak'-amham staff), STEM learning designers (PI's Krakowski and Foreman) and HCI expert (PI Ryokai). Participatory design workshops in this phase will immerse Ohlone youth in Indigenous Science learning grounded in their cultural heritage (e.g., meeting with elders, gathering, preparing, and eating Ohlone foods, learning about different basketry designs, plant compositions, and applications). Indigenous undergraduate and graduate STEM students at UC Berkeley will also be invited to participate in an Indigenous STEM career panel where they will share how they integrate their Indigenous cultural knowledge with their STEM learning and research. During the workshops, Ohlone youth will draw upon their cultural identity and heritage as they deepen their knowledge of relevant science concepts (e.g., related to ecology, organismal biology, engineering, Earth science, and land stewardship). Reflective conversations will be facilitated at the end of each workshop day (in all project phases). Key questions to consider in this phase will be: 1) What Ohlone scientific and cultural knowledge might be documented? 2) How might Ohlone knowledge be represented (e.g. audio, images, videos, spatial data visualization, motion capture)? and 3) How might Ohlone knowledge be experienced as museum exhibits (e.g., mobile and spatial AR, immersive projection, tangible user interfaces)?

Phase 2: Pilot testing of early prototypes. (*September 2024-August 2025)*. Building on the Indigenous Science content foci established through design workshops in Phase 1, project staff will begin the development of content (e.g., visual, media assets) for use in early IMRSE prototypes. Content for MR prototype development will continue to be produced and iteratively refined

throughout Phase 2. We will conduct four participatory design workshops during this phase. The design workshops in Phase 2 will position youth to deepen science conceptual understanding in conjunction with developing knowledge of digital technology design as they use physical computing tools (e.g., programming with interface boards such as Arduino and Raspberry Pi) and software tools (e.g., 3D authoring tools such as Lens Studio (Snap Inc., 2022) and Reality Composer (Apple, 2022) to design, develop, and iteratively refine MR prototypes, with the support of the project team. We will conduct pilot testing of early IMRSE prototype iterations with additional Indigenous youth (outside of the participatory design team), to ensure the authenticity of content; share feedback with the Ohlone youth design participants to inform subsequent iterations; and to inform the broader model for IMRSE prototype design. We will also conduct pilot testing of IMRSE prototype iterations with Lawrence informal educators and public visitors. Lawrence educators will receive professional learning before pilot testing and will participate in pilot testing as IMRSE experience facilitators. Insights from Lawrence educator professional learning and facilitation of IMRSE experiences will be used to inform subsequent professional learning.

Phase 3: Complete development and test MR exhibit components; disseminate findings. *(September 2025-August 2026)*. In the first part of this phase, we will refine the IMRSE prototypes in preparation for exhibit production and implementation at the Lawrence. We will conduct two participatory design workshops during this phase, which will focus on gathering insights from Ohlone youth design participants and refining content for the development of the IMRSE exhibit components. During these culminating design workshops, youth will also reflect on their learning, as well as the design process and resulting artifacts and experiences. Depending on the complexity of design and content development, these project activities will culminate in the completion of 3-5 IMRSE exhibit components. Project staff will also continue to gather insights from informal science educators as the IMRSE exhibits are implemented and refine professional learning resources to support educators in understanding and centering Indigenous epistemologies and values during experience facilitation. We will synthesize insights from the design process and analysis of research questions to articulate the IMRSE design model, documenting successes and challenges for dissemination. These project activities will conclude with the articulation of an ISE model for participatory design of Indigenous Science mixed reality experiences that include design practices that center Indigenous epistemologies in STEM; partnership practices that contribute to rightful presence; and insights to support informal science educators in facilitating Indigenous-centered STEM learning experiences. Project products and findings will be disseminated through practitioner and researcher journals and conferences, with Ohlone community members as co-presenters and co-authors (see Dissemination Plan). In this phase, we will be well-positioned to solicit funding from corporate sponsors and donor opportunities to support equipment and installation costs for permanent and long-standing exhibits.

Recruiting and selecting participants from underserved and underrepresented populations in STEM.

This project is centered on the project team's existing commitment to recruit and co-design with youth in the Ohlone community. In Phase 1, we will prioritize the recruitment of 20 Ohlone youth using mak-'amham's network of language classes, cultural classes, gathering trips, mak-'amham's listserve, and personal connections. The selection of 20 youth will be based on availability to attend participatory design workshops and will ensure a diversity of ages from 10-16. In Phase 2, we will recruit 50 additional Indigenous youth (Ohlone youth not already participating on the design team and regional youth who hold Indigenous identities) through the mak-'amham network, the personal networks of design team participants, and through Advisory Board members who work with regional Indigenous communities. Nikki Lim, Advisory Board member and Executive Director of the California Indian Museum and Cultural Center (CIMMC), has agreed to support recruitment for this project. In addition to running an activity museum space, working to preserve and protect California Indian cultural and intellectual properties, and having relationships with Indigenous groups across California, CIMCC runs a Tribal Youth Ambassador program, which engages Indigenous youth in

advocating for their tribal communities and cultures through educational projects, and the Native Youth Employment Training Program, which provides culturally-relevant educational support and job skills training to Native youth in order to connect them to the workforce and/or secondary education attainment. These programs provide an ideal recruitment pool for pilot testing with regional Indigenous youth. Pilot testing with general public visitors will occur during times when the Lawrence museum is open, and visitors will be invited to participate in the pilot testing process and as participants in the research.

e. Research Plan

The overall research goal is to further understand how to increase the rightful presence of Indigenous learners in ISE. To accomplish this, research activities will identify how the project features influence youth disposition toward science. Of particular interest are design practices and features that contribute to a sense of rightful presence in ISE spaces among Indigenous youth and the outcomes associated with the ways youth view their current and future selves in relation to STEM and potential careers. Additionally, we will examine support needed for museum educators to center Indigenous Science during exhibit facilitation. As such, the study will focus on generating evidence of promise for the design process and outcomes aligned with the following research questions:

RQ1) What are the outcomes of youth participation in the design of IMRSE exhibits?
   a. How do youth develop a sense of belonging, science identity, and STEM career interest, and in what ways do these make visible and amplify their rightful presence in ISE spaces?
   b. How do youth deepen and construct new STEM knowledge through Indigenous Science-based Participatory Design?

RQ2) How can a participatory design model be developed in ways that center Indigenous Science and contribute to Indigenous rightful presence in informal science education (ISE)?

RQ3) How can ISE educators be supported to make sense of and center Indigenous Science?

We will pursue the questions above through two approaches (described below): (1) participatory design-based research that is agile and responsive to emerging insights from the iterative development cycle and that can provide evidence for factors that contribute to rightful presence for Indigenous youth in ISE; and (2) decolonizing research methodologies and a Critical Indigenous Research Lens approach to guide the systematic collection and analysis of data in ways that are emancipatory and culturally responsive.

Participatory Design Research Approach. Participatory design research methodologies are closely tied to design-based research (DBR) practices that position participants as designers in partnership with researcher-designers (Bang & Vossoughi, 2016; Spinuzzi, 2005). Such methodologies call on researchers to attend to dynamics of race and power that mediate design relationships between learning researchers and youth and community designers, particularly in contexts aimed at designing for equity (Bang & Vossoughi, 2016; Gutiérrez et al., 2017; Vakil et al., 2016). The Advisory Board will play a role in providing critical reflection and feedback on power dynamics among design partners. They will also be engaged in this capacity at regular intervals throughout as part of their evaluation of the project.

Decolonizing Research Methodologies and Critical Indigenous Research Lens Approach. Decolonizing research methodologies are emancipatory and empowering through their commitment to dialogue, community, self-determination, and cultural autonomy (Denzin & Lincoln, 2008). Culturally responsive research practices will be employed that locate power within the Indigenous community: determination of acceptable research practices will be determined and defined by the community (Denzin et al., 2008). As such, a Research Advisory Committee composed of Ohlone community members will play a central role in incorporating Ohlone community values and beliefs in the research design, methods, and analysis. Similar to community-based design research (Bang et

al., 2016), this approach will equally involve the Ohlone community in the research. Non-Indigenous collaborators will work closely with Ohlone partners and be guided by a Critical Indigenous Research Lens (Brayboy et al., 2012), which uses the four R's—Relationality, Responsibility, Respect, and Reciprocity—to evaluate how and for what purposes research practices (e.g., data collection and documentation) may serve the Ohlone community. Additionally, we will draw upon the expertise of our advisory board to ensure research activities are actively engaging in a decolonization process and emphasizing Indigenous knowledge and values (Claw et al., 2018).

Methods, Data sources, and Analysis

The Advisory Board and the Research Advisory Committee will play a central role in the design of research instruments to be developed in Phase 1. We describe each data source along with the sample, and the analysis approach for each research question below.

Data Sources

Artifact-Elicited Focus Groups. Artifact-elicited focus groups composed of 5-7 youth each will occur at the end of Phases 1-2 for youth to reflect on their design prototypes, sketches, and design journals. We will take a similar approach as Calabrese Barton & Tan (2019) to ask youth about (a) what the artifact is (why, how it was developed) (b) participation and engagement (their interactions/ support, design process); (c) knowledge and practices (STEM knowledge learned and funds of knowledge); and (d) meaning and value (ways the design matters to them personally).

Interviews. *Youth interviews:* We will randomly select 3-5 youth to serve as focal students throughout the design experiences. Focal students will be interviewed at the beginning and middle of their experience and again at the end of the whole experience. Interview questions will elicit youth perceptions of their experience with the participatory design of IMRSE exhibits in six areas: (a) science identity formation (how youth personally relate to science and their cultural identity); (b) sense of belonging (how youth's Indigenous identities interact with the science learning environment); (c) interest in STEM careers (youth openness and curiosity toward future opportunities for enacting their science interests); (d) rightful presence (how youth shaped their learning and contributed to the learning community); and (e) STEM learning (youth science and technology design learnings, including their perceptions of the role of Indigenous Science in STEM and what youth attribute their learning to); and (f) unanticipated outcomes (youth perceptions of other personal impacts). *Educator interviews:* During Phases 2-3, interviews will be structured to gain insight into how educators can make sense of Indigenous epistemologies, and what support they would need in order to facilitate youth-led designs in such a way that centers Indigenous knowledge and values.

Surveys. The *youth survey* will be the science subscale of the STEM School and Career Interest Survey (Kier et al., 2014), administered to youth participants at the start, midpoint, and end of participation. This survey, which has been validated with 10–13-year-olds and used by Stevens et al. (2016) with Indigenous youth, includes items such as "I am interested in careers that use science." The *visitor survey* will be administered during prototyping with Indigenous youth and public visitors and will ask about perceptions of Indigenous Science, presence of Ohlone in ISE spaces, and cultural knowledge to understand shifts in awareness and perceptions as a result of engagement with the exhibit prototypes.

Observations. *Ethnographic observations* of design teams will take place during workshops and reflective conversations (as in Calabrese Barton et al., 2020). The observation protocol will focus on how the design teams identify design priorities that are relevant to youth, connections that the design teams make to Indigenous Science learning goals, pain points in the process (what worked and what didn't work, who felt comfortable and who didn't), challenges for design and implementation, and insights into the process of supporting rightful presence (similar to Calabrese Barton et al., 2020). Observations by more than one researcher will allow for multiple perspectives to understand contexts and interactions—and as much as possible, researchers will focus on understanding how participants are making sense of the workshops from the participant perspective. *Educator*

observations (3-5) will be conducted during the pilot testing of exhibit designs (Phase 2) and implementation of IMRSE exhibits (Phase 3) and will attend to the pedagogical practices of the educators in supporting Indigenous Science concepts.

Design Artifacts. Artifacts gathered from the project and design teams will include educator portfolios, documentation of workshop activities, and youth design artifacts including journals, design sketches, and presentations. In addition, critical reflection on the partnership between UC Berkeley and mak-'amham will be documented.

Data Analysis

An inductive analysis approach will be used for artifact-elicited focus group data, interviews, observations, and design artifacts. Interview and focus group data will be transcribed, and observations and design artifacts will undergo data reduction and be systematically organized to enable the abstraction of themes and other insights (Bowen, 2009) using Dedoose (2022), which enables multimedia (audio, video, text) and quantitative data to be integrated within a common coding scheme and coded directly (Salmona et al., 2019). Coding schemes will be developed dependent upon the research question (described below). The coding schemes will identify some factors a priori, based on the research and theories informing our design, and iteratively introduce new codes that emerge from the data itself, drawing on the principles of grounded theory (Corbin & Strauss, 1990). Inter-rater reliability will be established through consensus-building and then examined using Cohen's kappa, rejecting (or revising and retesting) codes with a kappa of 0.67, a threshold appropriate for exploratory studies (Burla et al., 2008). Researchers and the Ohlone Research Advisory Committee will debrief and discuss themes. Interpretations will be member-checked for validity and accuracy (Savin-Baden & Howell-Major, 2013).

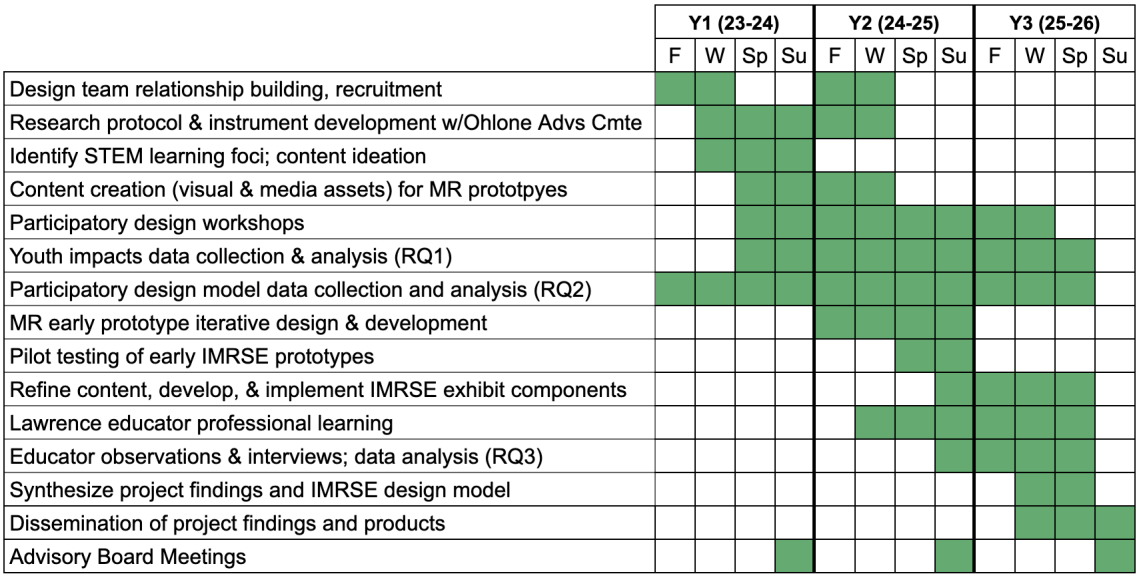
RQ1. To understand the impacts of youth involvement in the participatory design of IMRSE exhibits, including the development of sense of belonging, science identity, STEM career interest, and ways rightful presence is made visible and amplified in ISE spaces **(RQ1a)**, we will employ a complementary mixed methods research design, with qualitative findings used to drive interpretation, enhanced by quantitative findings (Creswell & Plano Clark, 2007). Qualitative data sources will include artifact-elicited focus groups and focal interviews. Quantitative data will be the youth surveys. Survey results will be descriptively analyzed to compare survey responses across time and identify individuals with relatively large shifts in STEM career interest. Survey findings will be used cautiously (due to the small sample size) to triangulate individual cases and to identify youth whose STEM career interest changed the most during the program, and how, if at all, it corresponds to their rightful presence. Artifact-elicited focus group analysis will involve open coding to surface critical episodes of engagement in youths' design work that make visible and amplify their rightful presence. Delving deeper into these episodes, the analysis will seek to describe: (a) the knowledge and practices youth drew on during critical episodes and (b) how youth shaped their learning and contributed to the learning community. Focal interview analysis will be used to characterize learners' perspectives for each of the focus areas (science identity formation, sense of belonging, STEM career interest, rightful presence, STEM learning, and unanticipated outcomes). Interviews will take place at the beginning, middle, and end of participation to develop a brief descriptive account of each focus area at each point. Interviews with focal participants will be used to develop individual cases that attend to shifts across time, culminating in a collective case narrative to analyze the impact of the program (as in Torso et al., 2021). Descriptive accounts will be juxtaposed across time to characterize shifts in relation to the critical episodes identified in artifact focus group analysis. To understand how youth deepen and construct new STEM knowledge through Indigenous Science-based Participatory Design (**RQ1b**), we will extend the RQ1a analysis related to youths' STEM learning to identify specific connections between the youths' integration of science, technology, and community knowledge and practice and their efforts to apply Indigenous Science knowledge/practice to the exhibit design, including novel applications and generation of Indigenous Science learning goals for the exhibit prototypes.

RQ2. To understand how the participatory design model can facilitate rightful presence, we will investigate the participatory design process, with attention to practices that center Indigenous epistemologies and lead to rightful presence in youth. The goal will be to construct new knowledge about: (a) what counts as success for centering Indigenous Science in the design process; (b) what positions a design process for success with Indigenous Science; (c) what design practices center Indigenous Science; and (d) what elements of the model are most essential for supporting rightful presence. Throughout all phases, the design process will be documented, including challenges encountered and lessons learned (e.g., when and how conflict arises and is addressed). Data sources will include design artifacts, ethnographic observations, youth interviews, and visitor surveys. Coding will attend to the development and integration of Indigenous Science and interactions between specific design strategies and youth rightful presence. Using the theoretical framework of rightful presence, we will then identify factors including: (a) practices that bridged disciplinary and cultural knowledge, practice, people, and locations; and (b) practices that disrupted and/or restructured normative power hierarchies. Integrated analyses of data will explore how these factors support rightful presence, including design features and practices. These analyses will be ongoing throughout the iterative development in Phases 1-3, resulting in a set of factors and practices for which we have "practice-based evidence" (Bryk, 2015, p. 474).

RQ3. To understand the diverse meanings that educators make of their experience facilitating youth-designed IMRSE exhibits, we will use qualitative data, including educator interviews and observations. The analysis will focus on identifying emergent themes and tensions, specific ways educators integrate and center Indigenous Science in pedagogical choices, and how educators make sense of Indigenous epistemologies. Coding will attend to the development and integration of Indigenous epistemological ideas and the application of Indigenous ways of knowing for understanding science concepts. Insights will be used to develop an understanding of how to support informal science educators in facilitating Indigenous-centered learning experiences.

Project Timeline

Project team members will engage in the following activities over a three-year time span:



III. Evaluation Plan

We will convene an Advisory Board that is both advisory and evaluative who will: (a) provide an ongoing, independent, and critical lens to monitor progress and suggest improvements related to the approach, instructional materials, research methods, and measures deployed; and (b) use project

research data to formatively evaluate the project's progress toward desired outcomes. Dr. Nelson-Barber, as Advisory Board Coordinator, will lead the Board's evaluative work, drawing on the approaches specified below using artifacts and evidence from project implementation, such as documentation from participatory design workshops and Ohlone Research Advisory meetings, interview protocols and survey instruments, and IMRSE design artifacts. In her role as Coordinator, Dr. Nelson Barber will lead the advisors' review portion of Advisory Board meetings, ensure that the Board has the materials and research data it needs, and regularly coordinate with the project team to synthesize Board findings, concerns, and suggestions, and to prepare written and oral evaluation reports. The Board will participate in periodic virtual meetings at critical project junctures (2-3/year) and annual 1-day meetings to evaluate project results and materials. Advisors will write brief summaries at the end of each meeting, and the Coordinator will synthesize the summaries, and work with the project team to develop a plan for addressing Board recommendations. The following six individuals have been selected because of their relevant expertise and have confirmed their commitment to serve in this role for all 3 years of the project: *Advisory Board Coordinator:* **Sharon Nelson-Barber***,* Director, Culture and Language in STEM Education, WestEd; with expertise in Indigenous culturally-responsive STEM education. *Advisory Board members*: **Angela Calabrese Barton**, Professor in the Educational Studies Department at the University of Michigan, with expertise in equity in STEM learning in informal and formal learning contexts and an author of the rightful presence framework; **Nikki Myers-Lim**, Executive Director of the California Indian Museum and Cultural Center, with expertise in developing educational resources, decolonizing Indigenous narratives in K-12 informal learning, and providing culturally relevant educational support and job skills training to Indigenous youth in order to connect them to the workforce and/or secondary education attainment; **Natalie Naranjo**, Specialist in the Science Museum of Minnesota's IDEAL Center with expertise in professional development for equitable teaching and learning; **Patrick Naranjo**, Director of UC Berkeley's American Indian Graduate Program and Native FEWS NSF INCLUDES UC Berkeley Lead; **Vanessa Anthony-Stevens**, Associate Professor of Social and Cultural Studies within the Department of Curriculum and Instruction at the University of Idaho, with expertise in Indigenous and decolonizing research methodology.

The following chart summarizes our approach to addressing our key evaluation questions:

Key Questions	Approach
1) Is the project implemented as designed (e.g. implementation of Indigenous learning design principles, development of the model)? How can it be improved?	Review implementation of the project; meet with stakeholders to ensure the project is meeting their needs; provide regular feedback to project design staff.
2) Did we achieve integration of Indigenous and Western science epistemologies in the exhibit designs?	Review the scientific and cultural accuracy and design of materials and experiences.
3) Is the research design appropriate and rigorous?	Review the design and performance of the instruments and protocols developed to evaluate the degree to which they meet appropriate standards of rigor.
4) What mechanisms have been put into place to ensure a successful partnership between LHS and mak-'amham?	Review project decision-making and power dynamics to evaluate the degree to which it provides evidence of successful partnership and evidence of promise for further partnership.

IV. Dissemination Plan

We will use a multi-faceted communication strategy to widely disseminate materials and findings. We will prioritize documenting and sharing findings back with participatory design participants to ensure that findings are representative of their experiences. With an agreed-upon set of findings, we will seek to disseminate findings to museum and informal science learning professionals and HCI

professionals using the networks of the Lawrence and UC Berkeley School of Information. Dissemination will occur through Lawrence Research and Practitioner Briefs, academic publications in peer-reviewed education and museum and informal science practitioner journals (e.g., *Curator*, *International Journal of STEM Education*), as well as HCI peer-reviewed conference proceedings (e.g., *ACM Conference on Human Factors in Computing Systems (CHI)*, *ACM Computer-Supported Cooperative Work & Social Computing (CSCW)*), and presentations at education conferences such as the *Association of Science Museums and Technology Centers (ASTC), Informal Science Education Association Conference, North American Association for Environmental Education,* and *Association of Nature Center Administrators*. Academic articles and conference presentations will share lessons learned about the design of the model, what factors of the model influenced rightful presence and sense of belonging among Indigenous participants, as well as what institutional changes were observed in order to support Indigenous rightful presence. Development codes and schematics for the MR components will also be make publicly available on GitHub.

V. Project Leadership, Expertise, and Management

Together, the project team has: (1) deep expertise and reliable networks within informal and outdoor science, Ohlone knowledge, and Indigenous cultural education communities; (2) successful experience designing technology-rich K-12 learning experiences, digital tools, and professional learning resources; and (3) expertise, experience, infrastructure, and a proven track record of success in designing and managing large-scale design, research, and evaluation efforts.

mak-'amham Leadership. mak'-amham, a cultural institution that empowers Ohlone people with a rich cultural identity, is a lead partner on this project. Since 2017, mak-'amham has offered cooking classes, gathering trips, weekly language classes, and cultural sessions to the Ohlone community. mak-'amham will play a key programmatic decision-making and leadership role in this project, including participating in project planning meetings and design processes. They will also be responsible for recruiting Ohlone youth and community members to participate in project activities and the Research Advisory Group.

- **Vincent Medina (Co-PI)** (East Bay Ohlone) is a co-founder of mak-'amham and the Capitán and cultural leader of the 'Itmay Cultural Association, a group of dedicated Verona Band culture bearers working to strengthen East Bay Ohlone identity. He will lead mak'-amham's role in this project, including co-leading the participatory design process, leading recruitment efforts of Ohlone youth and the Research Advisory Committee, and ensuring the authenticity of content and experiences.

UC Berkeley Leadership. The multidisciplinary team of researchers at UC Berkeley brings expertise in K-12 STEM learning design, human-computer interaction participatory design, educational research, and environmental learning.

- **Ari Krakowski (PI)** is Learning Labs Director and Director of the Transforming Science and Society Initiative at the Lawrence and will be responsible for the project's overall implementation and management, and will co-lead the participatory design of the mixed reality experiences. Dr. Krakowski has led a number of projects developing and researching digital tools, curricula, and pedagogical approaches to innovative technology learning experiences in formal and informal settings. She has extensive experience as a STEM educator, learning designer, and researcher in K-20 learning environments, with a focus on the impacts of innovations for youth historically marginalized in STEM pathways.
- **Jedda Foreman (Co-PI)** is Director of the Advancing Environmental Learning Initiative at the Lawrence and will co-lead the participatory design process, ensuring connections and alignment to Lawrence's Outdoor Nature Lab and Environmental Learning Initiative. She has led several projects related to working towards equity and justice in environmental and outdoor learning, including the Better Environmental Education, Teaching, Learning, and Expertise Sharing (BEETLES) Project, which is completing an NSF AISL Broad Implementation project. BEETLES

professional learning sessions and student activities are now widely known, used, and trusted throughout the outdoor science education field.

- **Kimiko Ryokai (Co-PI)** is Associate Professor in the UC Berkeley School of Information and Berkeley Center for New Media, and will lead the HCI design process and iterative development of mixed reality experiences and supervise the computational design graduate student on the project. Dr. Ryokai's research focuses on the design, implementation, and evaluation of computational media for youth learning and creative expression.
- **Sarah Olsen (Co-PI)** is Research Lead at The Lawrence Hall of Science, and will oversee the project's research activities and serve as liaison to the evaluative Advisory Board, paying specific attention to methods, data collection, and logistics. She is an early career scholar who has been a leading contributor to large-scale research and evaluation studies. Her expertise includes evaluation and research supporting underrepresented students' STEM trajectories through the use of qualitative and quantitative research methods.

VI. Results from Prior NSF Support

This project builds off the leadership team's prior work in human-computer interaction design, youth participatory design processes, and building capacity for equity.

NSF DRL 2116109, $1,604,219 (7/1/21 - 6/30/24). **PI Ari Krakowski** is Co-PI for *AI Behind Virtual Humans: Communicating the Capabilities and Impact of Artificial Intelligence to the Public through an Interactive Virtual Human Exhibit*. (NSF AISL #2116109). Intellectual Merit: The project will design, iteratively refine, and investigate an innovative, technology-rich Virtual Human exhibit that will support learning about the capability and implications of AI. The project holds transformative potential for producing theoretical and technological advances in AI education and generating knowledge about how young learners develop knowledge about AI. Broader Impacts: The interactive exhibit designed will be disseminated to other public science centers and the broader informal science learning community. The project will also produce and disseminate a novel instrument to measure AI learning. Publications & products: N/A.

NSF DRL 2005829, $1,321,642 (9/1/2021-8/31/2023). **Jedda Foreman** is Co-PI of *Working Toward Equitable Organizations: Building Capacity for Leadership of Color in Outdoor and Environmental Science Education.* Intellectual Merit: This project will contribute innovative approaches to broadening participation. The research will contribute to the field's understanding of the role that equity, inclusion and cultural relevance play in broadening participation in OSP by building evidence for how to foster equitable, inclusive and culturally relevant work environments. Broader Impacts: Understanding how organizations create equitable and inclusive working and learning environments is applicable broadly. This project has the potential to influence other fields to support organizational transformation and capacity-building in this area. Publications & products: N/A.

NSF DRL 2115614, $1,321,642 (9/15/21 – 8/31/25). **Sarah Olsen** is Co-PI of *Urban Youth Participation in Community and Citizen Science*. Intellectual Merit: The project is designed to explore the educational and developmental impact of an informal science education programming model that features Community and Citizen Science (CCS) activities on youth of color residing in urban communities. The project examines the development of science agency through engagement in CCS activities, and its relationship to the capacity for activism. Broader Impacts: The project aims to generate information useful in nationwide efforts designed to identify effective strategies and approaches that contribute to increasing STEM understanding and interest among youth of color. Publications & products: N/A.

PI's Ryokai and Medina do not have prior NSF support within the last 5 years.

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Submitted/PI: Ari Krakowski /Proposal No: 2241805

SUMMARY PROPOSAL BUDGET

YEAR 1

FOR NSF USE ONLY		
PROPOSAL NO.	DURATION (months)	
	Proposed	Granted
2241805		
AWARD NO.		

ORGANIZATION: University of California-Berkeley

PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR: Ari Krakowski

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-months CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. Ari Krakowski - Principal Inv	1.8			22,115	
2. Jedda Foreman	1.8			18,674	
3. Sarah Olsen	1.8			14,338	
4. Kimiko Ryokai	1.0			11,507	
5.					
6. ( ) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	0.0			0	
7. (4) TOTAL SENIOR PERSONNEL (1 - 6)	6.4			66,634	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (0) POST DOCTORAL SCHOLARS	0.0			0	
2. (3) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	2.4			18,175	
3. (2) GRADUATE STUDENTS				52,642	
4. (0) UNDERGRADUATE STUDENTS				0	
5. (0) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				0	
6. (0) OTHER				0	
TOTAL SALARIES AND WAGES (A + B)				137,451	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				90,510	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				227,961	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
TOTAL EQUIPMENT				0	
E. TRAVEL 1. DOMESTIC (INCL. U.S. POSSESSIONS)				6,783	
2. INTERNATIONAL				0	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ 20,000					
2. TRAVEL 0					
3. SUBSISTENCE 1,750					
4. OTHER 0					
TOTAL NUMBER OF PARTICIPANTS (20) TOTAL PARTICIPANT COSTS				21,750	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				11,000	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				0	
3. CONSULTANT SERVICES				0	
4. COMPUTER SERVICES				0	
5. SUBAWARDS				22,638	
6. OTHER				13,800	
TOTAL OTHER DIRECT COSTS				47,438	
H. TOTAL DIRECT COSTS (A THROUGH G)				303,932	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) MTDC (Rate: 40.0, Base:223112.0)					
TOTAL INDIRECT COSTS (F&A)				89,245	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				393,177	
K. FEE				0	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				393,177	

M. COST SHARING PROPOSED LEVEL $ 0 AGREED LEVEL IF DIFFERENT $

PI/PD NAME: Ari Krakowski

ORG. REP. NAME*: Mary Bonvillain

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INDIRECT COST RATE VERIFICATION		
Date Checked	Date Of Rate Sheet	Initials - ORG

*ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET

Submitted/PI: Ari Krakowski /Proposal No: 2241805

SUMMARY PROPOSAL BUDGET

YEAR 2

FOR NSF USE ONLY		
PROPOSAL NO.	DURATION (months)	
	Proposed	Granted
2241805		
AWARD NO.		

ORGANIZATION: University of California-Berkeley

PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR: Ari Krakowski

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-months CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. Ari Krakowski - Principal Inv	1.8			22,778	
2. Jedda Foreman	1.8			19,234	
3. Sarah Olsen	1.8			14,840	
4. Kimiko Ryokai	1.0			11,967	
5.					
6. ( ) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	0.0			0	
7. (4) TOTAL SENIOR PERSONNEL (1 - 6)	6.4			68,819	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (0) POST DOCTORAL SCHOLARS	0.0			0	
2. (3) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	3.4			26,184	
3. (2) GRADUATE STUDENTS				54,222	
4. (0) UNDERGRADUATE STUDENTS				0	
5. (0) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				0	
6. (0) OTHER				0	
TOTAL SALARIES AND WAGES (A + B)				149,225	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				80,722	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				229,947	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
TOTAL EQUIPMENT				0	
E. TRAVEL 1. DOMESTIC (INCL. U.S. POSSESSIONS)				938	
2. INTERNATIONAL				0	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ 17,000					
2. TRAVEL 1,800					
3. SUBSISTENCE 1,000					
4. OTHER 0					
TOTAL NUMBER OF PARTICIPANTS (70) TOTAL PARTICIPANT COSTS				19,800	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				11,000	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				250	
3. CONSULTANT SERVICES				0	
4. COMPUTER SERVICES				0	
5. SUBAWARDS				23,486	
6. OTHER				14,800	
TOTAL OTHER DIRECT COSTS				49,536	
H. TOTAL DIRECT COSTS (A THROUGH G)				300,221	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) MTDC (Rate: 40.0, Base:214198.0)					
TOTAL INDIRECT COSTS (F&A)				85,679	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				385,900	
K. FEE				0	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				385,900	

M. COST SHARING PROPOSED LEVEL $ 0 AGREED LEVEL IF DIFFERENT $

PI/PD NAME: Ari Krakowski

ORG. REP. NAME*: Mary Bonvillain

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*ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET

Submitted/PI: Ari Krakowski /Proposal No: 2241805

SUMMARY PROPOSAL BUDGET

YEAR 3

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PROPOSAL NO.	DURATION (months)	
	Proposed	Granted
2241805		
AWARD NO.		

ORGANIZATION: University of California-Berkeley

PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR: Ari Krakowski

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-months CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. Ari Krakowski - Principal Inv	1.8			25,170	
2. Jedda Foreman	1.8			20,992	
3. Sarah Olsen	1.8			15,359	
4. Kimiko Ryokai	1.0			12,446	
5.					
6. ( ) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	0.0			0	
7. (4) TOTAL SENIOR PERSONNEL (1 - 6)	6.4			73,967	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (0) POST DOCTORAL SCHOLARS	0.0			0	
2. (3) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	3.4			26,831	
3. (2) GRADUATE STUDENTS				55,848	
4. (0) UNDERGRADUATE STUDENTS				0	
5. (0) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				0	
6. (0) OTHER				0	
TOTAL SALARIES AND WAGES (A + B)				156,646	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				84,607	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				241,253	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
TOTAL EQUIPMENT				0	
E. TRAVEL 1. DOMESTIC (INCL. U.S. POSSESSIONS)				23,363	
2. INTERNATIONAL				0	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ 8,000					
2. TRAVEL 800					
3. SUBSISTENCE 500					
4. OTHER 0					
TOTAL NUMBER OF PARTICIPANTS (20) TOTAL PARTICIPANT COSTS				9,300	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				21,000	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				500	
3. CONSULTANT SERVICES				0	
4. COMPUTER SERVICES				0	
5. SUBAWARDS				31,526	
6. OTHER				64,710	
TOTAL OTHER DIRECT COSTS				117,736	
H. TOTAL DIRECT COSTS (A THROUGH G)				391,652	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) MTDC (Rate: 40.0, Base:303923.0)					
TOTAL INDIRECT COSTS (F&A)				121,569	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				513,221	
K. FEE				0	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				513,221	

M. COST SHARING PROPOSED LEVEL $ 0 AGREED LEVEL IF DIFFERENT $

PI/PD NAME: Ari Krakowski

ORG. REP. NAME*: Mary Bonvillain

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*ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET

Submitted/PI: Ari Krakowski /Proposal No: 2241805

SUMMARY PROPOSAL BUDGET

Cumulative

ORGANIZATION	FOR NSF USE ONLY: PROPOSAL NO.	DURATION (months) Proposed	Granted
University of California-Berkeley	2241805		
PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR: Ari Krakowski	AWARD NO.		

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-months CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. Ari Krakowski - Principal Inv	5.4			70,063	
2. Jedda Foreman	5.4			58,900	
3. Sarah Olsen	5.4			44,537	
4. Kimiko Ryokai	3.0			35,920	
5.					
6. ( ) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)					
7. (4) TOTAL SENIOR PERSONNEL (1 - 6)	19.2			209,420	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (0) POST DOCTORAL SCHOLARS	0.0			0	
2. (9) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	9.2			71,190	
3. (6) GRADUATE STUDENTS				162,712	
4. (0) UNDERGRADUATE STUDENTS				0	
5. (0) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				0	
6. (0) OTHER				0	
TOTAL SALARIES AND WAGES (A + B)				443,322	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				255,839	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				699,161	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
TOTAL EQUIPMENT				0	
E. TRAVEL 1. DOMESTIC (INCL. U.S. POSSESSIONS)				31,084	
2. INTERNATIONAL				0	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ 45,000					
2. TRAVEL 2,600					
3. SUBSISTENCE 3,250					
4. OTHER 0					
TOTAL NUMBER OF PARTICIPANTS (110) TOTAL PARTICIPANT COSTS				50,850	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				43,000	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				750	
3. CONSULTANT SERVICES				0	
4. COMPUTER SERVICES				0	
5. SUBAWARDS				77,650	
6. OTHER				93,310	
TOTAL OTHER DIRECT COSTS				214,710	
H. TOTAL DIRECT COSTS (A THROUGH G)				995,805	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE)					
TOTAL INDIRECT COSTS (F&A)				296,493	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				1,292,298	
K. FEE				0	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				1,292,298	

M. COST SHARING PROPOSED LEVEL $ 0 AGREED LEVEL IF DIFFERENT $

PI/PD NAME	FOR NSF USE ONLY: INDIRECT COST RATE VERIFICATION		
Ari Krakowski	Date Checked	Date Of Rate Sheet	Initials - ORG
ORG. REP. NAME* Mary Bonvillain			

*ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET

DTI: Indigenous Mixed Reality Science Experiences (IMRSE): Fostering Cultural and Science Identity through Youth Participatory Design of Mixed Reality Experiences
Submitted to National Science Foundation ITEST – Developing and Testing Innovations
Submitted by: Ari Krakowski (PI), Jedda Foreman, Kimiko Ryokai, & Sarah Olsen (Co-PIs)
The Lawrence Hall of Science • University of California, Berkeley

Budget Justification

The proposed budget goes toward:

A. ***Senior Personnel:***

PI **Ari Krakowski** will provide overall project leadership and oversight, and oversee the design, development of the learning experiences at 15% FTE in Years 1-3. Responsibilities also include dissemination of findings, design principles, and model.

Co-PI **Jedda Foreman** will lead the partnership with mak-'amham and Indigenous communities and collaborate with PIs Ryokai and Krakowski to lead the youth participatory design process, at 15% in Years 1-3. Responsibilities also include dissemination of findings, design principles, and model.

Co-PI **Sarah Olsen** will lead the project's research efforts, including data collection and analysis, and supervise a graduate student, at 15% FTE in Years 1-3. She will also liaise with the Advisory Board Coordinator to support project evaluation. Responsibilities also include dissemination of findings, design principles, and model.

Co-PI **Kimiko Ryokai** will lead the design of the mixed-reality experiences, collaborate with PIs Krakowski and Foreman to lead the youth participatory design process, and supervise a graduate student on the project, at 8% FTE in Years 1-3. Responsibilities also include dissemination of findings, design principles, and model.

The proposed levels of effort for this project are appropriate for the scope of work and are required in order to fulfill the objectives of the project within the proposed performance period.

These funds will be expended in accordance with NSF and University requirements. For the purposes of determining NSF's 2-month annual effort limit on senior personnel compensation, the University of California, Berkeley defines a "year" as the organization's fiscal year that spans from July 1 to June 30.

B. Other Personnel:

B.2 Other Professionals:
A Lawrence Hall of Science **Project Coordinator (TBD)** will support progress toward project deadlines and milestones and coordinate recruitment, scheduling, and travel, at 18% FTE in Years 1-3.

Chris Ziska, Outdoor Nature Lab Manager, will contribute input to the design of mixed-reality experiences at 1% in Year 1 and at 5% in Years 2-3.

Allyn Ayres, Exhibit Design Specialist, will contribute input to the design of mixed-reality experiences at 1% in Year 1 and at 5% in Years 2-3.

B.3 Graduate Students:

Meg Everett, PhD student in the Graduate School of Information, will support data collection and analysis for the research efforts, and prepare materials to support project evaluation at 40% FTE in Years 1-3. She will be supervised by Dr. Olsen.

Yangyang Yang, PhD student in the School of Information, will support the iterative design and development of the mixed reality prototypes and exhibit components, in collaboration with project leadership, at 40% FTE in Years 1-3. She will be supervised by Dr. Ryokai.

Salaries are based on July 2022 actual salaries and are projected to include an annual cost-of-living adjustment (and merit, if applicable) effective each year.

C. ***Fringe Benefits***: The University of California, Berkeley Composite Fringe Benefit Rates (CFBR) have been reviewed and federally approved by the Department of Health and Human Services (DHHS) for use by all fund sources through FY21. Rates beyond June 30, 2021 are estimates and are provided for planning purposes only. Future CFBR rates are subject to review and approval by DHHS on an annual or bi-annual basis. Fringe benefits are assessed as a percentage of the respective employee's salary. The benefit rates are as follows:

	Approved	**Projections for planning purposes**		
CBR Rate Group	**FY23**	**FY24**	**FY25**	**FY26**
Academic	35.4%	35.4%	35.4%	35.4%
Staff	42.8%	42.8%	42.8%	42.8%
Limited	14.0%	14.0%	14.0%	14.0%
Employees with No Benefit Eligibility	5.3%	5.3%	5.3%	5.3%
Students (Graduate and Undergraduate)	2.8%	2.8%	2.8%	2.8%

For more information, please see: https://spo.berkeley.edu/policy/benefits/benefits.html

In addition, tuition remission costs for the graduate students are calculated at $59,070 in Year 1, $45,099 in Year 2, and $46,903 in Year 3. The University of California provides partial remission of tuition, fees, and graduate student health insurance to all graduate students who are employed on-campus between 25-44% time during the academic year. In-state remission is included at the rate of $21,682 ($10,841 per semester), which is escalated annually in the budget at a rate of 4% per year. Out-of-state remission is included at the rate of $37,388 ($18,694 per semester) which is escalated annually in the budget at a rate of 4% per year. Additional information regarding the fee remission program can be found at: https://grad.berkeley.edu/financial/academic-employment/fee-remissions/.

D. ***Equipment:*** N/A

E. ***Travel*****:** Domestic: A travel budget of $31,084 is requested for the following travel events:

1. **Local travel for site visits, meetings with Ohlone Research Advisors, and participatory design workshops at Ohlone cultural meeting locations:** 20 visits in Y1; 10 visits in Ys 2-3 for 5 staff at 30 miles RT per site visit. Total cost: $3,751.

2. **Travel to biannual PI meeting** is budgeted for three people in years 1 and 3 for a 2-night/3-day stay in the Washington DC area. Airfare is estimated at $700 RT/person, lodging at $275/person/night, meals & incidentals at $62/ person/day. Ground transportation, including mileage to and from, and parking at the San Francisco Airport, is also requested at $250/person. Total cost is $9,816.

3. **Travel to professional conferences** for 4 days/3 nights each is budgeted for 4 people in Year 3 to share findings. Airfare is estimated at $700 RT/person, lodging at $275/person/night, meals & incidentals at $62/ person/day. Ground transportation, including mileage to and from, and parking at the San Francisco Airport, is also requested at $250/person. Conference registration is estimated at $500/person/conference. Total cost is $10,092.

2. **Travel to in-person advisory meeting** in Year 3 is budgeted for the 6-person advisory board: 1 Advisory Board Coordinator (3 nights) and 5 advisory board members (2 nights), 3 local and 3 national advisors: Airfare is estimated at $700 RT/national advisor, lodging at $275/person/night, meals & incidentals for 2 travel days at $62/ person/day, and ground transportation, including mileage to airport and parking is also requested at $250/person. 3 local advisors: Mileage is estimated at 250 miles-RT per advisor at $0.625/mile, lodging at $275/person/night, and meals & incidentals at $62/ person for two travel days. Total cost is $7,425.

F. Participant Support Costs:

1. Participation Stipends:

- *Ohlone youth:* participation stipends budgeted to provide financial assistance for participants to attend for up to 20 Ohlone youth, for a total of $44,000:
    - Year 1: $200 stipend for each of 2 design workshops and $600 for design summer intensive at Ohlone cultural meeting center.
    - Year 2: $200 stipend for each of 4 design workshops; two at Ohlone cultural meeting center, two at Lawrence Hall of Science.
    - Year 3: $200 stipend for each of 2 design workshops at Lawrence Hall of Science.

- *Additional Indigenous youth*: participation stipends budgeted to provide financial assistance for participants to attend, $20 / 50 participants in Year 2 for a total of $1000.

2. Travel stipends: travel stipends for participants budgeted as follows:

- *Ohlone youth:* travel stipends for workshops at Lawrence Hall of Science: $20 travel stipend/20 Ohlone youth participants / 4 workshops in Years 2 and 3
- *Additional Indigenous youth*: $20 travel stipend / 50 participants in each of Year 2.

3. Subsistence for design workshops is included for up to 20 participants/workshop for two workshops and one 1-week summer intensive in Y1; four workshops in Y2, and two workshops in Y3, at $250 per day x 13 days, for a total of $3,250.

G. Other Direct Costs

G.1 Materials and supplies to support digital device hardware and software ($10,000/year each year); exhibit production and fabrication materials ($10,000 in Year 3); and printing of materials and supplies for participatory design workshops ($1,000 per year each year), totaling $43,000.

G.2 Publication cost, documentation, and dissemination: We request $250 in Year 2 and $500 in Year 3 to cover costs for publication and dissemination of research findings and instructional materials, for a total cost of $750.

G.5 Subaward: to mak-'amham for $77,650 for overall oversight of project design and implementation, including Indigenous Science content ideation, coordination with Ohlone Research Advisory Committee, collaboration of participatory design workshops, and recruitment support. Please see separate subaward budget and budget justification for a detailed breakdown of costs.

G.6 Other:

a. **Honoraria:** for 5 advisors, $1,000 per person per year, and for one Advisory Board Coordinator at $4,000 per year for Years 1–3, for a total of $27,000.
b. **Meeting costs:** Lunch and snacks for 2 days at $30/day and dinner at $40/person for 13 persons (advisors and staff) for in-person Advisory Board meeting in Year 3 for a total of $910.
c. **Ohlone Research Advisory Committee Honoraria** for 3 Research Advisors, at $1,000 per person per year for Years 1–3, for a total of $9,000.
d. **Research incentives for data collection** 3 interviews per year in Years 1-2 for 20 Ohlone youth participants at $30/interview; survey completion incentives for 50 Indigenous youth in Year 2 at $20/survey, totaling $6,400.
e. **Exhibit component code completion and physical build subcontract** at $10,000/experience for up to 5 exhibit components is included in Year 3 for a total of $50,000.

H. Total direct costs: $995,803

I. Indirect Costs: Indirect Costs are requested at **$296,493**. Indirect costs are based on University negotiated rates with the cognizant federal authority and are applied at the On Campus Other Sponsored Activities Rate of 40% for the entire project period using the modified total direct cost (MDTC) formula as per the approved rate agreement dated October 24, 2019. Modified total direct costs consist of all direct salaries and wages, applicable fringe benefits, materials, supplies, services, travel, and up to the first $25,000 of each subaward (regardless of the period of performance of the subawards under the award). Modified total direct costs shall exclude equipment, capital expenditures, charges for patient care, student tuition remission, rental costs of off-site facilities, scholarships and fellowships, participant support costs, and the portion of each subaward in excess of $25,000. For more information, please see: https://spo.berkeley.edu/policy/fa.html. The rates after July 1, 2022 are provisional and subject to change based upon our updated federally negotiated indirect cost rate agreement.

J. Total indirect and direct costs: $1,292,298.

Submitted/PI: Ari Krakowski /Proposal No: 2241805

SUMMARY PROPOSAL BUDGET

YEAR 1

FOR NSF USE ONLY		
PROPOSAL NO.	DURATION (months)	
	Proposed	Granted
2241805		
AWARD NO.		

ORGANIZATION: CYPRESS MANDELA TRAINING CENTER (CMTC), INC.

PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR: Ari Krakowski

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-months CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. Vincent Medina	0.42			8,400	
2.					
3.					
4.					
5.					
6. ( ) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	0.0			0	
7. (1) TOTAL SENIOR PERSONNEL (1 - 6)	0.42			8,400	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (0) POST DOCTORAL SCHOLARS	0.0			0	
2. (2) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	0.74			12,180	
3. (0) GRADUATE STUDENTS				0	
4. (0) UNDERGRADUATE STUDENTS				0	
5. (0) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				0	
6. (0) OTHER				0	
TOTAL SALARIES AND WAGES (A + B)				20,580	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				0	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				20,580	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
TOTAL EQUIPMENT				0	
E. TRAVEL 1. DOMESTIC (INCL. U.S. POSSESSIONS)				0	
2. INTERNATIONAL				0	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ 0					
2. TRAVEL 0					
3. SUBSISTENCE 0					
4. OTHER 0					
TOTAL NUMBER OF PARTICIPANTS (0) TOTAL PARTICIPANT COSTS				0	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				0	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				0	
3. CONSULTANT SERVICES				0	
4. COMPUTER SERVICES				0	
5. SUBAWARDS				0	
6. OTHER				0	
TOTAL OTHER DIRECT COSTS				0	
H. TOTAL DIRECT COSTS (A THROUGH G)				20,580	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) De minimis rate (Rate: 10.0, Base:20580.0)					
TOTAL INDIRECT COSTS (F&A)				2,058	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				22,638	
K. FEE				0	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				22,638	

M. COST SHARING PROPOSED LEVEL $ 0 AGREED LEVEL IF DIFFERENT $

PI/PD NAME: Ari Krakowski

ORG. REP. NAME*: Mary Bonvillain

FOR NSF USE ONLY		
INDIRECT COST RATE VERIFICATION		
Date Checked	Date Of Rate Sheet	Initials - ORG

*ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET

Submitted/PI: Ari Krakowski /Proposal No: 2241805

SUMMARY PROPOSAL BUDGET

YEAR 2

ORGANIZATION	FOR NSF USE ONLY: PROPOSAL NO.	DURATION (months) Proposed	Granted
CYPRESS MANDELA TRAINING CENTER (CMTC), INC.	2241805		
PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR: Ari Krakowski	AWARD NO.		

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-months CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. Vincent Medina	0.5			8,401	
2.					
3.					
4.					
5.					
6. ( ) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	0.0			0	
7. (1) TOTAL SENIOR PERSONNEL (1 - 6)	0.5			8,401	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (0) POST DOCTORAL SCHOLARS	0.0			0	
2. (2) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	0.94			12,950	
3. (0) GRADUATE STUDENTS				0	
4. (0) UNDERGRADUATE STUDENTS				0	
5. (0) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				0	
6. (0) OTHER				0	
TOTAL SALARIES AND WAGES (A + B)				21,351	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				0	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				21,351	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
TOTAL EQUIPMENT				0	
E. TRAVEL 1. DOMESTIC (INCL. U.S. POSSESSIONS)				0	
2. INTERNATIONAL				0	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ 0					
2. TRAVEL 0					
3. SUBSISTENCE 0					
4. OTHER 0					
TOTAL NUMBER OF PARTICIPANTS (0) TOTAL PARTICIPANT COSTS				0	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				0	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				0	
3. CONSULTANT SERVICES				0	
4. COMPUTER SERVICES				0	
5. SUBAWARDS				0	
6. OTHER				0	
TOTAL OTHER DIRECT COSTS				0	
H. TOTAL DIRECT COSTS (A THROUGH G)				21,351	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) De minimis rate (Rate: 10.0, Base:21351.0)					
TOTAL INDIRECT COSTS (F&A)				2,135	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				23,486	
K. FEE				0	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				23,486	

M. COST SHARING PROPOSED LEVEL $ 0 AGREED LEVEL IF DIFFERENT $

PI/PD NAME	FOR NSF USE ONLY: INDIRECT COST RATE VERIFICATION		
Ari Krakowski	Date Checked	Date Of Rate Sheet	Initials - ORG
ORG. REP. NAME* Mary Bonvillain			

*ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET

Submitted/PI: Ari Krakowski /Proposal No: 2241805

SUMMARY PROPOSAL BUDGET

YEAR 3

FOR NSF USE ONLY		
PROPOSAL NO.	DURATION (months)	
	Proposed	Granted
2241805		
AWARD NO.		

ORGANIZATION: CYPRESS MANDELA TRAINING CENTER (CMTC), INC.

PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR: Ari Krakowski

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-months CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. Vincent Medina	0.6			11,040	
2.					
3.					
4.					
5.					
6. ( ) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)	0.0			0	
7. (1) TOTAL SENIOR PERSONNEL (1 - 6)	0.6			11,040	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (0) POST DOCTORAL SCHOLARS	0.0			0	
2. (2) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	1.19			17,620	
3. (0) GRADUATE STUDENTS				0	
4. (0) UNDERGRADUATE STUDENTS				0	
5. (0) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				0	
6. (0) OTHER				0	
TOTAL SALARIES AND WAGES (A + B)				28,660	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				0	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				28,660	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
TOTAL EQUIPMENT				0	
E. TRAVEL 1. DOMESTIC (INCL. U.S. POSSESSIONS)				0	
2. INTERNATIONAL				0	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ 0					
2. TRAVEL 0					
3. SUBSISTENCE 0					
4. OTHER 0					
TOTAL NUMBER OF PARTICIPANTS (0) TOTAL PARTICIPANT COSTS				0	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				0	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				0	
3. CONSULTANT SERVICES				0	
4. COMPUTER SERVICES				0	
5. SUBAWARDS				0	
6. OTHER				0	
TOTAL OTHER DIRECT COSTS				0	
H. TOTAL DIRECT COSTS (A THROUGH G)				28,660	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) De minimis rate (Rate: 10.0, Base:28660.0)					
TOTAL INDIRECT COSTS (F&A)				2,866	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				31,526	
K. FEE				0	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				31,526	

M. COST SHARING PROPOSED LEVEL $ 0 AGREED LEVEL IF DIFFERENT $

PI/PD NAME: Ari Krakowski

ORG. REP. NAME*: Mary Bonvillain

FOR NSF USE ONLY		
INDIRECT COST RATE VERIFICATION		
Date Checked	Date Of Rate Sheet	Initials - ORG

*ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET

Submitted/PI: Ari Krakowski /Proposal No: 2241805

SUMMARY PROPOSAL BUDGET

Cumulative

ORGANIZATION	FOR NSF USE ONLY: PROPOSAL NO.	DURATION (months) Proposed	Granted
CYPRESS MANDELA TRAINING CENTER (CMTC), INC.	2241805		
PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR: Ari Krakowski	AWARD NO.		

A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)	NSF Funded Person-months CAL	ACAD	SUMR	Funds Requested By proposer	Funds granted by NSF (if different)
1. Vincent Medina	1.52			27,841	
2.					
3.					
4.					
5.					
6. ( ) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)					
7. (1) TOTAL SENIOR PERSONNEL (1 - 6)	1.52			27,841	
B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)					
1. (0) POST DOCTORAL SCHOLARS	0.0			0	
2. (6) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)	2.87			42,750	
3. (0) GRADUATE STUDENTS				0	
4. (0) UNDERGRADUATE STUDENTS				0	
5. (0) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)				0	
6. (0) OTHER				0	
TOTAL SALARIES AND WAGES (A + B)				70,591	
C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)				0	
TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)				70,591	
D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)					
TOTAL EQUIPMENT				0	
E. TRAVEL 1. DOMESTIC (INCL. U.S. POSSESSIONS)				0	
2. INTERNATIONAL				0	
F. PARTICIPANT SUPPORT COSTS					
1. STIPENDS $ 0					
2. TRAVEL 0					
3. SUBSISTENCE 0					
4. OTHER 0					
TOTAL NUMBER OF PARTICIPANTS (0) TOTAL PARTICIPANT COSTS				0	
G. OTHER DIRECT COSTS					
1. MATERIALS AND SUPPLIES				0	
2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION				0	
3. CONSULTANT SERVICES				0	
4. COMPUTER SERVICES				0	
5. SUBAWARDS				0	
6. OTHER				0	
TOTAL OTHER DIRECT COSTS				0	
H. TOTAL DIRECT COSTS (A THROUGH G)				70,591	
I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE)					
TOTAL INDIRECT COSTS (F&A)				7,059	
J. TOTAL DIRECT AND INDIRECT COSTS (H + I)				77,650	
K. FEE				0	
L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)				77,650	

M. COST SHARING PROPOSED LEVEL $ 0 AGREED LEVEL IF DIFFERENT $

PI/PD NAME	FOR NSF USE ONLY: INDIRECT COST RATE VERIFICATION		
Ari Krakowski	Date Checked	Date Of Rate Sheet	Initials - ORG
ORG. REP. NAME* Mary Bonvillain			

*ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET

Cafe Ohlone Budget Justification
DTI: Indigenous Mixed Reality Science Experiences (IMRSE): Fostering Cultural and Science Identity through Youth Participatory Design of Mixed Reality Experiences

The proposed budget goes toward:

Senior Personnel:

PI Vincent Medina, who will provide leadership, oversight, perspective, recruitment support, and consulting services at a rate of $120 per hour. Total number of hours:

Year 1: 70
Year 2: 70
Year 3: 92
Total hours: 232

Other Personnel:

Louis Trevino, who will provide leadership, perspective, recruitment support, and consulting services at a rate of $120 per hour.

Year 1: 70
Year 2: 70
Year 3: 92
Total hours: 232

Deirdre Greene, who will support senior personnel, attend all meetings, and handle all administrative responsibilities, at a rate of $70 per hour.

Year 1: 54
Year 2: 65
Year 3: 94
Total hours: 213

Fringe Benefits: Funds for fringe benefits are not requested

Equipment: No equipment will be purchased for the purpose of this grant.

Travel: No travel budget is necessary for the purposes of this grant.

Participant Support Costs: Not included in this application.

Other Direct Costs: Not included in this application

Indirect Costs: included at 10% de minimis rate for a total of $7,059 .

Facilities, Equipment, and Other Resources

The Lawrence Hall of Science's mission is to inspire and engage through science discovery and learning in ways that advance equity and opportunity. The Lawrence is the public science center of the University of California, Berkeley, and an innovative leader in the field of science and mathematics education. As a national leader in the development of science and mathematics instructional materials, its approaches, programs, and tools are replicated, scaled up, and disseminated nationally in preK-12, college, and informal science education settings. The Lawrence Hall of Science also supports a network of teachers that test new, cutting-edge instructional materials in classrooms nationwide.

The public museum has a total of 30,000 square feet of programmatic spaces. This includes exhibition space, a planetarium/digital dome, an outdoor science park, a state-of-the-art auditorium that seats 275 people, and 10 teaching classrooms and laboratories that provide a venue for learning experiences. The Outdoor Nature Lab is a 32,600-square-foot outdoor learning space that includes an outdoor classroom, two outdoor viewing platforms, native vegetation, as well as equipment for visitors to borrow, including spotting scopes, magnifying lenses, and self-guided exploration activities. The outdoor area is universally accessible. The building also has a staffed office space for project staff and volunteers in the building. In addition, The Lawrence houses several, large meeting rooms suitable for Advisory Board and other large group meetings.

The Lawrence also houses the Learning Labs (of which the Outdoor Nature Lab is part) within the Research and Impact group, which is charged with providing evidence and insights to foster high quality, equitable, and innovative science and mathematics learning experiences. This group rigorously investigates and evaluates learning opportunities. Situated at the nexus of research and practice, the Research and Impact team is well positioned to engage in the work described herein. Collaborative partnerships improve the planning, use, and impact of our work and enable us to engage in highly successful recruitment efforts for research subjects.

The Lawrence Hall of Science employs a cloud-based file server, hosted and managed at the University of California Data Center, that provides all desktops and laptops with reliable shared storage for project information. A dedicated in-house backup facility exists for all project data stored on the cloud server, and backup is also provided by the Data Center. Many of the ongoing projects either have an online presence or deliver a significant amount of content over the Internet, so the technical staff members maintain web servers, web applications, and online file storage services hosted and managed by the University of California Data Center, and its approved commercial partners. The department has a total of 9 terabytes of managed storage.

The Berkeley network gateway is connected to both the California educational network and the commodity Internet via redundant links. The museum also works with campus departments and third-party systems to provide an event calendaring system, registration for educational and professional development services, and a networked display control system.

mak-'amham's vision is to work towards the restoration of Ohlone Indian culinary traditions as a part of a larger, ongoing effort that empowers Ohlone people with a rich cultural identity. mak-'amham has recently opened Café Ohlone at the Heart Museum at UC Berkeley. Cafe Ohlone is a one-of-a-kind

culinary and educational experience. Every meal of luxurious Ohlone cuisine educates the public about the rich, enduring Ohlone culture. Café Ohlone also functions as a tangible, cultural space for the living Ohlone community; a space where language classes are held, safe gatherings and meals for elders can occur, and the Ohlone community can see representation of its cultural identity outside of personal homes. Cafe Ohlone will also be a permanent center in the effort to build relationships with departments throughout campus to better relations between Ohlone people and the University of California, Berkeley.

Submitted/PI: Ari Krakowski /Proposal No: 2241805

Effective 10/04/2021 **NSF BIOGRAPHICAL SKETCH** **OMB-3145-0058**

NAME: Krakowski, Ari

POSITION TITLE & INSTITUTION: Learning Labs Digital Learning Director, Lawrence Hall of Science, UCB

A. PROFESSIONAL PREPARATION - (see PAPPG Chapter II.C.2.f.(i)(a))

INSTITUTION	LOCATION	MAJOR/AREA OF STUDY	DEGREE (if applicable)	YEAR (YYYY)
California State University, Humboldt	Arcata, CA	Natural Resources	BS	1994
California State University, San Francisco	San Francisco, CA	Molecular Cell Biology	MS	2000
University of California, Berkeley	Berkeley, CA	Molecular Cell Biology	PhD	2006

B. APPOINTMENTS - (see PAPPG Chapter II.C.2.f.(i)(b))

From - To	Position Title, Organization and Location
2022 - present	Director of the Transforming Science and Society Initiative, Lawrence Hall of Science, UC Berkeley, Berkeley, CA
2018 - present	Learning Labs Director, Lawrence Hall of Science, UC Berkeley, Berkeley, CA
2013 - 2022	Digital Learning Director & Senior Science Curriculum Specialist, Learning Design Group, Lawrence Hall of Science, UC Berkeley, Berkeley CA
2011 - 2013	Science Curriculum Specialist, Learning Design Group, Lawrence Hall of Science, UC Berkeley, Berkeley CA
2010 - 2011	Site Coordinator, East Bay Career Advancement Academy, Oakland, CA
2006 - 2011	Biology Professor and Curriculum Developer, Peralta Community College District, Oakland, CA
2000 - 2006	Graduate Student Researcher, University of California, Berkeley, Molecular Cell Biology Department, Berkeley, CA

C. PRODUCTS - (see PAPPG Chapter II.C.2.f.(i)(c)) Products Most Closely Related to the Proposed Project

1. ? ? Krakowski, A., Greenwald, E., & Roman, N. (2022, February). "That's What Science Is, All This Data:" Coding Data Visualizations in Middle School Science Classrooms. In Proceedings of the 53rd ACM Technical Symposium on Computer Science Education (pp. 36-42).

2. ? Krakowski, A., Greenwald, E., Hurt, T., Nonnecke, B., & Cannady, M. (2022, Feb) Authentic Integration of Ethics and AI Through Sociotechnical, Problem-Based Learning. In Proceedings of the AAAI Conference on Artificial Intelligence.

3. ? Krakowski, A., Greenwald, E., Duke, J., Comstock, M., and Roman, N. (2021, May). A Typology of Models for Integrating Computational Thinking in Science (CT+S). In Conference for Research on Equity and Sustained Participation in Engineering, Computing, and Technology (RESPECT) (pp. 1-6). IEEE.

4. Krakowski, A., & Bishop, L. (manuscript in preparation). The role of design process boundary objects in collaborative and participatory design.

5. Krakowski A. Amplify Science Digital Simulations and Modeling Tools. (2017). Portfolio of 35 digital simulations and 20 digital modeling tools for Amplify Science elementary and middle school curriculum units.

Other Significant Products, Whether or Not Related to the Proposed Project

1. Krakowski A, Bishop L, Romano C, Ryan J, Binding M. The Power of CRISPR High School Curriculum. (2021). Berkeley, CA: Lab Aids, with Lawrence Hall of Science and Innovative Genomics Institute, University of California, Berkeley.

2. Krakowski A, Greenwald E, Comstock M, Roman N. Coding Science Internship: Coral Restoration (Curriculum unit for commercial release through Amplify Science). (2020). Learning Design Group, Lawrence Hall of Science, University of California, Berkeley.

3. Krakowski A, Greenwald E, Roman N, Comstock M. Coding Science Internship: Investigating Air Quality (Curriculum unit for research trials). (2020). Learning Design Group, Lawrence Hall of Science, University of California, Berkeley.

4. Barber J, Loper S, Greenwald E, Krakowski A, Belisle R (manuscript in preparation). Designing for Deep, Equitable Science Learning at Scale.

5. Montgomery R, Greenwald E, Krakowski A, Barber J, Crane S. (2020). Operationalizing Optimization in a Middle School Virtual Engineering Internship. Journal of Science Education and Technology. 29(3):409-420.

D. SYNERGISTIC ACTIVITIES - (see PAPPG Chapter II.C.2.f.(i)(d))

1. Lawrence Hall of Science Principal Investigator for The AI behind Virtual Humans (NSF DRL 2116109), which is developing an interactive museum exhibit to engage youth and their families in learning about the capabilities and impact of artificial intelligence.

2. Direct Learning Lab spaces at the Lawrence Hall of Science, including the Inventors' Lab, focused on designing, developing, and researching learning experiences related to computational thinking, and digital design and fabrication.

3. Served as a panel reviewer for the National Science Foundation ITEST and Cyberlearning (now RETTL) programs.

4. Served as a reviewer for Computer Science Education and the SIGCSE Technical Symposium (multiple years).

5. Served on the leadership team for the design, development, and implementation of Amplify Science, a comprehensive TK-8th grade science curriculum designed for the Next Generation Science Standards.

Submitted/PI: Ari Krakowski /Proposal No: 2241805

Effective 10/04/2021 **NSF BIOGRAPHICAL SKETCH** **OMB-3145-0058**

NAME: Vincent Medina

POSITION TITLE & INSTITUTION: Co-Founder, Cafe Ohlone

A. PROFESSIONAL PREPARATION - (see PAPPG Chapter II.C.2.f.(i)(a))

INSTITUTION	LOCATION	MAJOR/AREA OF STUDY	DEGREE (if applicable)	YEAR (YYYY)
Berkeley City College	Berkeley, CA	Anthropology	AA	2009

B. APPOINTMENTS - (see PAPPG Chapter II.C.2.f.(i)(b))

From - To	Position Title, Organization and Location
2017-present	Co-founded mak-'amham/Cafe Ohlone in Berkeley, CA. mak-'amham—our food in Chochenyo langauge—is an organization focused on strengthening Ohlone culture and cuisine. In 2018, we opened the critically acclaimed Cafe Ohlone.
2012-present	Teacher of the Chochenyo Ohlone language.
2009-2017	Curator at Mission Dolores in San Francisco, Strove to find meaningful ways to change the narrative of how Mission history is taught there so that Ohlone culture could be a focus.

BS-1 of 3

C. PRODUCTS - (see PAPPG Chapter II.C.2.f.(i)(c)) Products Most Closely Related to the Proposed Project

Medina, V., & Trevino, L. (July 2020). The Cafe Ohlone Transition, in its Founders' Words. Bay Nature.

Acorns in Italy: Strengthening Our Traditional Foods Thousands of Miles Away (October 2016). News from Native California.

Breath of Life 2016: Bringing Story Back Home (June 2016). News from Native California.

Visions Into Infinite: Chumash Beauty (February, 2016). News from Native California.

Makkin Mak Hemmen. Mak Holše Ohlone Hemmentak.We are together. Our beautiful Ohlone Gathering (October, 2015). News from Native California.

Other Significant Products, Whether or Not Related to the Proposed Project

Medina, V., & Trevino, L. (February, 2022). Mak'amham: Cafe Ohlone, UC Riverside Native American Student Programs Winter Lecture Series.

Medina, V., & Trevino, L. (January 2021). Native Chefs Explore Food Sovereignty, American Indian Alaska Native Tourism Association webinar.

Medina, Vincent (April 8, 2019). Opening Othering and Belonging 2019 (Speech). Othering and Belonging Conference 2019. Oakland, California.

Medina, V., & Trevino, L. (July 2019). Reviving & Strengthening Indigenous Foods of SF Bay Area, Next Economy Now Podcast.

Medina, V. (March 2015). California Indians, Canonization of Junipero Serra, and Consequences of Colonialism, UC Riverside Panel.

D. SYNERGISTIC ACTIVITIES - (see PAPPG Chapter II.C.2.f.(i)(d))

Vincent Medina is East Bay Ohlone and is the captain of ‘Itmay Cultural Association—an association of Verona Band culture bearers. Vincent was born and lives in his family’s indigenous tribal area of Halkin (Southern Oakland/ San Leandro/San Lorenzo/Hayward). Vincent and Louis Trevino (Rumsen Ohlone) co-founded mak-‘amham, an organization, and Cafe Ohlone, a restaurant focused on reviving and strengthening Ohlone food and culture.

Board of Directors, Advocates for Indigenous California Language Survival, 2012-present.

Community Hero Award, Bay Nature, 2020.

Host, Bay Native Circle radio show and podcast, KPFA Berkeley, 2015 2021.

Submitted/PI: Ari Krakowski /Proposal No: 2241805

Effective 10/04/2021 **NSF BIOGRAPHICAL SKETCH** **OMB-3145-0058**

NAME: Olsen, Sarah

POSITION TITLE & INSTITUTION: Research Lead, Lawrence Hall of Science, UC Berkeley

A. PROFESSIONAL PREPARATION - (see PAPPG Chapter II.C.2.f.(i)(a))

INSTITUTION	LOCATION	MAJOR/AREA OF STUDY	DEGREE (if applicable)	YEAR (YYYY)
University of California, Santa Cruz	Santa Cruz, CA	Environmental Studies	BA	2010
University of Idaho	Moscow, ID	Natural Resources	MS	2016
University of Idaho	Moscow, ID	Water Resources	PhD	2019

B. APPOINTMENTS - (see PAPPG Chapter II.C.2.f.(i)(b))

From - To	Position Title, Organization and Location
2020 - present	Research Lead, Lawrence Hall of Science, University of California Berkeley, Berkeley, CA
2020 - 2021	Fellow, Advancing Research Impact in Society
2020 - 2022	Fellow, Deeper Learning, American Educational Research Association
2019 - 2019	Postdoctoral Associate/Curriculum and Evaluation Specialist, University of Wisconsin-Madison Extension, WI
2018 - 2019	Research Assistant, Upward Bound Math Science, Moscow, ID
2018 - 2019	Fellow, Integrative Graduate Education and Research Traineeship, National Science Foundation
2016 - 2019	Program Evaluator, SESTEP, Moscow, ID
2017 - 2018	Graduate Researcher, University of Idaho, Moscow, ID
2016 - 2016	Graduate Student Fellow, International Research Experience for Students' program, National Science Foundation

C. PRODUCTS - (see PAPPG Chapter II.C.2.f.(i)(c)) Products Most Closely Related to the Proposed Project

1. Romero, V., Foreman, J., Strang, C., Rodriguez, L., Payan, R., Bailey, K., Olsen, S. (2022). Racial equity and inclusion in United States of America-based environmental education organizations: A critical examination of priorities and practices in the work environment. Journal of Outdoor and Environmental Education, 1-26.
2. Yun, S., Olsen, S., Quigley, K., Cannady, M., Hartry., A. (2022). A review of augmented reality for informal science learning: Supporting design of intergenerational learning. Visitor Studies. DOI: 10.1080/10645578.2022.2075205.
3. Olsen S, Miller B, Eitel K, Cavazos Cohn T. (2020). Assessing teachers' environmental citizenship based on an adventure learning workshop: A case study from a social-ecological systems perspective. Journal of Science Teacher Education. 2020; 31(8):869-893.

Other Significant Products, Whether or Not Related to the Proposed Project

1. Kliskey A, Alessa L, Griffith D, Olsen S, Williams P, Matsaw S, Cenek M, Gosz J, Dengler S. Transforming sustainability science for practice: a social–ecological systems framework for training sustainability professionals. Sustainability Science. 2020 August 02; :1-12.
2. Hougham RJ, Herde I, Loveland J, Olsen S, Morgan T, Steinhauer M, Goodrow Z, Myers M, Oszuscik S. Science to Story, Story to Social. Connected Science Learning. Spring 2020; 2(2).

D. SYNERGISTIC ACTIVITIES - (see PAPPG Chapter II.C.2.f.(i)(d))

1. Developed research tools including new scales to measure STEM Advocacy and Engagement in older adults, and Environmental Justice Orientation in youth (2020-2022).
2. Developed a research product (Toolkit for scientist-youth program collaboration) for Advancing Research Impacts in Society (ARIS) (2019-2021).
3. Served as a peer reviewer for the journal Society & Natural Resources (2022).
4. Served as a proposal reviewer for American Evaluation Association Conference, STEM Education & Training TIG (2020) and AERA Division H, Category 2: Applied Research, Reports Outstanding Publication Competition (2022).
5. Organized a COMPASS Science Communication Workshop for graduate students and faculty at University of Idaho (2019).

Submitted/PI: Ari Krakowski /Proposal No: 2241805

Effective 10/04/2021 **NSF BIOGRAPHICAL SKETCH** **OMB-3145-0058**

NAME: Kimiko Ryokai

POSITION TITLE & INSTITUTION: Associate Professor, University of California Berkeley

A. PROFESSIONAL PREPARATION - (see PAPPG Chapter II.C.2.f.(i)(a))

INSTITUTION	LOCATION	MAJOR/AREA OF STUDY	DEGREE (if applicable)	YEAR (YYYY)
State University of New York Stony Brook	Stony Brook, NY	Linguistics & Psychology	BA	1997
Massachusetts Institute of Technology	Cambridge, MA	Media Arts & Sciences	MS	1999
Massachusetts Institute of Technology	Cambridge, MA	Media Arts & Sciences	PhD	2005

B. APPOINTMENTS - (see PAPPG Chapter II.C.2.f.(i)(b))

From - To	Position Title, Organization and Location
January 2007 to December 2013	Assistant Professor, School of Information, UC Berkeley
January 2014 to present	Associate Professor, School of Information, UC Berkeley

C. PRODUCTS - (see PAPPG Chapter II.C.2.f.(i)(c)) Products Most Closely Related to the Proposed Project

K Ryokai, S Jacobo, E Rivero, J Park (2022) Examining children's design processes, perspective-taking, and collaboration when using VR head-mounted displays International Journal of Child-Computer Interaction 33, 100451

S Tancredi, J Wang, HT Li, CJ Yao, G Macfarlan, K Ryokai (2022) Balance Board Math:"Being the graph" through the sense of balance for embodied self-regulation and learning
Interaction Design and Children, 137-149

Ryokai, K., Su, P., Kim, E., & Rollins, B. (2014). (Best Paper Honorable Mention) EnergyBugs: energy harvesting wearables for children. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '14). ACM, New York, NY, USA, 1039-1048.

Ryokai, K., Farzin, F., Kaltman, E., Niemeyer, G. (2013). Assessing Multiple Object Tracking in Young Children Using a Game. Educational Technology Research and Development. Springer. April 2013, Volume 61, Issue 2, pp 153-170.

Ryokai, K., Agogino, A.M. (2013) "Off the Paved Paths: Exploring Nature with a Mobile Augmented Reality Learning Tool." International Journal of Mobile Human Computer Interaction (IJMHCI) IGI Global. 5.2 (2013): 21-49.

Other Significant Products, Whether or Not Related to the Proposed Project

Ryokai, K., Duran, E., Howell, N., Gillick, J., Bamman, D. (2018). Capturing, Representing, and Interacting with Laughter. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI'18).

Howell, N., Niemeyer, G., & Ryokai, K. (2019). Life-Affirming Biosensing in Public: Sounding Heartbeats on a Red Bench. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI'19), ACM.

Devendorf, L., Lo, J., Howell, N., Lee, J.L., Gong, N., Karagozler, M.E., Fukuhara, S., Poupyrev, I., Paulos, E., and Ryokai, K. (2016). (Best Paper) “I don't Want to Wear a Screen": Probing Perceptions of and Possibilities for Dynamic Displays on Clothing. In Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems (CHI '16). ACM, New York, NY, USA, 6028-6039.

Howell, N., Devendorf, L., Galvez, T.V., Tian, R., Ryokai, K. 2018. Tensions of data-driven reflection: A case study of real-time emotional biosensing. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI'18).

Devendorf, L. and Ryokai, K. (2015). (Best Paper Honorable Mention) Being the Machine: Reconfiguring Agency and Control in Hybrid Fabrication. In Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems (CHI '15). ACM, New York, NY, USA, 2477-2486. Abrahamson, D., & Bakker, A. (2016). Making sense of movement in embodied design for mathematics learning. Cognitive Research: Principles and Implications, 1(33), 1-13.

D. SYNERGISTIC ACTIVITIES - (see PAPPG Chapter II.C.2.f.(i)(d))

1. Associate Chair, the ACM Conference on Human Factors in Computing Systems (CHI) 2018, 2015, 2012. ACM CHI is the premier international conference on Human-Computer Interaction. AC’s Responsibilities included recruiting and overseeing expert relevant reviewers and synthesize reviews during the paper chair meetings.
2. Subcommittee Chair, the ACM Conference on Designing Interactive Systems (DIS) 2020. ACM DIS is the premier, international arena where designers, artists, psychologists, user experience researchers, systems engineers. Responsibilities included recruiting, overseeing and supporting associate chairs effort in obtaining high quality reviews and meta-reviews, and lead the paper chair meetings.
3. NSF: Expanding the Accessibility of National Science Digital Libraries (NSDL) (Award 0840790, $150,000, with Alice Agogino, UC Berkeley; 09/2008-08/2010). This small grant informed the Core Integration team and other NSDL Collections and Pathways to increase access to the resources of the NSDL for small mobile computing devices.
4. Executive committee member & head graduate advisor, Berkeley Center for New Media, UC Berkeley (2007-present) (October 25–26, 2018). The Berkeley Center for New Media (BCNM) is a focal point for research and teaching about new media, led by a highly trans-disciplinary community of 120 affiliated faculty, advisors, and scholars, from 35 UC Berkeley departments.

Submitted/PI: Ari Krakowski /Proposal No: 2241805

Effective 10/04/2021 **NSF BIOGRAPHICAL SKETCH** **OMB-3145-0058**

NAME: Jedda Foreman

POSITION TITLE & INSTITUTION: Dir.of Environmental Literacy Programs, The Lawrence Hall of Science

A. PROFESSIONAL PREPARATION - (see PAPPG Chapter II.C.2.f.(i)(a))

INSTITUTION	LOCATION	MAJOR/AREA OF STUDY	DEGREE (if applicable)	YEAR (YYYY)
Carleton College	Northfield, MN	Psychology/Education	B.A.	2008
California College of Arts	San Francisco, CA	Design Strategy	M.B.A.	2015

B. APPOINTMENTS - (see PAPPG Chapter II.C.2.f.(i)(b))

From - To	Position Title, Organization and Location
2022-present	Director of Environmental Learning Initiative, The Lawrence Hall of Science, UC Berkeley. Berkeley, CA.
2019–2022	Director of Environmental Literacy Programs, The Lawrence Hall of Science, UC Berkeley. Berkeley, CA.
2017–present	Project Co-Director, BEETLES: Better Environmental Education, Teaching, Learning & Expertise Sharing (NSF AISL grant #1612512), The Lawrence Hall of Science, UC Berkeley. Berkeley, CA
2012–2017	Project Manager, BEETLES: Better Environmental Education, Teaching, Learning & Expertise Sharing (NSF AISL grant #1612512), The Lawrence Hall of Science, UC Berkeley. Berkeley, CA
2011–2012	Program Manager, Quality of Life Foundation, San Francisco, CA.
2009–2019	Program Assistant and Field Instructor, Teton Science Schools, Kelly, WY.

C. PRODUCTS - (see PAPPG Chapter II.C.2.f.(i)(c)) Products Most Closely Related to the Proposed Project

Romero, V., Foreman, J., Strang, C., Rodriguez, L., Payan, R., Moore Bailey, K., & Olsen, S. (2022). Racial equity and inclusion in U.S.-based environmental education organizations: A critical examination of priorities and practices in the work environment. Journal of Outdoor and Environmental Education.

Foreman, J., Strang, C., Rodriguez, L., Payan, R. (2020). Racial Equity in Outdoor Science and Environmental Education: Re-Establishing the Field with Intention. Lawrence Hall of Science, University of California, Berkeley; California.

Hernandez, B., Romero, V., Foreman, J., & Strang, C. (2020). Building Towards an Inclusive Organizational Culture: Insights and Lessons Learned from YES Nature to Neighborhoods: Practice Brief. Lawrence Hall of Science, University of California, Berkeley; California.

Romero, V., Foreman, J., Strang, C., Rodriguez, L., Payan, R., & Moore Bailey, K. (2019). Equitable and inclusive work environments in environmental education: Perspectives from the field and implications for organizations. Lawrence Hall of Science, Berkeley, CA. Accessed at: http://beetlesproject.org.

Foreman, J., Beals, K., Barakos, L., Lygren, E., and Strang, C. (2017). Guide for Program Leaders in Outdoor Science. Lawrence Hall of Science, Berkeley, CA. Accessed at: http://beetlesproject.org.

Other Significant Products, Whether or Not Related to the Proposed Project

Collins, M., Pande, A. Strang, C., Foreman, J., & Dorph, R. (2021). Impacts from covid-19: resilient outdoor science programs need support as challenges persist. Lawrence Hall of Science, University of California, Berkeley; California.

Foreman, J., Mitchel, B., Elkin, T., Pedemonte, S., Strang, C., & Lujan, V. (2021). An Approach to Walking Field Trips. National COVID-19 Outdoor Learning Initiative. https://www.greenschoolyards.org/walking-field-trips.

Collins, M. A., Dorph, R., Foreman, J., Pande, A., Strang, C., & Young, A. (2020). A field at risk: The impact of COVID-19 on environmental and outdoor science education: Policy brief. Lawrence Hall of Science, University of California, Berkeley; California.

Romero, V., Foreman, J., Strang, C., Maybury, C., Pepito, E., & Rocca, C. (2019). Intentional hiring and recruitment through the lens of equity and inclusion: Insights and lessons learned from Crissy Field Center, Golden Gate National Parks Conservancy. Berkeley, CA.

D. SYNERGISTIC ACTIVITIES - (see PAPPG Chapter II.C.2.f.(i)(d))

• I serve as an advisor to the NSF AISL funded project, Using Audubon's Guided Nature Experiences to Engage 18-25-Year-Olds in STEM and Climate Science Content (award #2006011)
• I collaborate with Justice Outside on several projects designed to advance racial equity and justice in the field of environmental learning and outdoor science.
• I am a member of the North American Association of Environmental Education professional association (2015-present)
• Some products listed above in section C are results of the BEETLES project and were developed in conjunction with other educators and scientists. They are in use in hundreds of informal organizations across the county and internationally.

Other Personnel Biographical Information

Data Not Available

Effective 10/04/2021 **NSF CURRENT AND PENDING SUPPORT** **OMB-3145-0058**

*PI/co-PI/Senior Personnel Name: Ari Krakowski

***Required fields**

Note: NSF has provided 15 project/proposal and 10 in-kind contribution entries for users to populate. Please leave any unused entries blank.

Project/Proposal Section:

Current and Pending Support includes all resources made available to an individual in support of and/or related to all of his/her research efforts, regardless of whether or not they have monetary value.[1] Information must be provided about all current and pending support, including this project, for ongoing projects, and for any proposals currently under consideration from whatever source, irrespective of whether such support is provided through the proposing organization or is provided directly to the individual. This includes, for example, Federal, State, local, foreign, public or private foundations, non-profit organizations, industrial or other commercial organizations, or internal funds allocated toward specific projects. Concurrent submission of a proposal to other organizations will not prejudice its review by NSF, if disclosed.[2]

[1] If the time commitment or dollar value is not readily ascertainable, reasonable estimates should be provided.
[2] The Biological Sciences Directorate exception to this policy is delineated in PAPPG Chapter II.D.2.

Projects/Proposals

1. *Project/Proposal Title : Enhancing Youth and Public Engagement with STEM-related Global Issues

*Status of Support : (•) Current ( ) Pending ( ) Submission Planned ( ) Transfer of Support

Proposal/Award Number (if available):

*Source of Support: Gordon and Betty Moore Foundation

*Primary Place of Performance : UC Berkeley

Project/Proposal Start Date (MM/YYYY) (if available) : 07/2022

Project/Proposal End Date (MM/YYYY) (if available) : 12/2023

*Total Award Amount (including Indirect Costs): $ 2,193,820

*Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1. 2023	1.20	4.	
2.		5.	
3.			

*Overall Objectives : The purpose of this project is to design, produce and implement exhibits and public programs about STEM-related global issues.

*Statement of Potential Overlap : N/A

Projects/Proposals

2. *Project/Proposal Title : Science and Technology Center on Real-Time Functional Imaging (STROBE)

*Status of Support : (•) Current ( ) Pending ( ) Submission Planned ( ) Transfer of Support

Proposal/Award Number (if available): Award #1548924

*Source of Support: CU Boulder/NSF

*Primary Place of Performance : UC Berkeley

Project/Proposal Start Date (MM/YYYY) (if available) : 10/2016

Project/Proposal End Date (MM/YYYY) (if available) : 09/2026

*Total Award Amount (including Indirect Costs): $ 5,413,793

*Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1. 2023	0.48	4. 2026	0.48
2. 2024	0.48	5.	
3. 2025	0.48		

*Overall Objectives : Design, develop, and implement direct experiences, learning tools, and educator professional learning opportunities focused on microscopy and concepts related to physical and temporal scale.

*Statement of Potential Overlap : N/A

Projects/Proposals

3. *Project/Proposal Title : AI Behind Virtual Humans: Communicating the Capabilities and Impact of Artificial Intelligence to the Public Through an Interactive Virtual Human Exhibit

*Status of Support : (●) Current ( ) Pending ( ) Submission Planned ( ) Transfer of Support

Proposal/Award Number (if available): Award 2116109

*Source of Support: National Science Foundation

*Primary Place of Performance : UC Berkeley

Project/Proposal Start Date (MM/YYYY) (if available) : 07/2021

Project/Proposal End Date (MM/YYYY) (if available) : 06/2024

*Total Award Amount (including Indirect Costs): $ 474,753

*Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1. 2022	2.40	4.	
2. 2023	2.40	5.	
3. 2024	1.80		

*Overall Objectives : This project will develop a Virtual Human exhibit to engage visitors through structured conversations with a Virtual Human, while showcasing how AI drives the Virtual Human's behavior behind the scenes. The exhibit will include collaborative learning experiences for visitors such as parent-child, siblings and peers to explore what AI is and is not, what AI is and is not capable of, and what impact it will have on their lives.

*Statement of Potential Overlap : N/A

Projects/Proposals

4. *Project/Proposal Title : DTI: Indigenous Mixed Reality Science Experiences (IMRSE): Fostering Cultural and Science Identity through Youth Participatory Design of Mixed Reality Experiences (this proposal)

*Status of Support : ○ Current ◉ Pending ○ Submission Planned ○ Transfer of Support

Proposal/Award Number (if available):

*Source of Support: National Science Foundation

*Primary Place of Performance : UC Berkeley

Project/Proposal Start Date (MM/YYYY) (if available) : 09/2023

Project/Proposal End Date (MM/YYYY) (if available) : 08/2026

*Total Award Amount (including Indirect Costs): $ 1,292,298

*Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1. 2022	1.80	4.	
2. 2023	1.80	5.	
3. 2024	1.80		

*Overall Objectives : Develop and study a model that strengthens Indigenous youths' capacity for, and disposition toward STEM pathways through the collaborative design of mixed reality Indigenous science experiences

*Statement of Potential Overlap : this proposal

Projects/Proposals

5. *Project/Proposal Title : Justice and Equity Centered Online Learning Design: Attending to ethics and collaboration in AI systems learning

*Status of Support : ○ Current ◉ Pending ○ Submission Planned ○ Transfer of Support

Proposal/Award Number (if available):

*Source of Support: National Science Foundation

*Primary Place of Performance : UC Berkeley

Project/Proposal Start Date (MM/YYYY) (if available) : 09/2023

Project/Proposal End Date (MM/YYYY) (if available) : 08/2026

*Total Award Amount (including Indirect Costs): $ 1,294,766

*Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1. 2024	1.80	4.	
2. 2025	1.80	5.	
3. 2026	1.80		

*Overall Objectives : Design, test, and iteratively revise TechHive:AI, a learning experience for high school aged youth that integrates AI technical learning with ethics principles.

*Statement of Potential Overlap : N/A

Projects/Proposals

6. *Project/Proposal Title : Collaborative Research: DTI: Engaging High School Students by Bridging Research in AI and Neuroscience (BRAIN)

*Status of Support : ○ Current ○ Pending ○ Submission Planned ○ Transfer of Support

Proposal/Award Number (if available):

*Source of Support: National Science Foundationd

*Primary Place of Performance : University of Southern California/NSF

Project/Proposal Start Date (MM/YYYY) (if available) : 05/2023

Project/Proposal End Date (MM/YYYY) (if available) : 04/2026

*Total Award Amount (including Indirect Costs): $ 415,338

*Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1. 2023	1.20	4.	
2. 2024	1.20	5.	
3. 2025	1.20		

*Overall Objectives : We propose to design and study learning experiences for high school aged youth related to AI involving computational neuroscience using innovative tools to help young students understand how the brain works and how AI can be used to find patterns in neuroimaging that enable predictions about mental states. In conjunction with a 5-8 session learning sequence, students will have pathway opportunities to serve as mentors to new cohorts and serve other roles on active research projects.

*Statement of Potential Overlap : N/A

Effective 10/04/2021 NSF CURRENT AND PENDING SUPPORT OMB-3145-0058

*PI/co-PI/Senior Personnel Name: Vincent Medina

*Required fields

Note: NSF has provided 15 project/proposal and 10 in-kind contribution entries for users to populate. Please leave any unused entries blank.

Project/Proposal Section:

Current and Pending Support includes all resources made available to an individual in support of and/or related to all of his/her research efforts, regardless of whether or not they have monetary value.[1] Information must be provided about all current and pending support, including this project, for ongoing projects, and for any proposals currently under consideration from whatever source, irrespective of whether such support is provided through the proposing organization or is provided directly to the individual. This includes, for example, Federal, State, local, foreign, public or private foundations, non-profit organizations, industrial or other commercial organizations, or internal funds allocated toward specific projects. Concurrent submission of a proposal to other organizations will not prejudice its review by NSF, if disclosed.[2]

[1] If the time commitment or dollar value is not readily ascertainable, reasonable estimates should be provided.
[2] The Biological Sciences Directorate exception to this policy is delineated in PAPPG Chapter II.D.2.

Projects/Proposals

1. *Project/Proposal Title : Connecting to Nature through Outdoor Science

*Status of Support : (•) Current ( ) Pending ( ) Submission Planned ( ) Transfer of Support

Proposal/Award Number (if available): #053517

*Source of Support: Woka Foundation

*Primary Place of Performance : UC Berkeley

Project/Proposal Start Date (MM/YYYY) (if available) : 06/2022

Project/Proposal End Date (MM/YYYY) (if available) : 05/2024

*Total Award Amount (including Indirect Costs): $ 249,216

*Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1. 2023	0.12	4.	
2. 2024	0.09	5.	
3. 2025	0.06		

*Overall Objectives : Creates learning experiences for the Lawrence Hall of Science's Outdoor Nature Lab. These experiences will be pilot tested for national dissemination to nature centers and other nature destinations that are visited by the general public.

*Statement of Potential Overlap : N/A

Projects/Proposals

2. *Project/Proposal Title : DTI: Indigenous Mixed Reality Science Experiences (IMRSE): Fostering Cultural and Science Identity through Youth Participatory Design of Mixed Reality Experiences (this proposal)

*Status of Support : ○ Current ◉ Pending ○ Submission Planned ○ Transfer of Support

Proposal/Award Number (if available):

*Source of Support: National Science Foundation

*Primary Place of Performance : UC Berkeley

Project/Proposal Start Date (MM/YYYY) (if available) : 09/2023

Project/Proposal End Date (MM/YYYY) (if available) : 08/2026

*Total Award Amount (including Indirect Costs): $ 1,292,298

*Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1. 2023	0.42	4.	
2. 2024	0.50	5.	
3. 2025	0.60		

*Overall Objectives : Address the ongoing marginalization of Native American communities from informal science learning spaces by developing and studying a model that cultivates Native youths' rightful presence and activation toward STEM pathways through the collaborative design of mixed reality Indigenous science experiences

*Statement of Potential Overlap : This proposal

Effective 10/04/2021 NSF CURRENT AND PENDING SUPPORT OMB-3145-0058

*PI/co-PI/Senior Personnel Name: Sarah Olsen

***Required fields**

Note: NSF has provided 15 project/proposal and 10 in-kind contribution entries for users to populate. Please leave any unused entries blank.

Project/Proposal Section:

Current and Pending Support includes all resources made available to an individual in support of and/or related to all of his/her research efforts, regardless of whether or not they have monetary value.[1] Information must be provided about all current and pending support, including this project, for ongoing projects, and for any proposals currently under consideration from whatever source, irrespective of whether such support is provided through the proposing organization or is provided directly to the individual. This includes, for example, Federal, State, local, foreign, public or private foundations, non-profit organizations, industrial or other commercial organizations, or internal funds allocated toward specific projects. Concurrent submission of a proposal to other organizations will not prejudice its review by NSF, if disclosed.[2]

[1] If the time commitment or dollar value is not readily ascertainable, reasonable estimates should be provided.
[2] The Biological Sciences Directorate exception to this policy is delineated in PAPPG Chapter II.D.2.

Projects/Proposals

1. *Project/Proposal Title : Exploring Biotechnology Program

*Status of Support : (•) Current ( ) Pending ( ) Submission Planned ( ) Transfer of Support

Proposal/Award Number (if available):

*Source of Support: Bayer Fund

*Primary Place of Performance : UC Berkeley

Project/Proposal Start Date (MM/YYYY) (if available) : 01/2022

Project/Proposal End Date (MM/YYYY) (if available) : 02/2022

*Total Award Amount (including Indirect Costs): $ 125,000

*Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1. 2022	0.60	4.	
2.		5.	
3.			

*Overall Objectives : Develop and implement, in partnership with the East Bay Area school districts, an integrated portfolio of Biotechnology educational and workforce development experiences.

*Statement of Potential Overlap : No expected overlap of effort

Projects/Proposals

2. *Project/Proposal Title : Urban Youth Participation in Community and Citizen Science

*Status of Support : (•) Current ( ) Pending ( ) Submission Planned ( ) Transfer of Support

Proposal/Award Number (if available): 2115614

*Source of Support: National Science Foundation

*Primary Place of Performance : UC Berkeley

Project/Proposal Start Date (MM/YYYY) (if available) : 09/2021

Project/Proposal End Date (MM/YYYY) (if available) : 08/2025

*Total Award Amount (including Indirect Costs): $ 1,999,250

*Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1. 2022	2.40	4. 2025	3.00
2. 2023	2.40	5.	
3. 2024	2.40		

*Overall Objectives : Provide learning experiences around place-based participatory science for middle and high school youth of color in urban communities

*Statement of Potential Overlap : No expected overlap of effort

Projects/Proposals

3. *Project/Proposal Title : CAREER: Subsurface critical zone architecture controls on hydrologic partitioning across spatial scales

*Status of Support : (•) Current ( ) Pending ( ) Submission Planned ( ) Transfer of Support

Proposal/Award Number (if available): 2046957

*Source of Support: UC Santa Cruz/NSF

*Primary Place of Performance : UC Berkeley

Project/Proposal Start Date (MM/YYYY) (if available) : 07/2021

Project/Proposal End Date (MM/YYYY) (if available) : 06/2026

*Total Award Amount (including Indirect Costs): $ 22,333

*Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1. 2022	0.12	4. 2025	0.12
2. 2023	0.12	5. 2026	0.12
3. 2024	0.12		

*Overall Objectives : This program will quantify how key hydrologic processes are controlled by the dynamic interactions between subsurface structure) and hydrologic forcings. Based in a semi-arid oak woodland in central coastal California, project outcomes will inform water resource management efforts by regional water managers. Also includes development of online high school and undergraduate curriculum at the intersection of hydrologic sciences and environmental justice.

*Statement of Potential Overlap : No expected overlap of effort

Projects/Proposals

4. *Project/Proposal Title : Racial Equity: A Collaborative Model for Increasing Racial Equity in STEM Education in Oakland, California

*Status of Support : ○ Current ◉ Pending ○ Submission Planned ○ Transfer of Support

Proposal/Award Number (if available): 2224462

*Source of Support: National Science Foundation

*Primary Place of Performance : UC Berkeley

Project/Proposal Start Date (MM/YYYY) (if available) : 09/2022

Project/Proposal End Date (MM/YYYY) (if available) : 08/2027

*Total Award Amount (including Indirect Costs): $ 3,442,186

*Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1. 2023	2.40	4. 2026	2.40
2. 2024	2.40	5. 2027	2.40
3. 2025	2.40		

*Overall Objectives : The project aims to develop, implement and evaluate a collaborative, multi-component model designed for increasing racial equity in an urban community with a large BIPOC population.

*Statement of Potential Overlap : No expected overlap of effort

Projects/Proposals

5. *Project/Proposal Title : DTI: Indigenous Mixed Reality Science Experiences (IMRSE): Fostering Cultural and Science Identity through Youth Participatory Design of Mixed Reality Experiences (This Proposal)

*Status of Support : ○ Current ◉ Pending ○ Submission Planned ○ Transfer of Support

Proposal/Award Number (if available):

*Source of Support: National Science Foundation

*Primary Place of Performance : UC Berkeley

Project/Proposal Start Date (MM/YYYY) (if available) : 09/2023

Project/Proposal End Date (MM/YYYY) (if available) : 08/2026

*Total Award Amount (including Indirect Costs): $ 1,292,298

*Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1. 2024	1.80	4.	
2. 2025	1.80	5.	
3. 2026	1.80		

*Overall Objectives : Develop and study a model that strengthens Indigenous youths' capacity for, and disposition toward STEM pathways through the collaborative design of mixed reality Indigenous science experiences

*Statement of Potential Overlap : this proposal

Effective 10/04/2021 NSF CURRENT AND PENDING SUPPORT OMB-3145-0058

*PI/co-PI/Senior Personnel Name: Kimiko Ryokai

***Required fields**

Note: NSF has provided 15 project/proposal and 10 in-kind contribution entries for users to populate. Please leave any unused entries blank.

Project/Proposal Section:

Current and Pending Support includes all resources made available to an individual in support of and/or related to all of his/her research efforts, regardless of whether or not they have monetary value.[1] Information must be provided about all current and pending support, including this project, for ongoing projects, and for any proposals currently under consideration from whatever source, irrespective of whether such support is provided through the proposing organization or is provided directly to the individual. This includes, for example, Federal, State, local, foreign, public or private foundations, non-profit organizations, industrial or other commercial organizations, or internal funds allocated toward specific projects. Concurrent submission of a proposal to other organizations will not prejudice its review by NSF, if disclosed.[2]

[1] If the time commitment or dollar value is not readily ascertainable, reasonable estimates should be provided.
[2] The Biological Sciences Directorate exception to this policy is delineated in PAPPG Chapter II.D.2.

Projects/Proposals

1. *Project/Proposal Title : DTI: Indigenous Mixed Reality Science Experiences (IMRSE): Fostering Cultural and Science Identity through Youth Participatory Design of Mixed Reality Experiences (This Proposal)

*Status of Support : ○ Current ◉ Pending ○ Submission Planned ○ Transfer of Support

Proposal/Award Number (if available):

*Source of Support: NSF

*Primary Place of Performance : UC Berkeley

Project/Proposal Start Date (MM/YYYY) (if available) : 09/2023

Project/Proposal End Date (MM/YYYY) (if available) : 08/2026

*Total Award Amount (including Indirect Costs): $ 1,292,298

*Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1. 2024	1.00	4.	
2. 2025	1.00	5.	
3. 2026	1.00		

*Overall Objectives : Develop and study a model that strengthens Indigenous youths' capacity for, and disposition toward STEM pathways through the collaborative design of mixed reality Indigenous science experiences

*Statement of Potential Overlap : No personal, no equipment, nor location overlap.

Projects/Proposals

2. *Project/Proposal Title : Charting Our Embodied Territories: Learning Geometry as Collaborative Negotiation of Complementary Perspectives

*Status of Support : ○ Current ◉ Pending ○ Submission Planned ○ Transfer of Support

Proposal/Award Number (if available): 10038535

*Source of Support: Spencer Foundation

*Primary Place of Performance : UC Berkeley

Project/Proposal Start Date (MM/YYYY) (if available) : 07/2022

Project/Proposal End Date (MM/YYYY) (if available) : 06/2025

*Total Award Amount (including Indirect Costs): $ 412,363

*Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1. 2022	1.00	4. 2025	1.00
2. 2023	1.00	5.	
3. 2024	1.00		

*Overall Objectives : The research aims to operationalize and evaluate the project's thematic theoretical construct, conceptually generative perspectival complementarity (CGPC). Taking a design-based research approach to the study of collaborative geometry learning, the project will collect data gathered from iterative implementations of experimental pedagogical activities of our design.

*Statement of Potential Overlap : No personal, no equipment, nor location overlap.

Projects/Proposals

3. *Project/Proposal Title : Google Walnut Design Studies

*Status of Support : (•) Current ( ) Pending ( ) Submission Planned ( ) Transfer of Support

Proposal/Award Number (if available): 517204

*Source of Support: Google, Inc.

*Primary Place of Performance : UC Berkeley

Project/Proposal Start Date (MM/YYYY) (if available) : 11/2016

Project/Proposal End Date (MM/YYYY) (if available) : 08/2022

*Total Award Amount (including Indirect Costs): $ 881,700

*Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1. 2022	1.00	4.	
2.		5.	
3.			

*Overall Objectives : The objective of this research is to develop and evaluate non-verbal haptic communication devices to support human connectedness over distance.

*Statement of Potential Overlap : No personal, no equipment, nor location overlap.

Effective 10/04/2021 **NSF CURRENT AND PENDING SUPPORT** **OMB-3145-0058**

*PI/co-PI/Senior Personnel Name: Jedda Foreman

***Required fields**

Note: NSF has provided 15 project/proposal and 10 in-kind contribution entries for users to populate. Please leave any unused entries blank.

Project/Proposal Section:

Current and Pending Support includes all resources made available to an individual in support of and/or related to all of his/her research efforts, regardless of whether or not they have monetary value.[1] Information must be provided about all current and pending support, including this project, for ongoing projects, and for any proposals currently under consideration from whatever source, irrespective of whether such support is provided through the proposing organization or is provided directly to the individual. This includes, for example, Federal, State, local, foreign, public or private foundations, non-profit organizations, industrial or other commercial organizations, or internal funds allocated toward specific projects. Concurrent submission of a proposal to other organizations will not prejudice its review by NSF, if disclosed.[2]

[1] If the time commitment or dollar value is not readily ascertainable, reasonable estimates should be provided.
[2] The Biological Sciences Directorate exception to this policy is delineated in PAPPG Chapter II.D.2.

Projects/Proposals

1. *Project/Proposal Title : Working Toward Equitable Organizations: Building Capacity for Leadership of Color in Outdoor and Environmental Science Education

*Status of Support : (•) Current ( ) Pending ( ) Submission Planned ( ) Transfer of Support

Proposal/Award Number (if available): 2005829

*Source of Support: National Science Foundation

*Primary Place of Performance : UC Berkeley

Project/Proposal Start Date (MM/YYYY) (if available) : 09/2020

Project/Proposal End Date (MM/YYYY) (if available) : 08/2023

*Total Award Amount (including Indirect Costs): $ 1,999,323

*Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1. 2021	3.60	4.	
2. 2022	3.60	5.	
3. 2023	3.60		

*Overall Objectives : Addresses inequities in the outdoor and environmental science education by broadening participation of people of color, including African Americans, Latinx, and Native Americans in the leadership and staff of outdoor science programs (OSP) by supporting the development of vertical leadership teams to create and sustain equitable, inclusive, and culturally relevant workplaces and learning environments, and 2) supporting professionals of color currently working in participating OSPs.

*Statement of Potential Overlap : There is no potential overlap.

Projects/Proposals

2. *Project/Proposal Title : Building Capacity in EE through Subnational Networks

*Status of Support : (•) Current ( ) Pending ( ) Submission Planned ( ) Transfer of Support

Proposal/Award Number (if available): 21-00589

*Source of Support: Pisces Foundation

*Primary Place of Performance : UC Berkeley

Project/Proposal Start Date (MM/YYYY) (if available) : 06/2021

Project/Proposal End Date (MM/YYYY) (if available) : 05/2023

*Total Award Amount (including Indirect Costs): $ 206,000

*Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1. 2022	1.80	4.	
2. 2023	2.40	5.	
3.			

*Overall Objectives : Addresses the lack of support for current and emerging network leaders in the environmental education field by creating a national backbone network.

*Statement of Potential Overlap : There is no potential overlap

Projects/Proposals

3. *Project/Proposal Title : Connecting to Nature through Outdoor Science

*Status of Support : (•) Current ( ) Pending ( ) Submission Planned ( ) Transfer of Support

Proposal/Award Number (if available): 053517

*Source of Support: Woka Foundation

*Primary Place of Performance : UC Berkeley

Project/Proposal Start Date (MM/YYYY) (if available) : 06/2022

Project/Proposal End Date (MM/YYYY) (if available) : 05/2024

*Total Award Amount (including Indirect Costs): $ 249,216

*Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1. 2023	0.60	4.	
2. 2024	0.60	5.	
3.			

*Overall Objectives : Creates learning experiences for the Lawrence Hall of Science's Outdoor Nature Lab. These experiences will be pilot tested for national dissemination to nature centers and other nature destinations that are visited by the general public.

*Statement of Potential Overlap : There is no potential overlap.

Projects/Proposals

4. *Project/Proposal Title : DTI: Indigenous Mixed Reality Science Experiences (IMRSE): Fostering Cultural and Science Identity through Youth Participatory Design of Mixed Reality Experiences (this proposal)

*Status of Support : ○ Current ◉ Pending ○ Submission Planned ○ Transfer of Support

Proposal/Award Number (if available):

*Source of Support: National Science Foundation

*Primary Place of Performance : UC Berkeley

Project/Proposal Start Date (MM/YYYY) (if available) : 09/2023

Project/Proposal End Date (MM/YYYY) (if available) : 08/2026

*Total Award Amount (including Indirect Costs): $ 1,292,298

*Person-Month(s) (or Partial Person-Months) Per Year Committed to the Project

*Year (YYYY)	*Person Months (##.##)	Year (YYYY)	Person Months (##.##)
1. 2023	1.80	4.	
2. 2024	1.80	5.	
3. 2025	1.80		

*Overall Objectives : Develop and study a model that strengthens Indigenous youths' capacity for, and disposition toward STEM pathways through the collaborative design of mixed reality Indigenous science experiences

*Statement of Potential Overlap : n/a

Table 1

1	Your Name:	Your Organizational Affiliation(s), last 12 mo	Last Active Date
	Krakowski, Ari	University of California, Berkeley	

Table 2

2	Name:	Type of Relationship	Optional (email, Department)	Last Active Date

Table 3

3	Advisor/Advisee Name:	Organizational Affiliation	Optional (email, Department)
G	Bilder, David	University of California, Berkeley	
G	Bissell, Mina	Lawrence Berkeley National Laboratory	
G	Bjeldanes, Leonard	University of California, Berkeley	
G	Luo, Kunxin	University of California, Berkeley	
G	Martin, Steven	University of California, Berkeley	

Table 4

4	Name:	Organizational Affiliation	Optional (email, Department)	Last Active Date
C	Allan, Sara	University of California, Berkeley		
A	Barber, Jacqueline	University of California, Berkeley		
A	Belisle, Renee	Denver Unified School District		
C	Bishop, Lee	University of California, Berkeley		
C	Cannady, Matthew	University of California, Berkeley		
A	Comstock, Meghan	University of Pennsylvania		
A	Crane, Samuel	Amplify		
C	Dorph, Rena	University of California, Berkeley		
A	Duke, Jacob	Lake Washington School District		
C	Duke, Jacob	Lake Washington School District		
C	Ginsberg, Naomi	University of California, Berkeley		
A	Greenwald, Eric	University of California, Berkeley		
C	Hartry, Ardice	University of California, Berkeley		
C	Hurt, Timothy	University of California, Berkeley		
C	Kafai, Yasmin	University of Pennsylvania		

C	Keister, Ellen	University of Colorado, Boulder		
A	Loper, Suzanna	University of California, Berkeley		
C	McClean, Kathleen	Independent Exhibitions		
A	Montgomery, Ryan	University of California, Berkeley		
A	Morales, Christina	University of California, Berkeley		
C	Nonnecke, Brandie	University of California, Berkeley		
C	Quigley, Kathryn	University of California, Berkeley		
A	Roman, Natalie	University of California, Berkeley		
A	Romano, Carissa	University of California, Berkeley		
C	Salehi, Niloufar	University of California, Berkeley		
C	Schreiner, Sarah	University of Colorado, Boulder		
C	Silberman, Eve	Amplify		
C	Wang, Ning	University of Southern California		
C	Zavari, Steven	Amplify		

Table 5

5	Name:	Organizational Affiliation	Journal/Collection	Last Active Date

Table 1

1	Your Name:	Your Organizational Affiliation(s), last 12 mo	Last Active Date
	Vincent Medina	Café Ohlone	

Table 2

2	Name:	Type of Relationship	Optional (email, Department)	Last Active Date
R				

Table 3

3	Advisor/Advisee Name:	Organizational Affiliation	Optional (email, Department)
G			
T			

Table 4

4	Name:	Organizational Affiliation	Optional (email, Department)	Last Active Date
C	Jedda Foreman	Lawrence Hall of Science		
C	Craig Strang	Lawrence Hall of Science		
C	Susan Schwartzenberg	Exploratorium		
C	Ashley Terry	Oakland Zoo		
C	Aya Yamamoto	Cal Academy of Science		
C	Lauren Kroiz	UC Berkeley Hearst Museum of Anthropology		

Table 5

5	Name:	Organizational Affiliation	Journal/Collection	Last Active Date
B				
E				

Table 1

1	Your Name:	Your Organizational Affiliation(s), last 12 mo	Last Active Date
	Olsen, Sarah K.	University of California, Berkeley	

Table 2

2	Name:	Type of Relationship	Optional (email, Department)	Last Active Date
R				

Table 3

3	Advisor/Advisee Name:	Organizational Affiliation	Optional (email, Department)
G	Miller, Brant G.	University of Idaho	Curriculum and Instruction
T	Haltinner, K.	University of Idaho	Sociology
T	Kolok, A.	University of Idaho	Idaho Water Resources Institute
T	Dousay, T.	University of Idaho	Education

Table 4

4	Name:	Organizational Affiliation	Optional (email, Department)	Last Active Date
A	Eitel, Karla	University of Idaho		03/20/20
A	Cohn, Teresa Cavasos	University of Idaho		03/20/20
A	Hougham, Robert Justin	University of Wisconsin, Madison		12/20/19
A	Herde, Isabelle	University of Wisconsin, Madison		12/20/19
A	Loveland, Jennifer	University of Wisconsin, Madison		12/20/19
A	LaPaglia, Kirsten	University of Idaho		08/01/19
A	Kliskey, Andrew	University of Idaho		07/01/20
A	Alessa, Lilian	University of Idaho		07/01/20
A	Griffith, David	University of Idaho		07/01/20
A	Matsaw, Sammy	University of Idaho		07/01/20
A	Cenek, Martin	University of Idaho		07/01/20
A	Gosz, Jim	University of Idaho		07/01/20
A	Dengler, Sarah	University of Idaho		07/01/20
A	Williams, Paula	University of Idaho		07/01/20
A	Morgan, Tempestt			12/20/19
A	Steinhauer, Maggie			12/20/19
A	Goodrow, Zoe			12/20/19
A	Myers, Max			12/20/19

A	Oszuscik, Sarah			12/20/19
A	Matthew Cannady	University of California, Berkeley		07/25/22
A	Salina Yun	University of California, Berkeley		07/25/22
A	Kathryn Quigley	University of California, Berkeley		07/25/22
A	Ardice Hartry	University of California, Berkeley		07/25/22
A	Valeria Romero	University of California, Berkeley		07/25/22
A	Jedda Foreman	University of California, Berkeley		07/25/22
A	Craig Strang	University of California, Berkeley		07/25/22
A	Laura Rodriguez	Justice Outside		07/25/22
A	Rena Payan	Justice Outside		07/25/22
A	Kim Moore Bailey	Justice Outside		07/26/22
C	Kevin Cuff	University of California, Berkeley		

Table 5

5	Name:	Organizational Affiliation	Journal/Collection	Last Active Date
E	Knutson, Karen	University of Pittsburgh Center for Learning in Out-of-School Enviornments	Visitor Studies	05/09/22

Table 1

1	Your Name:	Your Organizational Affiliation(s), last 12 mo	Last Active Date
	Ryokai, Kimiko	University of California Berkeley	

Table 2

2	Name:	Type of Relationship	Optional (email, Department)	Last Active Date
R	Marti, Stefan	Family		

Table 3

3	Advisor/Advisee Name:	Organizational Affiliation	Optional (email, Department)
G	Ishii, Hiroshi	MIT	Media Lab
T	Rosner, Daniela	University of Washington	Human Centered Design & Engineering
T	Devendorf, Laura	University of Colorado Boulder	Information Science
T	Howell, Noura	Georgia Tech	School of Literature, Media, and Communication
T	Yang, YangYang	University of California Berkeley	School of Information

Table 4

4	Name:	Organizational Affiliation	Optional (email, Department)	Last Active Date
A	Abrahamson, Dor	University of California Berkeley	School of Education	
A	Palatnik, Alik	The Hebrew University of Jerusalem	The Seymour Fox School of Education	
A	Benally, Jessica	University of California Berkeley	School of Education	
A	Bamman, David	University of California Berkeley	School of Information	
A	Gillick, Jon	University of California Berkeley	School of Information	
A	Jacobo, Sandra	University of California Berkeley	School of Education	
A	Bulalacao, Nicole	University of California Berkeley	School of Education	
A	Rivero, Edward	University of California Berkeley	School of Education	
A	Park, Julia	University of California Berkeley	School of Information	
A	Tancredi, Sofia	University of California Berkeley	School of Education	
A	Wang, Julia	University of California Berkeley	Computer Science	
A	Li, Helen	University of California Berkeley	School of Information	
A	Yao, Carissa	University of California Berkeley	School of Information	
A	Macfarlan, Genna	University of California Berkeley	School of Education	
A	Deng, Wesley	Carnegie Mellon University	Human Computer Interaction Institution	
C	Dobson, Kelly	Google		
C	Boradkar, Prasad	Google		

Table 5

5	Name:	Organizational Affiliation	Journal/Collection	Last Active Date
B	Billinghurst, Mark	University of South Australia, Adelaide	Multimodal Technologies and Interaction	
B	Ricart, Christina	Universitat de València, 46010 Valencia, Spain	Multimodal Technologies and Interaction	
E	Ginnakos, Michail	Norwegian University of Science and Technology	International Journal of Child-Computer Interaction	
E	Horn, Michael	Northwestern University	International Journal of Child-Computer Interaction	

Table 1

1	Your Name:	Your Organizational Affiliation(s), last 12 mo	Last Active Date
	Foreman, Jedda	University of California, Berkeley	

Table 2

2	Name:	Type of Relationship	Optional (email, Department)	Last Active Date
R				

Table 3

3	Advisor/Advisee Name:	Organizational Affiliation	Optional (email, Department)
G			
T			

Table 4

4	Name:	Organizational Affiliation	Optional (email, Department)	Last Active Date
C	Dorph, Rena	University of California, Berkeley		
A	Strang, Craig	University of California, Berkeley		
C	Lujan, Vanessa	University of California, Berkeley		
C	Cowe, Karen	Ten Strands		
C	Beals, Kevin	University of California, Berkeley		
A	Romero, Valeria	University of California, Berkeley		
C	Barakos, Lynn	University of California, Berkeley		
C	Lygren, Emilie	University of California, Berkeley		
C	Pedemonte, Sarah	University of California, Berkeley		
C	Velez, Diana	University of California, Berkeley		
C	Storksdieck, Martin	Oregon State University		
A	Rodriguez, Laura	Justice Outside		
A	Payan, Rena	Justice Outside		
A	Moore Bailey, Kim	Justice Outside		
C				
C				

Table 5

5	Name:	Organizational Affiliation	Journal/Collection	Last Active Date

B				
E				

DTI: Indigenous Mixed Reality Science Experiences (IMRSE): Fostering Cultural and Science Identity through Youth Participatory Design of Mixed Reality Experiences
Submitted to National Science Foundation ITEST – Developing and Testing Innovations
Submitted by: Ari Krakowski (PI), Jedda Foreman, Kimiko Ryokai, & Sarah Olsen (Co-PIs)
The Lawrence Hall of Science • University of California, Berkeley

Data Management Plan

Data Description. The proposed project will include human subjects data consisting of (1) pre/post surveys with participating youth; (2) youth interview data; (3) educator and partner interview data (4) projects artifacts (e.g., meeting notes, youth design products such as posters, PowerPoint presentations); (5) researcher observation notes; (6) surveys with indigenous youth and public visitors.

Responsibility. The principal investigators (PIs) will have overall responsibility for data management and dissemination over the course of the research project and will monitor compliance with the plan. In the case that the PIs leave UC Berkeley, they will take the data with them and implement an analogous data management plan at the transfer institution.

Data Storage. We will store physical paper/printed versions of consent forms, contact information, student interview notes, audio and video files, and written surveys in a locked cabinet. Electronic research files, including digital audio and video files, will be maintained in digital form and password-protected and encrypted and will not contain names of participants. Data will be scanned and kept in a secure password-protected electronic server that can only be accessed by the study personnel on this project through the secure practices of Lawrence Hall of Science employees. Any physical paper documents will be kept in a secure file cabinet, only accessible to the research team.

Confidentiality. Since these data will be from human subjects, approval for human subjects research will be obtained through UC Berkeley's institutional review board and the Committee for the Protection of Human Subjects. Whenever possible, data will be collected anonymously. When it is necessary to link data over time, to protect subject confidentiality, each subject will be assigned an arbitrary code, which will be associated with the demographic and survey data. One file or key that contains the correspondence between subject names and codes will be kept in an encrypted password-controlled file. Only members of the project team, including the PI, Co-PIs, and personnel, will have access to participants' identities for research purposes. All such staff members will be required to pass the CITI course and have current CITI certification, and to sign confidentiality agreements, agreeing not to reveal the names of study participants to anyone outside the research team. Any names collected will be permanently removed from data files prior to analysis. All data will be presented in an aggregated format so that no one person can be identified. To maintain the privacy of the participants, any report of individual responses, such as quotes, will be reported with pseudonyms.

Data Access and Sharing. De-identified data will be shared among members of the research team, including the Ohlone Research Advisory Committee. The research team will promptly prepare and submit for publication the significant findings resulting from this work. Reports or publications resulting from the project will be submitted to NSF and be made available through research conferences and journals. UC Berkeley / Lawrence Hall of Science will participate actively in conferences on learning sciences, human-computer interaction, and informal science and environmental education. We will distribute materials sufficient to permit replication of results. Research papers published as a result of the project will be freely available for download from the UC Berkeley / Lawrence Hall of Science website.

Upon completion of the project, members of the project analysis team will have exclusive access to the data for five years. During this time, the team will (1) analyze data to address specific aims; and (2) conceptualize, present, write and publish the study findings. If requested, access to the de-identified data will be provided by contacting the PI. Data will in principle be available for access and sharing as soon as is reasonably possible, normally not longer than one year after publication. We will place data in a fully cleaned and documented form in a data archive or library within one year after the expiration of the award.

The data acquired and preserved in the context of this proposal will be further governed by the University of California's policies pertaining to intellectual property, record retention, and data management, and constraints imposed by the University of California IRB. We do not anticipate that significant intellectual property issues involved with these data will arise. Reports or publications resulting from the project will be submitted to NSF and be made available through research conferences and journals. However, in the event that discoveries or inventions are made in direct connection with these data, access to the data will be granted upon request once appropriate invention disclosures and/or provisional patent filings are made.

The data acquired and preserved in the context of the proposed project will additionally be governed by the Ohlone Research Advisory Committee. This group will advise and develop additional necessary governance in regard to: 1) Indigenous ownership of teaching and knowledge sharing protocols; 2) access to and control of data storage and ownership; 3) ongoing care, maintenance, and consent for the use of materials and exhibits.

DTI: Indigenous Mixed Reality Science Experiences (IMRSE): Fostering Cultural and Science Identity through Youth Participatory Design of Mixed Reality Experiences

Other Supplementary Documents
Table of Contents

I. Collaborator Letters

Subaward

1. **Deirdre Green, Vincent Medina, Lous Trevino**, mak'amham/Cafe Ohlone

II. Advisors

1. **Vanessa Anthony-Stevens**, Associate Professor of Social & Cultural Studies and Affiliate Faculty, American Indian Studies, University of Idaho
2. **Angela Calbrese Barton**, Sr. Director, Culture, Language in STEM Education, WestEd
3. **Nikki Meyers-Lim**, Executive Director, California Indian Museum & Cultural Center
4. **Natalie Narjanjo**, Professional Development Specialist, The IDEAL Center at the Science Museum of Minnesota
5. **Patrick Naranjo**, Director, American Indian Graduate Program, University of California, Berkeley

July 21, 2022

Ari Krakowski
Lawrence Hall of Science
University of California
Berkeley, CA 94720-5200

If the proposal submitted by Ari Krakowski entitled Indigenous Mixed Reality Science Experiences (IMRSE): Fostering Cultural and Science Identity through Youth Participatory Design of Mixed Reality Experiences is selected for funding by NSF, it is my intent to collaborate as detailed in the Project Description.

Deirdre Greene, Vincent Medina, Louis Trevino
mak-'amham/Cafe Ohlone

University of Idaho

August 2, 2022

Ari Krakowski
Lawrence Hall of Science
University of California
Berkeley, CA 94720-5200

If the proposal submitted by Ari Krakowski entitled *Indigenous Mixed Reality Science Experiences (IMRSE): Fostering Cultural and Science Identity through Youth Participatory Design of Mixed Reality Experiences,* is selected for funding by NSF it is my intent to collaborate as an advisor.

I understand that the purpose of the Advisory Board is to provide an external review to ensure that the project is making satisfactory progress toward its goals, and to assess the value and integrity of project outcomes. As a member of the Advisory Board, I will participate in yearly meetings, as well as periodic reviews of research, design concepts, and content materials.

Regarding my qualification to serve as an advisor, I provide expertise in pedagogy, Indigenous research methodologies, and decolonial practices in education.

Sincerely,

Vanessa E. Anthony-Stevens, Ph.D.
Associate Professor of Social & Cultural Studies
Affiliate Faculty, American Indian Studies
Principal. Investigator, Indigenous Knowledge for Effective Education Program (IKEEP)
Principal Investigator, Cultivating Relationships (NSF-DRK12)
Department of Curriculum & Instruction
University of Idaho
(208) 885-0178
vstevens@uidaho.edu

SCHOOL OF EDUCATION
UNIVERSITY OF MICHIGAN

July 19, 2022

Ari Krakowski
Lawrence Hall of Science
University of California
Berkeley, CA 94720-5200

If the proposal submitted by Dr. Ari Krawoski entitled "*Indigenous Mixed Reality Science Experiences (IMRSE): Fostering Cultural and Science Identity through Youth Participatory Design of Mixed Reality Experiences*" is selected for funding by NSF, it is my intent to collaborate as an advisor.

Regarding my qualification to serve as an advisor, I am the chair and a professor in the Educational Studies Department at the University of Michigan. I have served as the WT Grant Distinguished Fellow, and am a Fellow of the American Education Research Association. I am the former co-Editor of the Journal of Research in Science Teaching, and currently co-Editor of the American Educational Research Journal. My research has been recognized by the American Education Research Association with the American Education Research Association Award for Exemplary Contributions to Practice-Engaged Research in 2018 (AERA-wide), the 2009 Award for Research Leading to Transformations of Social Contexts (Division G Social Contexts of Education), and with the 2004 Exemplary Research Award in Teaching and Teacher Education (Division K). In addition, I am one of the authors of the rightful presence framework.

Sincerely,

Angela Calabrese-Barton, PhD
Professor & Chair, Educational Studies
angiecb@umich.edu

610 East University Avenue, 4107SEB
Ann Arbor, MI 48109
T: 734.763.9497
AngieCB@umich.edu

Weaving Native Culture into the Future

August 1, 2022

Ari Krakowski
Lawrence Hall of Science
University of California
Berkeley, CA 94720-5200

If the proposal submitted by Ari Krakowski entitled Indigenous Mixed Reality Science Experiences (IMRSE): Fostering Cultural and Science Identity through Youth Participatory Design of Mixed Reality Experiences, is selected for funding by NSF, it is my intent to collaborate as an advisor. I understand that the purpose of the Advisory Board is to provide an external review to ensure that the project is making satisfactory progress toward its goals, and to assess the value and integrity of project outcomes. As a member of the Advisory Board, I will participate in yearly meetings, as well as periodic reviews of research, design concepts, and content materials. I will also support tribal community engagement the Lawrence Hall of Science team.

Regarding my qualification to serve as an advisor, I have served as the director of the California Indian Museum and Cultural Center (CIMCC) for fifteen years. I am Pomo and Miwok, a representative of regional tribal communities and have been a Native American Studies lecturer for over twenty years. CIMCC is located in Sonoma County and provides culturally relevant, positive youth development programming for Native youth to help strengthen their cultural identities, connectivity to culture and other protective factors for health and well-being. We received the National Arts and Humanities Youth Program Award from the President's Committee in 2016. Our STEM Maker Station field trips and activities serve K through 12 students throughout the greater Bay Area. We provide culturally relevant curriculum development and have conducted professional development for thousands of teachers throughout California. Additionally, during times of crisis we have provided emergency resources to tribal community members in Sonoma, Mendocino and Lake Counties for multiple wildfire victims and native families in need during COVID 19. We are currently working on the development of a resiliency hub and traditional food incubator. We are actively engaging and prioritizing traditional ecological knowledge in climate change mitigation, environmental stewardship, community resilience and Native American health.

Sincerely,

Nicole Lim, J.D.
Executive Director
nikkimyers@aol.com
http://cimcc.org

5250 Aero Drive, Santa Rosa, CA 95403 Phone: (707) 579-3004 Fax: (707) 579-9019

Natalie Naranjo
282 6th St E #309
St. Paul, MN 55101
nnaranjo@smm.org

08/02/22

Ari Krakowski
Lawrence Hall of Science
University of California
Berkeley, CA 94720-5200

If the proposal submitted by Ari Krakowski entitled *Indigenous Mixed Reality Science Experiences (IMRSE): Fostering Cultural and Science Identity through Youth Participatory Design of Mixed Reality Experiences,* is selected for funding by NSF, it is my intent to collaborate as an advisor.

I understand that the purpose of the Advisory Board is to provide an external review to ensure that the project is making satisfactory progress toward its goals, and to assess the value and integrity of project outcomes. As a member of the Advisory Board, I will participate in yearly meetings, as well as periodic reviews of research, design concepts, and content materials.

Regarding my qualifications to serve as an advisor, I am a Professional Development Specialist in the IDEAL (Inclusion, Diversity, Equity, Access and Leadership) Center at the Science Museum of Minnesota. Our department develops and delivers equity training to other informal STEM (science, technology, math and engineering) institutions, folks involved in K-12 education, and colleges. Because our programs are small and last 5-11 days, we are able to develop strong relationships with participants as they work towards systems change at their institutions. Additionally, I am involved in many cross institutional efforts at the museum including: restorative circle keeping; facilitating listening sessions with Hmong, Maya, Dakota and Ojibwe community members around education programs and collections digitization; and co-facilitating our race and identity digital engagement group after we reopened. Outside of my work at SMM, I recently started consulting with Critical Incident Stress Consultants in the Twin Cities as a healthcare bias interruptor.

Prior to moving to MN in 2019, I was a high school math teacher for five years in NYC and CA. During my time as a teacher, I was very involved in affinity group spaces for adults and students. I co facilitated a BIPOC staff affinity space and a mixed race affinity group for middle schoolers. I also coached the student co-leaders of a high school BIPOC affinity group. Supporting and advocating for student identity development was a central part of my career as a teacher.

My teaching career started as an educational assistant at a school in Taos, NM. I am mixed race, Santa Clara Pueblo, and I was the only indigenous educator at this small school that served many Taos Pueblo students. This work focused my goals as teacher to work towards decolonized, indigenized, student centered math education.

Sincerely,

natalie narajo

Natalie Naranjo
Professional Development Specialist
The IDEAL Center at the Science Museum of Minnesota

Submitted/PI: Ari Krakowski /Proposal No: 2241805

Berkeley
UNIVERSITY OF CALIFORNIA

Patrick V. Naranjo
American Indian Graduate Program
Office for Graduate Diversity
AIGP@berkeley.edu

August 1, 2022

Patrick V. Naranjo
American Indian Graduate Program
Office for Graduate Diversity
University of California
Berkeley, CA 94720-5900

If the proposal submitted by Ari Krakowski entitled *Indigenous Mixed Reality Science Experiences (IMRSE): Fostering Cultural and Science Identity through Youth Participatory Design of Mixed Reality Experiences*, is selected for funding by NSF, it is my intent to collaborate as an advisor. I understand that the purpose of the Advisory Board is to provide an external review to ensure that the project is making satisfactory progress toward its goals, and to assess the value and integrity of project outcomes. As a member of the Advisory Board, I will participate in yearly meetings, as well as periodic reviews of research, design concepts, and content materials.

Regarding my qualification to serve as an advisor, I have served for three years as the Director of UC Berkeley's American Indian Graduate Program (AIGP), which seeks to confront barriers to full participation of American Indian and Alaska Native students in graduate education. The AIGP also provides guidance on Indigenous careers in STEM and ways in which Indigenous researchers and professionals embrace Indigenous knowledge practices within contemporary STEM career pathways. Prior to my current role, I served as the Resource Coordinator for the Intersection, Academic Multicultural Resource Center at the University of Nevada, Las Vegas (UNLV), where I developed and implemented campuswide strategies to enhance student academic outcomes and establish strong Native American student engagement.

AIGP will provide guidance on resources pertaining to graduate mentorship, and opportunities for students that can support the Indigenous student experience and career resource enhancement for the IMRSE project. AIGP will provide advisory information related to mentoring, student resources, student socialization, cultural humility training, and culturally attuned research practices.

Sincerely,

Patrick V. Naranjo
Director, UC Berkeley American Indian Graduate Program

List of Suggested Reviewers

Data Not Available

List of Reviewers Not to Include

Data Not Available

EXHIBIT F

NATIONAL SCIENCE FOUNDATION

Award Notice

Award Number (FAIN): 2241805
Managing Division Abbreviation: DRL **Amendment Number:** 000

RECIPIENT INFORMATION

Recipient (Legal Business Name): REGENTS OF THE UNIVERSITY OF CALIFORNIA, THE
Recipient Address: 1608 4TH ST STE 201 BERKELEY, CA 94710-1749
Official Recipient Email Address: spoawards@berkeley.edu
Unique Entity Identifier (UEI): GS3YEVSS12N6

AMENDMENT INFORMATION

Amendment Type: New Project
Amendment Date: 02/19/2023
Amendment Number: 000
Proposal Number: 2241805
Amendment Description:

The National Science Foundation hereby awards a Standard Grant for support of the project described in the proposal referenced above as modified by revised budget dated 02/13/2023.

The grantee is encouraged to work with the ITEST resource center by participating in meetings of ITEST projects and ongoing collaborative activities. The ITEST resource center will contact awardees directly to discuss participation in the annual meeting.

PIs are encouraged to include reports of evaluation activities as part of their annual and final project reports.

No work with human subjects, including recruitment, may be conducted under this protocol or grant until IRB approval has been obtained.

Funds provided for participant support may not be diverted by the awardee to other categories of expense without the prior written approval of the cognizant NSF Program Officer. Since participant support cost is not a normal account classification, the awardee organization must be able to separately identify participant support costs. It is highly recommended that separate accounts, sub-accounts, sub-task, or sub-ledgers be established to accumulate these costs. The awardee should have written policies and procedures to segregate participant support costs.

Incentive payments or gifts to participants must be made in accordance with written institutional policies and procedures and supported by auditable documentation. The allowability of these costs will ultimately be based on the awardee institution's ability to adequately demonstrate that the incentives have been disbursed in accordance with its policies and procedures.

The Foundation authorizes the awardee to enter into the proposed subaward arrangement. The subaward agreement should contain appropriate provisions in accordance with the award terms and conditions in effect at the time of this award amendment, and contain any special conditions included in this award.

Costs of entertainment, amusement, diversion and social activities, and any costs directly associated with such activities (such as meals, lodging, rentals, transportation and gratuities) are unallowable. When certain meals are an integral and necessary part of a conference or meeting (i.e., working meals where business is transacted), grant funds may be used for such meals. Grant funds may also be used to furnish a reasonable amount of coffee or soft drinks for conference or meeting participants and attendees during coffee breaks.

No NSF funds may be spent on meals or coffee breaks for intramural meetings of an organization or any of its components, including, but not limited to, laboratories, departments and centers.

AWARD INFORMATION

Award Number (FAIN): 2241805
Award Instrument: Standard Grant
Award Date: 02/19/2023
Award Period of Performance: Start Date: 06/01/2023 End Date: 05/31/2026
Project Title: Supporting Rightful Presence in Museum Spaces: Youth as Participatory Designers of Indigenous Mixed Reality Science Exhibits
Managing Division Abbreviation: DRL
Research and Development Award: Yes
Funding Opportunity: NSF 22-585 Innovative Technology Experiences for Students and Teachers
Assistance Listing Number(s) and Name(s): 47.076 Education and Human Resources (Predominant source of funding for SEFA reporting)

FUNDING INFORMATION

Amount Obligated by this Amendment: $1,292,298
Total Intended Award Amount: $1,292,298
Total Approved Cost Share or Matching Amount: $0
Total Amount Obligated to Date: $1,292,298
Expenditure Limitation: Not Applicable

PROJECT PERSONNEL

Principal Investigator: Ari Krakowski	**Email:** akrakowski@berkeley.edu	**Organization:** REGENTS OF THE UNIVERSITY OF CALIFORNIA, THE
co-Principal Investigator: Kimiko Ryokai	**Email:** kimiko@ischool.berkeley.edu	**Organization:** REGENTS OF THE UNIVERSITY OF CALIFORNIA, THE

co-Principal Investigator: Jedda Foreman	**Email:** jforeman@berkeley.edu	**Organization:** REGENTS OF THE UNIVERSITY OF CALIFORNIA, THE
co-Principal Investigator: Sarah Olsen	**Email:** skolsen@berkeley.edu	**Organization:** REGENTS OF THE UNIVERSITY OF CALIFORNIA, THE
co-Principal Investigator: Vincent Medina	**Email:** vincent@makamham.com	**Organization:** CYPRESS MANDELA TRAINING CENTER INC

NSF CONTACT INFORMATION

Managing Grants Official (Primary Contact) **Name:** Cartia Brown-Morgan **Email:** cbrownmo@nsf.gov **Phone:** (703) 292-8709	**Awarding Official** **Name:** Angela A. Turner **Email:** aturner@nsf.gov	**Managing Program Officer** **Name:** Fengfeng Ke **Email:** fke@nsf.gov **Phone:** (703) 292-2411

GENERAL TERMS AND CONDITIONS

This is awarded pursuant to the authority of the National Science Foundation Act of 1950, as amended (42 U.S.C. 1861-75) and is subject to Research Terms and Conditions (RTCs) dated 11/12/2020, and NSF Agency Specific Requirements, dated 01/30/2023, available at https://www.nsf.gov/awards/managing/rtc.jsp.

This institution is a signatory to the Federal Demonstration Partnership (FDP) Phase VI Agreement which requires active institutional participation in new or ongoing FDP demonstrations and pilots.

This award is made in accordance with the provisions of NSF Solicitation: NSF 22-585 Innovative Technology Experiences for Students and Teachers.

BUDGET

A. Senior Personnel	
Senior Personnel Count	12.00
Senior Personnel Calendar Months	19.20
Senior Personnel Academic Months	0.00
Senior Personnel Summer Months	0.00
Senior Personnel Amount	$209,420
B. Other Personnel	
Post Doctoral Scholars	

Post Doctoral Count	0.00
Post Doctoral Calendar Months	0.00
Post Doctoral Academic Months	0.00
Post Doctoral Summer Months	0.00
Post Doctoral Amount	$0
Other Professionals	
Other Professionals Count	9.00
Other Professionals Calendar Months	9.20
Other Professionals Academic Months	0.00
Other Professionals Summer Months	0.00
Other Professionals Amount	$71,190
Graduate Students	
Graduate Students Count	6.00
Graduate Students Amount	$162,712
Undergraduate Students	
Undergraduate Students Count	0.00
Undergraduate Students Amount	$0
Secretarial - Clerical	
Secretarial - Clerical Count	0.00
Secretarial - Clerical Amount	$0
Other	
Other Count	0.00
Other Amount	$0
Total Salaries and Wages (A+B)	$443,322
C. Fringe Benefits	$255,839
Total Salaries, Wages, Fringe Benefits (A + B + C)	$699,161
D. Equipment	$0
E. Travel	
Domestic	$31,084
International	$0
F. Participant Support Costs	
Participant Support Costs Stipends	$45,000
Participant Support Costs Travel	$2,600
Participant Support Costs Subsistence	$3,250
Participant Support Costs	$0

Other	
Total Number of Participants	110.00
Total Participant Costs (F)	$50,850
G. Other Direct Costs	
Materials Supplies	$43,000
Publication Costs	$750
Consultant Services	$0
Computer Services	$0
Subawards	$77,650
Other	$93,310
Total Other Direct Costs (G)	$214,710
H. Total Direct Costs (A Through G)	**$995,805**
I. Indirect Costs*	**$296,493**
J. Total Direct and Indirect Costs (H + I)	$1,292,298
K. Fees	$0
L. Total Amount of Request (J) OR (J + K)	**$1,292,298**
M. Cost Sharing Proposed Level	$0

*Indirect Cost Rates

Item Name	Indirect Cost Rate
MTDC	40.0000%

These rates are at the time of award and are based upon the budget submitted to the NSF. It does not include any out-year adjustments. The NSF will not modify awards simply to correct indirect cost rates cited in the award notice. See the Proposal & Award Policies & Procedures Guide (PAPPG) Chapter X.A.3.a. for guidance on re-budgeting authority.

EXHIBIT G

NATIONAL SCIENCE FOUNDATION

Award Notice

Award Number (FAIN): 2241805
Managing Division Abbreviation: DRL **Amendment Number:** 001

RECIPIENT INFORMATION

Recipient (Legal Business Name): REGENTS OF THE UNIVERSITY OF CALIFORNIA, THE
Recipient Address: 1608 4TH ST STE 201 BERKELEY, CA 94710-1749
Official Recipient Email Address: spoawards@berkeley.edu
Unique Entity Identifier (UEI): GS3YEVSS12N6

AMENDMENT INFORMATION

Amendment Type: Supplement
Amendment Date: 01/15/2025
Amendment Number: 001
Proposal Number: 2506089
Amendment Description:

The purpose of this amendment is to:

- Add supplemental support to the award in the amount shown below in the Funding Information section.
- Extend the end date from 05/31/2026 to 11/30/2026.

In accordance with 2 CFR 200, Appendix III, C.7, the grantee must use the negotiated rates for indirect costs (F&A) in effect at the time of the initial award throughout the life of the sponsored agreement (including any continuing grant increments and any supplemental funding awarded under the agreement.) Award levels for sponsored agreements may not be adjusted in future years as a result of changes in negotiated rates.

NSF intends to make a public announcement regarding all NSF STEM Day awardees in January 2025. Please hold all media announcements until the NSF national announcement has been released. The NSF Program Officer will notify awardees once the national announcement has been released.

Reporting for the NSF 75th Supplement should be included in the Annual Report with a heading of "NSF STEM Day DCL Supplement" and include, as relevant: announcement has been released. Description of event (one paragraph maximum)

- Focal audience(s)
- Approximate attendance
- Links to media/social media coverage.

Except as modified by this amendment, the award conditions remain unchanged.

AWARD INFORMATION

Award Number (FAIN): 2241805
Award Instrument: Standard Grant
Award Date: 02/19/2023
Award Period of Performance: Start Date: 06/01/2023 End Date: 11/30/2026
Project Title: Supporting Rightful Presence in Museum Spaces: Youth as Participatory Designers of Indigenous Mixed Reality Science Exhibits
Managing Division Abbreviation: DRL
Research and Development Award: Yes
Funding Opportunity: NSF 22-585 Innovative Technology Experiences for Students and Teachers
Assistance Listing Number(s) and Name(s): 47.076 Education and Human Resources, 47.070 Computer and Information Science and Engineering (See Amendment 000 for source of funding for SEFA reporting)

FUNDING INFORMATION

Amount Obligated by this Amendment: $98,981
Total Intended Award Amount: $1,292,298
Total Approved Cost Share or Matching Amount: $0
Total Amount Obligated to Date: $1,391,279

PROJECT PERSONNEL

Principal Investigator: Ari Krakowski	**Email:** akrakowski@berkeley.edu	**Organization:** REGENTS OF THE UNIVERSITY OF CALIFORNIA, THE
co-Principal Investigator: Kimiko Ryokai	**Email:** kimiko@ischool.berkeley.edu	**Organization:** REGENTS OF THE UNIVERSITY OF CALIFORNIA, THE
co-Principal Investigator: Jedda Foreman	**Email:** jforeman@berkeley.edu	**Organization:** REGENTS OF THE UNIVERSITY OF CALIFORNIA, THE
co-Principal Investigator: Sarah Olsen	**Email:** skolsen@berkeley.edu	**Organization:** REGENTS OF THE UNIVERSITY OF CALIFORNIA, THE
co-Principal Investigator: Vincent Medina	**Email:** vincent@makamham.com	**Organization:** CYPRESS MANDELA TRAINING CENTER (CMTC), INC.

NSF CONTACT INFORMATION

Managing Grants Official (Primary Contact)	**Awarding Official** **Name:** Tracy N. Shields	**Managing Program Officer**

Name: Tracy N. Shields
Email: tshields@nsf.gov
Phone: (703) 292-4882

Email: tshields@nsf.gov

Name: Fengfeng Ke
Email: fke@nsf.gov
Phone:

GENERAL TERMS AND CONDITIONS

This is awarded pursuant to the authority of the National Science Foundation Act of 1950, as amended (42 U.S.C. 1861-75) and is subject to NSF Grant General Conditions (GC-1), dated 10/01/2024, available at https://www.nsf.gov/awards/managing/general_conditions.jsp.

This institution is a signatory to the Federal Demonstration Partnership (FDP) Phase VI Agreement which requires active institutional participation in new or ongoing FDP demonstrations and pilots.

BUDGET

A. Senior Personnel	
Senior Personnel Count	5.00
Senior Personnel Calendar Months	0.40
Senior Personnel Academic Months	0.00
Senior Personnel Summer Months	0.00
Senior Personnel Amount	$4,660
B. Other Personnel	
Post Doctoral Scholars	
Post Doctoral Count	0.00
Post Doctoral Calendar Months	0.00
Post Doctoral Academic Months	0.00
Post Doctoral Summer Months	0.00
Post Doctoral Amount	$0
Other Professionals	
Other Professionals Count	10.00
Other Professionals Calendar Months	3.40
Other Professionals Academic Months	0.00
Other Professionals Summer Months	0.00
Other Professionals Amount	$28,888
Graduate Students	
Graduate Students Count	0.00
Graduate Students Amount	$0
Undergraduate Students	

Undergraduate Students Count	0.00
Undergraduate Students Amount	$0
Secretarial - Clerical	
Secretarial - Clerical Count	0.00
Secretarial - Clerical Amount	$0
Other	
Other Count	0.00
Other Amount	$0
Total Salaries and Wages (A+B)	$33,548
C. Fringe Benefits	$13,291
Total Salaries, Wages, Fringe Benefits (A + B + C)	$46,839
D. Equipment	$0
E. Travel	
Domestic	$0
International	$0
F. Participant Support Costs	
Participant Support Costs Stipends	$3,750
Participant Support Costs Travel	$3,236
Participant Support Costs Subsistence	$3,600
Participant Support Costs Other	$0
Total Number of Participants	200.00
Total Participant Costs (F)	$10,586
G. Other Direct Costs	
Materials Supplies	$9,350
Publication Costs	$0
Consultant Services	$0
Computer Services	$0
Subawards	$0
Other	$6,950
Total Other Direct Costs (G)	$16,300
H. Total Direct Costs (A Through G)	**$73,725**
I. Indirect Costs*	**$25,256**
J. Total Direct and Indirect Costs (H + I)	$98,981
K. Fees	$0
L. Total Amount of Request (J) OR (J + K)	**$98,981**
M. Cost Sharing Proposed Level	$0

EXHIBIT H

REDACTED

---------- Forwarded message ---------
From: **NSF Grants** <grants005@nsf.gov>
Date: Fri, Apr 18, 2025 at 12:27 'a0PM
Subject: Notice from National Science Foundation
To: arford@berkeley.edu <arford@berkeley.edu>
Cc: spoawards@berkeley.edu <spoawards@berkeley.edu>

U.S. National Science Foundation Division of Grants and Agreements
2415 Eisenhower Avenue
Alexandria, Virginia 22314
(703) 292-8210

04/18/2025

Angela R. Ford
Executive Director
University of California-Berkeley
arford@berkeley.edu

Dear Angela R. Ford:

The U.S. National Science Foundation (NSF) has undertaken a review of its award portfolio. Each award was carefully and individually reviewed, and the agency has determined that termination of certain awards is necessary because they are not in alignment with current NSF priorities.

Effective immediately, the following are terminated:

NSF Award Id
2243822
2315277
2314075
2314435

NSF is issuing this termination to protect the interests of the government pursuant to NSF Grant General Conditions (GC-1) term and condition entitled 'Termination and Enforcement,' on the basis that they no longer effectuate the program goals or agency priorities. This is the final agency decision and not subject to appeal.

Costs incurred as a result of this termination may be reimbursed, provided such costs would otherwise be allowable under the terms of the award and the governing cost principles. In accordance with your award terms and conditions, you have 30 days from the termination date to furnish a summary of progress under the award and an itemized accounting of allowable costs incurred prior to the termination date.

Sincerely,

Jamie H. French, Division Director
Office of Budget Finance and Award Management (BFA)
Division of Grants and Agreements (DGA)

REDACTED

--
Jedda Foreman (she/her)
Director, Center for Environmental Learning
Lawrence Hall of Science, UC Berkeley

The Lawrence Hall of Science is on the territory of xučyun, the ancestral and unceded land of the Chochenyo-speaking Ohlone people.

EXHIBIT I

REDACTED

---------- Forwarded message ---------
From: **NSF Grants** <grants005@nsf.gov>
Date: Fri, Apr 25, 2025 at 8:50 'a0AM
Subject: Notice from National Science Foundation
To: arford@berkeley.edu <arford@berkeley.edu>
Cc: spoawards@berkeley.edu <spoawards@berkeley.edu>

U.S. National Science Foundation Division of Grants and Agreements
2415 Eisenhower Avenue
Alexandria, Virginia 22314
(703) 292-8210

04/25/2025

Angela R. Ford
Executive Director
University of California-Berkeley

arford@berkeley.edu

Dear Angela R. Ford:

The U.S. National Science Foundation (NSF) has undertaken a review of its award portfolio. Each award was carefully and individually reviewed, and the agency has determined that termination of certain awards is necessary because they are not in alignment with current NSF priorites.

Effective immediately, the following are terminated:

NSF Award Id
2420364
2413236
2115614
2427457
2227705
2241576
2241805

NSF is issuing this termination to protect the interests of the government pursuant to NSF Grant General Conditions (GC-1) term and condition entitled 'Termination and Enforcement,' on the basis that they no longer effectuate the program goals or agency priorities. This is the final agency decision and not subject to appeal.

Costs incurred as a result of this termination may be reimbursed, provided such costs would otherwise be allowable under the terms of the award and the governing cost principles. In accordance with your award terms and conditions, you have 30 days from the termination date to furnish a summary of progress under the award and an itemized accounting of allowable costs incurred prior to the termination date.

Sincerely,

Jamie H. French, Division Director
Office of Budget Finance and Award Management (BFA)
Division of Grants and Agreements (DGA)

--
Jedda Foreman (she/her)
Director, Center for Environmental Learning
Lawrence Hall of Science, UC Berkeley

The Lawrence Hall of Science is on the territory of xučyun, the ancestral and unceded land of the Chochenyo-speaking Ohlone people.

EXHIBIT J

REDACTED

---------- Forwarded message ---------
From: **Ari Krakowski** <akrakowski@berkeley.edu>
Date: Fri, Apr 25, 2025 at 10:31 'a0AM
Subject: Fwd: Re. Award 2241805
To: Jedda Foreman <jforeman@berkeley.edu>, Rena Dorph <rdorph@berkeley.edu>, Claudia Andrea Bustos <claudia.bustos@berkeley.edu>

Here's the official communication.

---------- Forwarded message ---------
From: **Lyons, Leilah B.** <llyons@nsf.gov>
Date: Fri, Apr 25, 2025 at 11:06 'a0AM
Subject: Re. Award 2241805
To: akrakowski@berkeley.edu <akrakowski@berkeley.edu>

Hello Dr. Krakowski,

I am given to understand you and/or your SRO received the news this morning that the following award has been terminated:

Award ID Award Title

2241805 Supporting Rightful Presence in Museum Spaces: Youth as Participatory Designers of Indigenous Mixed Reality Science Exhibits

I understand that this is distressing news. These types of grant actions are not common, and I have not yet been trained on how to manage them, so in interim I will point you towards current policy guides.

Our existing proposal and awards policies and procedures guide (PAPPG) has this to say about terminations:

https://www.nsf.gov/policies/pappg/24-1/ch-12-disputes-misconduct#a-suspension-and-termination-procedures-ca9

I am given to understand the letter you were sent said that there was no appeals process, in contradiction to the PAPPG, which outlines an appeal process (https://www.nsf.gov/policies/pappg/24-1/ch-12-disputes-misconduct#ch12A4), and states that any appeal must be received by NSF within 30 days of the termination notice. As I was not trained on this, I cannot give any advice about following the PAPPG process to submit an appeal of the cancellation within 30 days – you now have as much information as I do. I am not a lawyer, and have no authority to attempt to interpret these conflicting sources of guidance.

With regards to shutting down award activity, this is covered in the PAPPG and in standard statutes (https://www.ecfr.gov/current/title-2/subtitle-A/chapter-II/part-200/subpart-E/subject-group-ECFRed1f39f9b3d4e72/section-200.472).

If you have any questions, please give me a call at 734-274-1412.

Best regards,

-Leilah Lyons

--

Jedda Foreman (she/her)
Director, Center for Environmental Learning
Lawrence Hall of Science, UC Berkeley

The Lawrence Hall of Science is on the territory of xučyun, the ancestral and unceded land of the Chochenyo-speaking Ohlone people.

Erwin Chemerinsky (*pro hac vice* forthcoming)
echemerinsky@law.berkeley.edu
Claudia Polsky (CA Bar No. 185505)
cpolsky@law.berkeley.edu
U.C. BERKELEY SCHOOL OF LAW
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Berkeley, CA 94720-7200
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Elizabeth J. Cabraser (CA Bar No. 83151)
ecabraser@lchb.com
Richard M. Heimann (CA Bar No. 63607)
rheimann@lchb.com
LIEFF CABRASER HEIMANN & BERNSTEIN, LLP
275 Battery Street, 29th Floor
San Francisco, CA 94111
Telephone: 415.956.1000

Anthony P. Schoenberg (CA Bar No. 203714)
tschoenberg@fbm.com
FARELLA BRAUN + MARTEL LLP
One Bush Street, Suite 900
San Francisco, CA 94104
Telephone: 415. 954.4400

Attorneys for Plaintiffs and the Proposed Class
[Additional counsel listed on signature page]

UNITED STATES DISTRICT COURT

NORTHERN DISTRICT OF CALIFORNIA

NEETA THAKUR, KEN ALEX, NELL GREEN NYLEN, ROBERT HIRST, CHRISTINE PHILLIOU, and JEDDA FOREMAN, on behalf of themselves and all others similarly situated,

Plaintiffs,

v.

DONALD J. TRUMP, in his official capacity as President of the United States; DEPARTMENT OF GOVERNMENT EFFICIENCY ("DOGE"); AMY GLEASON, in her official capacity as Acting Administrator of the Department of Government Efficiency; NATIONAL SCIENCE FOUNDATION;

[*caption cont'd next page*]

Case No. 3:25-cv-04737-RL

DECLARATION OF ROBERT H. HIRST

The Honorable Rita F. Lin

BRIAN STONE, in his official capacity as Acting Director of the National Science Foundation;
NATIONAL ENDOWMENT FOR THE HUMANITIES;
MICHAEL MCDONALD, in his official capacity as Acting Chairman of the National Endowment for the Humanities;
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY;
LEE ZELDIN, in his official capacity as Administrator of the U.S. Environmental Protection Agency;
UNITED STATES DEPARTMENT OF AGRICULTURE;
BROOKE ROLLINS, in her official capacity as Secretary of the U.S. Department of Agriculture;
AMERICORPS (a.k.a. the CORPORATION FOR NATIONAL AND COMMUNITY SERVICE);
JENNIFER BASTRESS TAHMASEBI, in her official capacity as Interim Agency Head of AmeriCorps;
UNITED STATES DEPARTMENT OF DEFENSE;
PETE HEGSETH, in his official capacity as Secretary of the U.S. Department of Defense;
UNITED STATES DEPARTMENT OF EDUCATION;
LINDA MCMAHON, in her official capacity as Secretary of the U.S. Department of Education;
UNITED STATES DEPARTMENT OF ENERGY;
CHRIS WRIGHT, in his official capacity as Secretary of Energy;
UNITED STATES DEPARTMENT OF HEALTH AND HUMAN SERVICES;
ROBERT F. KENNEDY, JR., in his official capacity as Secretary of the U.S. Department of Health and Human Services;
UNITED STATES CENTERS FOR DISEASE CONTROL;
MATTHEW BUZZELLI, in his official capacity as Acting Director of the Centers for Disease Control;
UNITED STATES FOOD AND DRUG ADMINISTRATION;
MARTIN A. MAKARY, in his official capacity as Commissioner of the Food and Drug Administration;
UNITED STATES NATIONAL INSTITUTES OF HEALTH;
JAYANTA BHATTACHARYA, in his official capacity as Director of the National Institutes of

Health;
INSTITUTE OF MUSEUM AND LIBRARY SERVICES;
KEITH SONDERLING, in his official capacity as Acting Director of the Institute of Museum and Library Services;
UNITED STATES DEPARTMENT OF THE INTERIOR;
DOUG BURGUM, in his official capacity as Secretary of the Interior;
UNITED STATES DEPARTMENT OF STATE;
MARCO RUBIO, in his official capacity as Secretary of the U.S. Department of State;
DEPARTMENT OF TRANSPORTATION;
SEAN DUFFY, in his official capacity as Secretary for the U.S. Department of Transportation,

Defendants.

DECLARATION OF ROBERT H. HIRST

I, Robert H. Hirst, declare as follows:

1. I have personal knowledge of the facts contained in this declaration and, if called as a witness, could and would testify competently to those facts.

2. I am the curator of the Mark Twain Papers and general editor of the Mark Twain Project at the Bancroft Library at the University of California, Berkeley. I have served in this role since 1980. From 1997 through 2013 I also served as an adjunct professor within the university's English department, usually teaching one course a year.

3. I am a graduate of Harvard University and hold an M.A. and a Ph. D in American Literature from the University of California, Berkeley. As a graduate student I began work on the Mark Twain Papers in 1967 and, as noted, assumed the positions of curator and general editor in 1980.

4. The Project has received numerous awards for its work. These include the John Tuckey Lifetime Achievement Award for Contributions to Mark Twain Studies from Elmira College, and two prizes conferred by the Modern Language Association: the Morton N. Cohen Award for a Distinguished Edition of Letters, and the Prize for a Distinguished Scholarly Edition (both for *Mark Twain's Letters, Volume 6* and *Roughing It*).

5. A true and correct copy of my curriculum vitae is attached as Exhibit A.

The Mark Twain Papers

6. A clear consensus among 20th Century American writers is that Samuel Langhorne Clemens (Mark Twain) was one of the most important writers of the previous century. *Adventures of Huckleberry Finn* is told entirely in the voice of a fourteen-year-old illiterate white boy with a "sound heart and a deformed conscience." It simply revolutionized the way novelists could tell their stories. Hemingway's famous remark says it clearly: "All modern American literature comes from one book by Mark Twain called *Huckleberry Finn.* . . . All American writing comes from that. There was nothing before. There has been nothing as good since."

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7. Mark Twain wrote a great deal besides *Huck Finn*, left a vast amount of documentation behind, and has continued to be of real interest to modern readers around the world, not just in America. For example, the first volume of his *Autobiography* sold more than half a million copies when it was published in 2010, one hundred years after his death, and was on the New York Times bestsellers list for 14 weeks. Publishers around the world were willing to pay substantial fees for the right to translate it into Chinese, Japanese, German, French, Italian, Russian, and Czech.

8. The Mark Twain Papers contain the voluminous private papers of Clemens. Before his death in 1910, Clemens passed these documents to his official biographer, who published sparingly from them until his own death in 1937. Several successive editors served as literary executors for Clemens's estate and custodians of the Papers. After stays at Harvard and the Huntington Library, these documents by and about Mark Twain—the core of the collection—were ultimately deposited in the General Library of the University of California, Berkeley, in 1949. They were officially bequeathed to the University of California in 1962 upon the death of Mark Twain's sole surviving daughter, Clara Clemens Samossoud. In 1971, the Papers became part of the Bancroft Library. The copyright on those papers remained the property of her estate but, in 1962, the University of California signed a contract with the Mark Twain Foundation (renewed and revised in 1982) giving it the exclusive right to publish anything by Mark Twain that was still protected by copyright, for the life of the copyright, which extends through 2047.

9. Since 1949, the University of California, Berkeley, has added hundreds of original documents to that core collection: letters; literary manuscripts; a dozen scrapbooks with unique clippings of the author's newspaper work; first editions and other rare printings; photographs; and various important collateral documents, such as the diaries of Mark Twain's secretary, Isabel V. Lyon. Complementing and greatly enlarging the core archive of original documents is a working archive of photocopies and transcriptions of documents held elsewhere. This expansive working archive of documents by and about Mark Twain is available to anyone, either in person or remotely, and is being continuously supplemented and updated by editors of the Mark Twain Project, the editorial enterprise housed within the Papers.

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10. The combination of original and photocopied documents now makes it possible to read, in a single location, virtually every document in Mark Twain's hand known to survive. This collection includes the ten major literary manuscripts; some 50 notebooks kept by Clemens between 1855 and his death in 1910; approximately 14,000 letters by him, his wife, and their three daughters, with two or three new letters still found each week; more than 15,000 letters to him or his family; several hundred literary manuscripts that Mark Twain left unpublished (and often unfinished), many with his typed and revised copies of the manuscript; manuscripts ranging from mere fragments to complete drafts (including chapters Mark Twain wrote but decided to omit) for some of the books he published; and manuscripts or copies of first printings for some two thousand short works—sketches, essays, editorials, speeches, and poems; working notes, typescripts, and magazine proofs for various titles; first editions and other lifetime editions, including American, English, Australian, Canadian, and Continental European printings of his various books; about 150 books from his library, usually with marginalia; and uncounted business documents, clippings, scrapbooks, interviews, bills, receipts, contracts, photographs, and a handful of objects originally owned by him.

The Mark Twain Project

11. Housed within the Mark Twain Papers archive is the Mark Twain Project, a major editorial and publishing program of the Bancroft Library. The aim of this Project is to create, maintain, correct, and update a permanent, globally accessible resource for the life and writings of Mark Twain.

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12. The Mark Twain Project's resident editors are at work on a comprehensive scholarly edition designed to include everything of significance that Mark Twain wrote. More than 30 volumes are currently available, all published by the University of California Press. Including texts available only on the Project's website, these encompass: more than half of the literary manuscripts left unpublished by Mark Twain; a growing body of his letters: from 1853 through 1885, many with annotation; his notebooks through 1891 (two-thirds of the extant texts); collections of early fiction and journalism through 1865; and critically established texts of his major works, including *Huckleberry Finn, Tom Sawyer, A Connecticut Yankee in King Arthur's Court, The Prince and the Pauper, Roughing It, Pudd'nhead Wilson,* the "Mysterious Stranger Manuscripts," and the three-volume *Autobiography of Mark Twain*. Despite more than fifty years of intensive editorial activity, there are dozens of works, long and short, and thousands of letters still to come.

13. Since 2001, the Mark Twain Project has focused much of its effort on the Mark Twain Project Online (the "Online Project"), which is intended to make freely available *all* of the Project's edited texts—past, present, and future.

14. The Online Project launched officially on November 2, 2007, with the contents of the six volumes of *Mark Twain's Letters* and *Huckleberry Finn*. In April 2022, the NEH awarded the Mark Twain Project a Challenge Grant (CHA-286607-23) for the redesign and rebuild of its digital infrastructure. The four-year term of this grant, first funded on September 14, 2023, will allow the Mark Twain Project to migrate from its existing online website platform and database to a modern and technologically supportable platform. In the fifteen years since it was created, the existing digital infrastructure has become obsolete, and the University of California, Berkeley's Library IT department will soon be unable to continue its support for its old technology.

15. The Project receives approximately 150 requests per year from scholars and general readers for information and/or copies of documents by or about Mark Twain. These requests are almost always the result of readers consulting the catalogs of documents available through the Online Project. The project also receives at least 50 requests to visit and work with the Papers every year.

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16. Further, as an important facet of the Project, the editors routinely go out to speak about the collection and the edition to students of every grade, from high school through graduate school, and to a variety of other interested groups.

17. Interest in Mark Twain—stemming in significant part from what editorial work has revealed about the author—has grown steadily since I became general editor in 1980. In his recently published biography of Mark Twain, Ron Chernow said: "Perhaps no other American author can boast such a richly documented record. . . With its learned editions and digitized website, the Mark Twain Papers ranks as one of the foremost scholarly achievements of our era."

Staffing and Other Expenses for This Research

18. In order to maintain this collection and conduct this ongoing research, the Mark Twain Papers and Project employ five full-time editors (named in paragraph 27). Catapano is primarily responsible for revising and maintaining the publishing website; Bronson-Bartlett, Driscoll, and Griffin do the editorial heavy lifting; and I also edit (currently *The Innocents Abroad*), review and approve their work, manage outreach, and raise the needed funds to pay the editors.

19. The Papers and the Project staff are housed in the Bancroft Library on the UC Berkeley campus. They occupy five offices, a conference room, a reading room, a working library, a storage room and scanning site, and a temperature and humidity-controlled vault for housing all rare and fragile materials, manuscripts, books, and other records.

Grant Funding for This Research

20. The Mark Twain Project's ambitious undertaking requires ongoing work. Financial and other crucial support has been instrumental in the development of critical editions and the Project's website—and will continue to be so.

21. The National Endowment for the Humanities ("NEH") has awarded more than $11,000,000 to support the editorial work of the Mark Twain Project, without interruption, since 1967, and has also made a generous challenge grant for the renovation of the Online Project.

Application (RQ-300297) for Grant Funding

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(415) 954-4400

22. On November 29, 2023, the Mark Twain Project, through the Regents of the University of California, submitted to the NEH an Application for Federal Domestic Assistance—application RQ-300297, entitled "Mark Twain Project"—consisting of a completed form and the following attachments: a narrative proposal, work plan, list of key personnel, resumes for key personnel, bibliography, samples, appendices, and table of past productivity (collectively, the "Grant Application"). A true and correct copy of the Grant Application is attached hereto as Exhibit B.

23. In essence, the Grant Application sought to draw the Mark Twain Project nearer to its goal of making all of Twain's works available to the public for free through the Online Project.

24. The Grant Application proposed: to publish, in print and digitally on the Online Project, critically edited texts of two large travel books: *The Innocents Abroad* and *Following the Equator*.

25. The Grant Application also proposed adding to the online platform a digital edition based on the three printed volumes of *Mark Twain's Notebooks & Journals*, with high-resolution digital facsimiles of all notebook pages accompanying the fully annotated transcription. In its most recent grant term of 2022 through 2024, the Mark Twain Project completed the online publication of all seventeen of the previously published volumes in "The Works of Mark Twain" and "Mark Twain Papers" series, save only these three volumes of Notebooks. Thus, the Grant Application sought to complete the free online publication of all the Project's scholarly editions to date.

26. Lastly, the Grant Application proposed to publish on the Online Project the edited texts of 586 letters written by Mark Twain in 1886, 1887, and 1888, and full annotation for 308 letters written in 1878, the texts of which are already available there.

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27. The Grant Application proposed a cumulative budget of $900,000.00, including $450,000 in NEH funds. This budget would fund roughly half the salaries for four project-personnel: Blake Bronson-Bartlett, an Associate Editor at the Mark Twain Project; Terence H. Catapano, Digital Publications Manager at the Mark Twain Project; Kerry Driscoll, an Associate Editor at the Mark Twain Project; Benjamin Griffin, an Associate Editor at the Mark Twain Project; for the period from October 2024 through September 2027. The other half of the staff salaries for this three-year period—approximately $1 million—would need to be paid by private funds raised by me.

Award of Grant (RQ-300297) Funding

28. On August 28, 2024, the University of California, Berkeley received a letter from the chair of the NEH, approving the Mark Twain Projection application RQ-300297 to receive an offer for funding ("Offer Letter"). A true and correct copy of this Offer Letter is attached hereto as Exhibit C.

29. The Offer Letter provided the University of California, Berkeley, up to $450,000 in federal matching funds subject to two conditions: (a) we had to raise an equal amount of eligible non-federal, third-party gifts, and certify their availability, or forward them to NEH by June 30, 2027; and (b) NEH's Division of Research Programs had to have available to it sufficient funds allocated for matching purposes.

30. The Offer Letter provided, "If you wish to accept this offer of support, your response to the above condition(s) and the Gift Certification Form must be submitted via eGMS Reach, NEH's online electronic grant management system no later than June 30, 2027."

31. Finally, the Offer Letter stated, "This 'offer' letter does not constitute an award. It formally communicates the level of funding recommended for the project and the conditions that must be met before an award will be issued by NEH."

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32. When the Offer Letter arrived in August, I had already raised $450,000 in matchable gifts, and on October 31, 2024, Sabina Gafarova from the university's Sponsored Projects Office ("SPO") accepted the NEH offer and sent it the required certification, signed by me, the Principal Investigator (PI). A true and correct copy of the certification provided to NEH is attached as Exhibit D.

Termination of Grant (RQ-300297) Funding

33. On April 2, 2025, the University of California, Berkeley, received an email from the address "Grant_Notifications@nehemail.onmicrosoft.com," purporting to be Michael McDonald, Acting Chairman for the National Endowment for the Humanities (the "Termination Email"). This is not, to my knowledge, an e-mail domain that NEH has ever used to communicate with me for any reason. A true and correct copy of this email can be found at page 7 of **Exhibit E**, further referenced below.

34. Attached to the Termination Email was a letter from Michael McDonald, Acting Chairman for the National Endowment for the Humanities, cancelling the Mark Twain Project's grant, Award No. RQ-300297-25, in its entirety effective April 2, 2025 (the "Termination Letter"). A true and correct copy of this letter is attached hereto as Exhibit F.

35. The Termination Letter reads in relevant part:

> Your grant no longer effectuates the agency's needs and priorities and conditions of the Grant Agreement and is subject to termination due to several reasonable causes, as outlined in *2CFR§200.340.* NEH has reasonable cause to terminate your grant in light of the fact that the NEH is repurposing its funding allocations in a new direction in furtherance of the President's agenda. The President's February 19, 2025 executive order mandates that the NEH eliminate all non-statutorily required activities and functions. *See Commencing the Reduction of the Federal Bureaucracy*, E.O. 14217 (Feb. 19, 2025). Your grant's immediate termination is necessary to safeguard the interests of the federal government, including its fiscal priorities. The termination of your grant represents an urgent priority for the administration, and due to exceptional circumstances, adherence to the traditional notification process is not possible. Therefore, the NEH hereby terminates your grant in its entirety effective April 1, 2025.

See Exh. F.

36. After reviewing this letter, I searched for the Mark Twain Project's grant on eGMS Reach, NEH's online electronic grant management system. I could find no record of the grant or our several communications about it on eGMS Reach. It had apparently been deleted entirely from the system.

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37. The fact that the grant was no longer available in the eGMS system was unprecedented and disturbing. NEH requires that all communications back and forth about a current grant use eGMS. So once an Offer Letter is sent, communications about that offer go through eGMS and are essentially permanent, and available to return to for review. But in early April, when I learned of the cancellation, I went to see what had been said on eGMS about it. I had previously used eGMS to communicate with NEH about it but, as noted, found that it was no longer listed among the various grants we had received over the years. The normal way to consult communications about a particular grant would be to click it and let the system take you to various options, like "Messages." So, because there was no longer any listing of RQ-300297, I could not access previous exchanges about it. This removal of communications between me and NEH is unique in my 40-year experience with the agency and, I would say, is contrary to its own purposes in insisting on our using eGMS, i.e., to have a permanent record of what was said and by whom about the entire grant, from start to finish.

38. On April 8, 2025, I received an email from Jason Boffetti, our longtime program officer at NEH, inviting me to speak with him by phone. We subsequently spoke and he explained that he was "still there" (i.e. employed) while most NEH staff were gone. He told me that NEH had been informed by DOGE that the agency must fire most of its staff if it wanted to continue to operate – perhaps up to 75% of its employees. He told me in an email several weeks later that there was nothing he could do about the cancelled grant and inquired if I had submitted an appeal of the cancellation.

Harm Suffered from Termination of Grant (RQ-300297) Funding

39. The Mark Twain Project, its staff, and I have suffered immediate harm as a result of the cancellation of the grant, which will continue into the future.

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San Francisco, California 94104
(415) 954-4400

a. In lieu of conducting my editorial work mentioned above, I have had to refocus my time on fundraising to replace the cancelled grant funding ($450,000). While I planned to fundraise approximately $1 million from non-federal sources to pay salaries for the next three years previously covered by the grant, this cancellation increases my fundraising responsibilities by 45%. As I had not anticipated this would be required, I will need to identify additional potential donors, with great urgency, and return to donors who have already given to ask that they give more for this emergency. Typically, it takes time, months or years, to cultivate new donors or to substantially increase the gifts of existing donors. As a result, I do not know whether I can raise this additional money during the grant period or at all.

b. The financial uncertainty created by this grant cancellation significantly threatens my ability to retain the highly trained and experienced staff working on the Mark Twain Project. These individuals are among the world's experts on Mark Twain and their knowledge of the collection is irreplaceable. From my conversations with them, I have learned that two of the four staff experts are contemplating resigning in order to find positions elsewhere.

c. This is a particularly critical time for the Online Project because, as noted above, we are migrating the collection to new platforms as the existing ones have become obsolete. I do not want to lose key staff—people who have designed the renovation and are uniquely able to implement it—because they cannot count on being employed here. Because the online platform allows scholars and students from all over the world to access these original documents, any interruption or delay in this work is very harmful to the Project and to the many who regularly access or will want to access these materials in the future.

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d. In addition to what I have just described, my staff and I have begun to consider cutbacks in our work plans and goals for the year. I am concerned that we will have less ability to go out to schools and universities to share our work and introduce new audiences to the incomparable work of Mark Twain.

Appeal from Termination of Grant (RQ-300297) Funding

40. On April 30, 2025, the University of California, Berkeley submitted via email an Appeal of Termination of the Mark Twain Project Award ("Appeal Letter"). A true and correct copy of this appeal is attached hereto as Exhibit G.

41. The Appeal Letter notes that "[a]lthough no statute or regulation requires UC to exhaust any administrative appeal process, the University is filing this appeal in accordance with Sextion XIII of the General Terms and Conditions for Awards to Organizations." See Exhibit G at 2, n. 2.

42. The Appeal Letter sets forth three grounds: (I) Section 200.340 Does Not Permit Termination of the Award; (II) The General Terms and Conditions Do Not Permit Termination of the Award; and (III) This Award is Not Inconsistent with Agency Priorities. See Exhibit G at 2-4.

43. The Award of Grant Funding remains unavailable to the Mark Twain Project pending the appeal.

Role of Class Representative

44. I am ready to assume the responsibilities of serving as a class representative. I understand that I must stay informed regarding developments in the lawsuit, communicate regularly with my attorneys, and act in the best interests of the class. I have no conflicts that would prevent me from assuming this responsibility.

I declare under penalty of perjury under the laws of the State of California and the United States that the foregoing is true and correct.

Executed this 30th day of May, 2025.

Signed by:
Robert H. Hirst
2BD25FF0C7E048A...

Robert H. Hirst

Farella Braun + Martel LLP
One Bush Street, Suite 900
San Francisco, California 94104
(415) 954-4400

EXHIBIT A

CURRICULUM VITAE

CORRECTED AS OF 4 JUNE 2025, 11:23 AM

ROBERT H. HIRST

General Editor, Mark Twain Project
Curator, Mark Twain Papers
University of California
The Bancroft Library, Room 475
Berkeley, California 94720-6000
(510) 643-3560 $ FAX: (510) 642-6349 $ rhirst@library.berkeley.edu

3550 Robinson Drive
Oakland, CA 94602-4140
(510) 530-8799

$BASICS: *born,* New York, N.Y., 11 August 1941; *married,* Margaret A. Wade; *two children,* Thomas Wade Hirst (b. 5 May 1984) *and* Emma Christine Hirst (b. 3 May 1988)

1. EDUCATION

Ph.D., English, University of California, Berkeley, 1976
M.A., English, University of California, Berkeley, 1965
B.A., English, Harvard University, 1963
Public schools, Hastings-on-Hudson, N.Y., 1946B1959

2. EMPLOYMENT

General Editor, Mark Twain Project; also Head and Curator, Mark Twain Papers, The Bancroft Library, University of California, Berkeley, 1980 to the present

Adjunct professor, Department of English, University of California, Berkeley, 1996B2013[1]

Assistant professor, Department of English, UCLA, 1976B79

Principal editor, Senior editor, Editor, and Editorial assistant, Mark Twain Papers, The Bancroft Library, under Frederick Anderson, 1966B76, with a few interruptions

Instructor for Henry Nash Smith, Arts & Sciences 104x (AThe Theme of the Self in American Literature@), University of California, Berkeley, 1970B71

Teaching assistant, Department of English, University of California, Berkeley, 1964B1966

3. TEACHING

Second Reader for Bailey Strelow, AThe Reporter Gets a Name: Samuel Clemens in Nevada and th Emergence of >Mark Twain,=@ English H195, May 2015, Professor Katherine Snyder

Second Reader for Alex Parry,@God and the Machine: The Legal Theology and Narrative Structure of Mark Twain,@ English 195H, May 2013, Professor Eric Falci

[1]My primary appointment is Research Literary Editor, 100% time, last reviewed and promoted to Step 7 in 2008. My secondary appointment was AAdjunct Professor, on a without salary basis in the Department of English.@ With three exceptions (1999, 2006, and 2011) I taught one course a year since 1996; I resigned this position after the Spring 2013 semester.

English 150 and English 190 (AMark Twain@), research seminars for juniors and seniors, Department of English, University of California, Berkeley: Fall 1998, Spring 2000, 2001, 2002, 2003, 2004, 2005, 2007, 2008, 2009, 2010, 2012, and 2013

English 250 (AEditing Mark Twain: Theory and Practice@), a graduate seminar, Department of English, University of California, Berkeley, Fall 1997

English 250 (AMark Twain: Text and Context@), a graduate seminar, Department of English, University of California, Berkeley, Spring 1996

Second reader for Joseph Di Prisco, AMark Twain=s Art of Doing Business: Commerciality and Form in the 1890s,@ Ph.D. diss., Department of English, University of California at Berkeley, filed 28 October 1985 [When I learned that my signature did not Acount@as a reader, I declined to read any more dissertations, with one exception, below.]

Second reader for Jay E. Gillette, AMark Twain=s Literary Production: the Writer at Work, 1876B1885,@ Ph.D. diss., Department of English, University of California at Berkeley, filed 23 April 1985

English 151 (AMark Twain@), a seminar for seniors, Department of English, University of California, Berkeley, Spring 1981

Various undergraduate and graduate courses in 19th-century American literature and especially on Mark Twain, Department of English, UCLA, 1976B79

See also below, section **10.**

4. FELLOWSHIPS

Regents= Junior Faculty Fellowship, UCLA, 1978B79

Regents= Graduate Fellowship, 1969B70

Woodrow Wilson Fellowship, 1963B64

5. GRANTS AND ENDOWMENTS

$As Principal Investigator for the Mark Twain Project since 1980, I have applied for, received, and managed the following twenty-three (23) grants from the National Endowment for the Humanities (NEH). The amounts listed here include outright and federal matching funds from NEH, as well as the private (nonstate, nonfederal) funds raised by the Project and matched by NEH as part of these grants. All grants were made in support of a professional staff numbering between five and eight editors, who have been at work on a comprehensive scholarly edition of Mark Twain=s writings since 1967.

2025–28	$900,000	1995B98 $696,442
2021–24	$900,000	1993B95: $760,000
2020–21	$300,000	1992B93: $390,000
2018–20	$1,050,000	1990B92: $740,000
2016B18:	$1,050,000	1988B90: $640,000
2014B16:	$700,000	1986B88: $900,318
2012B14:	$700,000	1984B86: $596,000
2010B12:	$600,000	1982B84: $700,262
2008B10:	$600,000	1980B82: $500,000

2006B08:	$1,100,000
2003B06:	$900,000
2001B03:	$310,000
1999B01:	$736,000
1998B99:	$420,000

TOTAL: $16,189,022

$Since about 2,003, the Project has, with the help of Bancroft Library administration, UC Library Development office, and the Mark Twain Luncheon Club, been able to raise not just the Amatch@ for the then current NEH grant, but also funds for the long haul. In the last fifteen years I have been present at the creation of four (4) endowments or funds functioning as endowments. I did not solicit these gifts and do not claim responsibility for them. At the end of fiscal year 2024 these endowments had a market value of **$3,032,167** and were yielding spendable, annual income of about **$96,000**. At the start of the current NEH grant period (October 2024) the Project had available for all expenses, including the next NEH matching offer, somewhat more than **$450,000,** *not counting* the market value of the four endowments, from four sources: interest, gifts, grants, and royaltiesCby far the most secure financially it has ever been. And this year the Project has just received from the U.S. Mint a payment of **$427,937** which is its share of the proceeds from the sale of two commemorative coins dedicated to Mark Twain. Some of these funds are being used for matching NEH grants, but most are ineligible for matching and are spent providing major supplements to NEH grants, i.e., funds neither matched nor provided by NEH. Likewise, after 2010, the Project earned more than **$1,000,000** in royalties from the *Autobiography.*

6. Awards and Prizes to the Mark Twain Project

In June 2018 the Project received $427,937 from the U.S. Mint as its share of the proceeds from the 2016 sale of two Mark Twain gold and silver coins, the result of the Mark Twain Commemorative Coin Act of December 4, 2012, public law 112-201, which named four Mark Twain institutions as equal beneficiaries: Mark Twain Boyhood Home and Museum in Hannibal, Mo; Elmira College, Elmira, N.Y.; Mark Twain House and Museum, Hartford, Conn.; and Mark Twain Project at UC Berkeley.

In September 2015 the National Endowment for the Humanities listed the Mark Twain Project as one among A50 NEH-supported grant projects@ it chose to highlight on a website <https://www.neh.gov/50> celebrating the Endowment=s 50th anniversary.

The John Tuckey Award in recognition of lifetime achievements and contributions to Mark Twain Studies, 2 August 2013, presented to Robert H. Hirst by Elmira College at the 7th International Conference on the State of Mark Twain Studies, Elmira, N.Y.

Our web site, MARKTWAINPROJECT.ORG, was honored in 2011 by the American Library Association as among free websites it designated ABest of Reference.@

Mark Twain=s Autobiography, volume 1, received in 2010 the AAward for Excellence in the Humanities@ from the American Publishers Awards for Professional and Scholarly Excellence.

Honorary D. Litt. to Robert H. Hirst, General Editor, Mark Twain Project, from Elmira College, 6 June 2010.

Mark Twain Circle of America, 23 May 2008, the Thomas A. Tenney Award presented to ARobert H. Hirst, General Editor, The Mark Twain Project and his Staff in appreciation of their outstanding service to the field of Mark Twain studies by their ongoing preparation of authoritative, state-of-the-art editions of Mark Twain=s literary works and papers.@

Designated by the National Endowment for the Humanities, in August 2006 with its two-year grant of $100,000 outright and $500,000 matching, a AWe the People@ project, honored Afor promoting knowledge and understanding of American history and culture.@

Modern Language Association=s Morton N. Cohen Award for a Distinguished Edition of Letters, awarded in December 2003 to the Mark Twain Project=s 2002 edition *Mark Twain=s Letters, Volume 6: 1874B1875,* edited by Michael B. Frank and Harriet Elinor Smith. The volume is listed below under section **7.**

Winner, Division 2 (Moderately Expensive), the year 2000 Katharine Kyes Leab and Daniel J. Leab *American Book Prices Current* Exhibition Catalogue Award for Excellence, presented 9 July 2000 at the Chicago meeting of the Rare Book and Manuscripts Section of the Association of College and Research Libraries, American Library Association, for *Mark Twain at Large: His Travels Here and Abroad,* prepared for an exhibition from the Mark Twain Papers of The Bancroft Library, University of California, Berkeley, 25 September to 11 December 1998. Curators and authors of the catalog and exhibition: Lin Salamo, Harriet Elinor Smith, and Robert Pack Browning of the Mark Twain Project. Designer: Mary Scott of Library Graphics.

Modern Language Association Prize for a Distinguished Scholarly Edition, awarded in December 1995 to the Mark Twain Project=s 1993 edition of *Roughing It,* edited by Harriet Elinor Smith and Edgar Marquess Branch, and associate editors Lin Salamo and Robert Pack Browning. The volume is listed below under section **7.**

The Mark Twain Circle of America, on 2 June 1994, ACertificate of Merit@ to Robert H. Hirst and the Mark Twain Project.

All of the books listed under section **7.** appeared in the Mark Twain Papers, Works of Mark Twain, Mark Twain Library, or Jumping Frogs series.[2] Except

[2]The *Mark Twain Papers* series is for texts and documents that Mark Twain did *not* publish, or in some cases *intend* to publish (letters, notebooks, literary manuscripts, the autobiographical dictations). The *Works of Mark Twain*

for the latter series (which publishes accurate texts but not critical editions), all but one (*Mark Twain=s Satires & Burlesques,* 1967) were examined by the MLA=s Committee on Scholarly Editions (CSE) or its Center for Editions of American Authors (CEAA) and awarded its AApproved Edition@ or AApproved Text@ seal, as appropriate.

7. PUBLICATIONS (PRINTED, MICROFORM, AND DIGITAL)

PAS GENERAL EDITOR:

Pudd'nhead Wilson Manuscript and Revised Versions with "Those Extraordinary Twins." Edited by Benjamin Griffin. Works of Mark Twain, 2024.

Autobiography of Mark Twain, Volume 3. Edited by Benjamin Griffin and Harriet Elinor Smith, with Associate editors Victor Fischer, Michael B. Frank, Amanda Gagel, Sharon K. Goetz, Leslie Diane Myrick, and Christopher Ohge. Mark Twain Papers, 2015. Published simultaneously in print and electronically on Mark Twain Project Online, which is open access.

A Family Sketch and Other Private Writings by Mark Twain, Livy Clemens, and Susy Clemens. Edited by Benjamin Griffin of the Mark Twain Project. Jumping Frogs Series, 2014.

Autobiography of Mark Twain, Volume 2. Edited by Benjamin Griffin and Harriet Elinor Smith, with Associate editors Victor Fischer, Michael B. Frank, Sharon K. Goetz, and Leslie Diane Myrick. Mark Twain Papers, 2013. Published simultaneously in print and electronically on Mark Twain Project Online, which is open access.

Autobiography of Mark Twain, Volume 1. Edited by Harriet Elinor Smith, with Associate editors Benjamin Griffin, Victor Fischer, Michael B. Frank, Sharon K. Goetz, and Leslie Diane Myrick. Mark Twain Papers, 2010. Published simultaneously in print and electronically on Mark Twain Project Online, which is open access.

Letters Newly Published, Part 1. Edited by the Mark Twain Project. Published only on Mark Twain Project Online, 2010.

Mark Twain=s Book of Animals. Edited by Shelley Fisher Fishkin. Text established by the Mark Twain Project. Jumping Frogs Series, 2009.

Mark Twain=s Letters, 1876B1880. Edited by the Mark Twain Project. Published only electronically in Mark Twain Project Online, 2007.

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series publishes critical editions of writings, long and short, which Mark Twain did publish, whether or not he ever collected them into books. And the *Mark Twain Library* series REPRINTS edited texts from both the *Papers* and *Works* seriesCcorrected as necessary, and absent technical annotation, but sometimes with extensive new explanatory notes or other additions. A fourth series recently begun, *Jumping Frogs: Undiscovered, Rediscovered, and Celebrated Writings of Mark Twain,* is designed to publish gift books containing carefully established texts without scholarly apparatus. All printed titles in these four series are published by the University of California Press in Berkeley, Los Angeles, and London. Microfilm editions and digital catalogs are published by the Mark Twain Project, The Bancroft Library, University of California, Berkeley.

Mark Twain Project Online, Beta version: http://www.marktwainproject.org. University of California Press, California Digital Library, and the Mark Twain Project: 23 October 2007. Edited by Anh Q. Bui, Victor Fischer, Michael B. Frank, Sharon K. Goetz, Benjamin Griffin, Robert H. Hirst, Andrea Laue, Leslie Myrick, Lin Salamo, and Harriet Elinor Smith.

Mark Twain=s Helpful Hints for Good Living: A Handbook for the Damned Human Race. Edited by Lin Salamo, Victor Fischer, and Michael B. Frank. Jumping Frogs Series, 2004.

Is He Dead? A Comedy in Three Acts by Mark Twain. Edited by Shelley Fisher Fishkin. Text established by the Mark Twain Project. Illustrations by Barry Moser. Jumping Frogs Series, 2003.

Adventures of Huckleberry Finn. Edited by Victor Fischer and Lin Salamo. Works of Mark Twain, *revised edition,* 2003.

Mark Twain=s Letters, 1876B1880: An Electronic Edition. Edited by the Mark Twain Project. Berkeley: The Bancroft Library, 2003. Available online via <ebrary.com> and <www.ucpress.edu>.

Mark Twain=s Letters, Volume 6: 1874B1875. Edited by Michael B. Frank and Harriet Elinor Smith. Mark Twain Papers, 2002.

Microfilm Edition of Mark Twain=s Literary Manuscripts Available in the Mark Twain Papers. 42 reels. Edited by Anh Quynh Bui, Victor Fischer, Michael B. Frank, Robert H. Hirst, Lin Salamo, and Harriet Elinor Smith. Berkeley: The Bancroft Library, 2001.

Microfilm Edition of Mark Twain=s Manuscript Letters Now in the Mark Twain Papers. 11 reels. Edited by Anh Quynh Bui, Victor Fischer, Michael B. Frank, Robert H. Hirst, Lin Salamo, and Harriet Elinor Smith. Berkeley: The Bancroft Library, 2001.

Microfilm Edition of Mark Twain=s Previously Unpublished Letters. 8 reels. Edited by Anh Quynh Bui, Victor Fischer, Michael B. Frank, Robert H. Hirst, Lin Salamo, and Harriet Elinor Smith. Berkeley: The Bancroft Library, 2001.

Adventures of Huckleberry Finn. Edited by Victor Fischer, Lin Salamo, Harriet Elinor Smith, and Walter Blair. Mark Twain Library, *revised edition,* 2001.

Mark Twain Papers: Index to the Microfilm. Edited by Paul Berkowitz and the Mark Twain Project. Berkeley: The Bancroft Library, 1999. <http://www.berks.com/ mtp/>

Database of Letters Written by and to Samuel L. Clemens (Mark Twain). Edited by the Mark Twain Project. Berkeley: The Bancroft Library, 1998. <http//www.lib. berkeley.edu/BANC/MTP/database/>, now part of <marktwainproject.org>

Mark Twain=s Letters, Volume 5: 1872B1873. Edited by Lin Salamo and Harriet Elinor Smith. Mark Twain Papers, 1997.

Roughing It. Edited by Harriet Elinor Smith and Edgar Marquess Branch; Associate Editors, Lin Salamo, and Robert Pack Browning. Mark Twain Library, 1996.

Mark Twain=s Letters, Volume 4: 1870B1871. Edited by Victor Fischer and Michael B. Frank; Associate Editor, Lin Salamo. Mark Twain Papers, 1995.

Roughing It. Edited by Harriet Elinor Smith and Edgar Marquess Branch; Associate Editors, Lin Salamo, and Robert Pack Browning. Volume 2. Works of Mark Twain, 1993. [N.B. This edition was designed to supersede the 1972 edition of *Roughing It,* the first volume published in the Works of Mark Twain series.]

Mark Twain=s Letters, Volume 3: 1869. Edited by Victor Fischer and Michael B. Frank; Associate Editor, Dahlia Armon. Mark Twain Papers, 1992.

Mark Twain=s Letters, Volume 2: 1867B1868. Edited by Harriet Elinor Smith and Richard Bucci; Associate Editor, Lin Salamo. Mark Twain Papers, 1990.

Huck Finn and Tom Sawyer among the Indians, and Other Unfinished Stories. Foreword and notes by Dahlia Armon and Walter Blair. Texts established by Dahlia Armon, Paul Baender, Walter Blair, William M. Gibson, and Franklin R. Rogers. Mark Twain Library, 1989.

Mark Twain=s Letters, Volume 1: 1853B1866. Edited by Edgar Marquess Branch, Michael B. Frank and Kenneth M. Sanderson; Associate Editors, Harriet Elinor Smith, Lin Salamo, and Richard Bucci. Mark Twain Papers, 1988.

Adventures of Huckleberry Finn. Edited by Walter Blair and Victor Fischer, with the assistance of Dahlia Armon and Harriet Elinor Smith. Volume 8. Works of Mark Twain, 1988.

Union Catalog of Clemens Letters. Edited by Paul Machlis. University of California Publications: Catalog and Bibliographies, Volume 1. 1986.

Adventures of Huckleberry Finn. Edited by Walter Blair and Victor Fischer. Mark Twain Library, 1985.

Adventures of Huckleberry Finn. Illustrated by Barry Moser. Foreword by Henry Nash Smith. 1985. [Reprints in photofacsimile the Pennyroyal typesetting originally published by Barry Moser, which was set from the critically established but then unpublished text produced by the Mark Twain Project.]

A Connecticut Yankee in King Arthur=s Court. Edited by Bernard L. Stein. Mark Twain Library, 1983.

The Prince and the Pauper. Foreword and notes by Victor Fischer and Michael B. Frank. Text established by Victor Fischer. Mark Twain Library, 1983.

Tom Sawyer Abroad – Tom Sawyer, Detective. Foreword and notes by John C. Gerber. Text established by Terry Firkins. Mark Twain Library, 1982.

The Adventures of Tom Sawyer. Foreword and notes by John C. Gerber. Text established by Paul Baender. Mark Twain Library, 1982.

No. 44, The Mysterious Stranger. Foreword and notes by John S. Tuckey. Text established by William M. Gibson and the staff of the Mark Twain Project. Mark Twain Library, 1982.

Early Tales & Sketches, Volume 2 (1864B1865). Edited by Edgar Marquess Branch, Robert H. Hirst, with the assistance of Harriet Elinor Smith. Volume 15:1. Works of Mark Twain, 1981.

IN PROGRESS AND FORTHCOMINGC

Mark Twain=s San Francisco Correspondence, 1865B1866. Edited by Edgar Marquess Branch, Richard Bucci, Louis J. Budd, Benjamin Griffin, and Robert H. Hirst. Works of Mark Twain, forthcoming 2028.

The Innocents Abroad, or The New Pilgrim=s Progress. Edited by Robert H. Hirst, Harriet Elinor Smith, Amanda Gagel, Christopher Ohge, and other editors of the Mark Twain Project. Works of Mark Twain, forthcoming 2026.

PAS EDITOR OR CO-EDITOR:

Who Is Mark Twain? Edited with an introduction by Robert H. Hirst. New York: Harper Studio, 2009.

Early Tales & Sketches, Volume 2 (1864B1865). Edited by Edgar Marquess Branch, Robert H. Hirst, with the assistance of Harriet Elinor Smith. Volume 15:2. Works of Mark Twain, 1981. [I was also the General Editor for this volume.]

Early Tales & Sketches, Volume 1 (1851B1864). Edited by Edgar Marquess Branch, Robert H. Hirst, with the assistance of Harriet Elinor Smith. Volume 15:1. Works of Mark Twain, 1979.

PAS EDITORIAL ASSOCIATE:

A Connecticut Yankee in King Arthur=s Court. Edited by Bernard L. Stein, with an Introduction by Henry Nash Smith. Volume 9. Works of Mark Twain, 1979.

Mark Twain=s Notebooks & Journals, Volume 1 (1855B1873). Edited by Frederick Anderson, Michael B. Frank, and Kenneth M. Sanderson. Mark Twain Papers, 1975.

Roughing It. Edited by Franklin R. Rogers and Paul Baender. Volume 2. Works of Mark Twain, 1972. [This volume was superseded by the 1993 edition of this same title, listed above.]

8. OTHER WRITINGS (ARTICLES, NOTES, REVIEWS, AND UNPUBLISHED WORK)

AThree, and Done. *Autobiography of Mark Twain, Volume 3,* to be published October 15th,@ *Bancroftiana* (Fall 2015), 146:7.

AMark Twain and Four Aliases,@ *Bancroftiana* (Fall 2014), 145:8B9.

ANew Photographs of Mark Twain,@ *Bancroftiana* (Spring 2010), 136:10.

AClass of =58 Donates $1 Million to Mark Twain Project,@ *Bancroftiana* (Spring 2009), 134: 10B11.

AMissing Maxims Returned to the Mark Twain Papers,@ *Bancroftiana* (Fall 2008), 133:11.

AMark Twain=s Autobiography: Frank and Free and Unembarrassed as a Love Letter,@ *Bancroftiana* (Spring 2008), 132:8B9.

AMark Twain Papers and Project@ in *Exploring The Bancroft Library: A Centennial Guide to Bancroft=s Extraordinary History, Spectacular Special Collections, Research Pleasures, Its Amazing Future, & How It All Works.* Edited by Charles Faulhaber and Stephen Vincent. Berkeley: The Bancroft Library and Signature Books, 2006.

AO Brave New World: Progress Report on the Mark Twain Digital Project,@ *Bancroftiana* (Spring 2006), 128:10.

AGlossary of Terms,@ with John Unsworth and Morris Eaves, in *Electronic Textual Editing*. Edited by Lou Burnard, Katherine O=Brien O=Keeffe, and John Unsworth. New York: Modern Language Association (MLA) and Text Encoding Initiative (TEI), 2006

AWhat Paine Left Out: 200 New Letters by Samuel Clemens and His Wife,@ *Bancroftiana* (Fall 2004), 125:10.

AThe Curators= Chickens Come Home to Roost: Mark Twain=s Satire on Charles A. Dana,@ *Bancroftiana* (Spring 2004), 124:11.

AMark Twain and Music.@ Compact Disk produced by Harriet Elinor Smith and the San Francisco Choral Artists, 2003. A recording of the Mark Twain Luncheon Club performance on 8 October 2003.

A>Permission to Drink Anything=: Mark Twain=s Letters to Eduard Pötzl,@ *Bancroftiana* (Fall 2002), 121:10.

AMark Twain Photo OpCDecember 21, 1908: Alvin Langdon Coburn, Mark Twain, and Isabel V. Lyon,@ with Lin Salamo, *Bancroftiana* (Spring 2002), 120:1, 4.

AAbout the Author.@ *A Murder, a Mystery, and a Marriage.* Foreword and Afterword by Roy Blount, Jr. Transcribed and emended by Robert H. Hirst, General Editor, Mark Twain Project. New York and London: W. W. Norton & Company, 2001.

ANew Mark Twain LettersCAgain,@ *Bancroftiana* (Fall 2001), 119:13.

AHome at LastCFour Manuscript Chapters of Mark Twain=s *A Tramp Abroad* Come to Bancroft,@ *Bancroftiana* (Spring 2001), 118:11, 15.

AWho Was >G. G., Chief of Ordnance=?Ca Peek at the New Edition of *Huckleberry Finn,*@ *Bancroftiana* (Fall 2000), 117:8, 11.

ANew (Old) Mark Twain Found in Bancroft Scraps,@ *Bancroftiana* (Fall 1999), 115: 10,12.

AWhere Do You *Find* Mark Twain=s Letters?@ *Bancroftiana* (Spring 1999), 114: 13.

A>Sinners & Pilgrims=: Colonel Denny=s Journal and Photo Album Give Different Version of *The Innocents Abroad,*@ *Bancroftiana* (Fall 1998), 113: 1, 6B7.

AMark Twain Project: Back from the Brink,@ *Bene Legere,* Winter 1997B98, 8.

AMark Twain Still Lives! Reports of His Death Are an Exaggeration,@ *Bene Legere,* Summer 1997, 9.

AA Note on the Text@ in each of 29 volumes in *The Oxford Mark Twain,* a photographic facsimile of the first American edition for each of Mark Twain=s principal books. General Editor, Shelley Fisher Fishkin. Oxford University Press, New York, 1996.

ANew Acquisitions to the Mark Twain Papers,@ *Bene Legere,* Summer 1996, 7

AMark Twain Exhibition at the Blackhawk Museums@ and ANew Mark Twain Letters and Manuscripts,@ *Bancroftiana* (January 1995). 108: 4B6.

AEditing Mark Twain, Hand to Hand, >Like All DCd Fool Printers,=@ *Papers of the Bibliographical Society of America* 88 (June 1994): 157B88.

AHuck Finn Manuscript,@ *Bancroftiana* (December 1992), 3B4.

AMark Twain=s Letters, Volume 3: 1869,@ *Bancroftiana* (January 1992): 3.

AHuck Finn and Tom Sawyer Go to High School,@ *Bancroftiana* (October 1989): 8.

AAnnual Meeting of the Friends, May 5th,@ *Bancroftiana* (April 1985): 10.

The Grangerford-Shepherdson Feud . . . .with an Account of Mark Twain=s Literary Use of the Bloody Encounters at Compromise, Kentucky. (With Edgar Marquess Branch). Keepsake No. 33. Berkeley: The Friends of The Bancroft Library, 1985.

ANote on the Text,@ *Adventures of Huckleberry Finn,* illustrated by Barry Moser. Foreword by Henry Nash Smith. Berkeley, Los Angeles, and London: University of California Press, 1985, 415B17.

AWilliam E. James=s Stereoscopic Views of the *Quaker City* Excursion@ (with Brandt Rowles). *Mark Twain Journal* 22 (Spring 1984): 15B33.

AThe Mark Twain Project: >The Most Significant Ongoing Editorial Enterprise in the Country,=@ *The General Library Faculty Newsletter* (October 1983): 2B3.

AMark Twain Swims the Hellespont!@ *Bancroftiana* (April 1983): 5B7.

AMark Twain Project Funding,@ *Bancroftiana* (November 1982): 11B12.

Review: *Mark Twain International: A Bibliography and Interpretation of His Worldwide Popularity,* edited and compiled by Robert P. Rodney. Westport, Conn.: Greenwood Press, 1982, in *RQ,* August 1982.

AThe Unmarked Twain,@ *California Monthly* 92 (July 1982): 15B17.

AFundraising for the Mark Twain Project,@ *Bancroftiana* (July 1981): 5B6

AWhen Is a Knight a Labrick?@ *Bancroftiana* (October 1980): 9B10.

AMark Twain Becomes a Writer,@ *Wilson Quarterly* 4 (Autumn 1980): 168B81.

ANewly Published Mark Twain,@ *Bancroftiana* (June 1980): 11B12.

A>He Trimmed & Trained & Schooled Me=: How Bret Harte Edited *The Innocents Abroad,*@ typescript of 46 pages, accepted for publication by David Erdman in January 1979 for *Bulletin of Research in the Humanities,* but never published.

Review: W. D. Howells, *A Modern Instance,* A Selected Edition of W. D. Howells, Volume 10. Edited by George N. Bennett, David J. Nordloh, and David Kleinman. Bloomington and London: Indiana University Press, 1977, in *Nineteenth-Century Fiction* 33 (March 1979): 493B98.

Review: George C. Carrington, Jr., *The Dramatic Unity of AHuckleberry Finn.*@ Columbus: Ohio State University Press, 1976; and William Searle, *The Saint and the Skeptics: Joan of Arc in the Work of Mark Twain, Anatole France, and Bernard Shaw.* Detroit: Wayne State University Press, 1976, in *Nineteenth-Century Fiction* 32 (September 1977): 241B 47.

AThe Making of *The Innocents Abroad:* 1867B1872,@ Ph.D diss., 1975, accepted in 1979 for publication by the University of Nebraska Press, but never published. Published **without my permission** in microfilm by University Microfilms International (UMI)

9. PROFESSIONAL ACTIVITIES

NEH panelist for "American and British Literature," Program for Editions and Translations, National Endowment for the Humanities, 25 March 2025

NEH panelist for AAmerican and British Literature,@ Program for Editions and Translations, National Endowment for the Humanities, 22 March 2017

NEH panelist for ALiterature,@ Program for Editions and Translations, National Endowment for the Humanities, 13 March 2013

NEH reviewer, Collaborative Research Program, AEditing Volumes I and II of The Complete Letters of Henry James,@ by Greg W. Zacharias, October 2001

Reviewer for the Social Sciences and Humanities Research Council (SSHRC) of Canada, a proposal to continue the *Collected Works of Northrop Frye,* by Professor Alvin Lee, January 2001

Advisory Board for the Charles Brockden Brown Electronic Archive and Scholarly Edition, 2001Bpresent

NEH reviewer, Division of Preservation and Access, AAmerican Documentary Heritage Library: American Renaissance Collection,@ a proposal to digitize existing volumes of ten print editions, by David R. Chesnutt, October 1999

Reader/Consultant to the University of California Press for *Robert Duncan: The Collected Early Poems and Plays,* volume one of a projected seven volumes, edited by Robert J. Bertholf: three separate and distinct reviews, all negative, in January 1993, June 1995, and February 1999

Project faculty member for ALiterature and Writing,@ an NEH sponsored summer seminar at Illinois State University, designed to encourage high-school teachers to use manuscript in teaching literature; directed by Rodger L. Tarr and Ron Fortune, 27B31 July 1998

Advisory Board and Executive Committee, Charles Sanders Peirce Edition Project, Indiana UniversityBPurdue University, Indianapolis, 1985Bpresent

Chair, Committee on Scholarly Editions (CSE) of the MLA, two terms: 1996B2000, and 2000B2001; continued as a member through 2004

Member of the Publications Committee, Bibliographical Society of America, 1995B99

Advisory Board, 1995B98, *The Oxford Reader=s Companion to Mark Twain,* edited by Gregg Camfield, forthcoming 2001

Consultant for the CSE, advising James Karman, editor of *The Collected Letters of Robinson Jeffers with Selected Letters of Una Jeffers,* to be published by Stanford University Press, 2002

Reviewer for the Social Sciences and Humanities Research Council (SSHRC) of Canada, a proposed union catalog of the correspondence of Sir Walter Scott, by Professor Jane Millgate, February 1995

NEH reviewer, Tools Program, a proposed calendar of the correspondence of Henry James, Jr., by Professor Steven H. Jobe, December 1994

Council Member, Bibliographical Society of America, two terms: 1994B1997 and 1997B2000

CSE vettor (i.e., pre-publication inspector or consultant) for each of the following:

PGeorge Santayana, *The Letters of George Santayana, Book Six, 1937B1940.* Edited by William G. Holzberger, Herman J. Saatkamp, and Marianne S. Wokeck, with Kristine Frost and Johanna Resler. The Works of George Santayana. MIT Press, forthcoming. [Inspection report submitted on 24 February 2004]

PWilliam Wordsworth, *Sonnet Series and Itinerary Poems, 1820B1845.* edited by Geoffrey Jackson. The Cornell Wordsworth. Cornell University Press, forthcoming 2004. [This is actually a post-inspection report to the CSE, which asked me to supplement the original vetting report that seemed less than satisfactory to me.]

PGeorge Santayana, *The Letters of George Santayana, Book Five, 1933B1936.* Edited by William G. Holzberger, Herman J. Saatkamp, and Marianne S. Wokeck, with Kristine Frost and Johanna Resler. The Works of George Santayana. MIT Press, forthcoming. [Inspection report submitted on 2 April 2003]

PThomas Carlyle. *On Heroes, Hero-Worship, & the Heroic in History.* Edited by Michael K. Goldberg, Joel J. Brattin, and Mark Engel. Editor-in-Chief, Murray Baumgarten. The Norman and Charlotte Strouse Edition of the

Works of Thomas Carlyle. Berkeley, Los Angeles, Oxford: University of California Press, 1993 [Inspection report submitted on 31 March 1992]

PThe Correspondence of William James, Volume 1: William and Henry, 1861B 1884. Edited by Ignas K. Skrupskelis and Elizabeth M. Berkeley, with the assistance of Bernice Grohskopf and Wilma Bradbeer. Charlottesville and London: University Press of Virginia, 1992 [Inspection report submitted on 7 December 1990]

PWilliam James. *Psychology: The Briefer Course*. Edited by Fredson Bowers and Ignas K. Skrupskelis. The Works of William James. Cambridge: Harvard University Press, 1985 [Inspection report submitted on 29 March 1984]

PWilliam James. *Principles of Psychology*. 3 volumes. Edited by Fredson Bowers and Ignas K. Skrupskelis. The Works of William James. Cambridge: Harvard University Press, 1980 [Inspection report submitted on 7 March 1979]

PJohn Dewey. *Experience and Nature*. Edited by Jo Ann Boydston. The Later Works of John Dewey. Urbana: Southern Illinois University Press, 1981 [Inspection report submitted on 5 August 1978.]

PWilliam Dean Howells. *Venetian Life*. Edited by David Nordloh. Bloomington: Indiana University Press, 1976 [Inspection report submitted on 18 October 1976]

NEH panelist, Reference Materials: Tools and Access Categories, Literature and Philosophy panel, February 1989 (27 applications)

Executive Committee on Methods of Literary Research of the MLA, 1986B90

Consultant to the Library of America, 1986B92, for Mark Twain=s *Collected Tales, Sketches, Speeches: 1852B1890* and *Collected Tales, Sketches, Speeches: 1891B1910,* selected and annotated by Louis J. Budd. New York: Literary Classics of the United States, 1992

Member, Committee on Scholarly Editions (CSE) of the MLA, one term: 1985B89

NEH panelist, Travel to Collections Program, March 1985

NEH reviewer, Editions Program, proposed edition of Nathaniel Hawthorne=s letters and later writings (Ohio State University Centenary Edition of the Works of Nathaniel Hawthorne), 7 December 1984

NEH consultant, Program for Editions, project site visit to the Charles Sanders Peirce Edition Project (Indianapolis), 1B4 August 1984

NEH reviewer, Editions Program, proposed edition of Theodore Dreiser=s *Jennie Gerhardt,* edited by James L. W. West III, 9 January 1984

NEH consultant, Editions Program, volumes 1 and 2 of *Walt Whitman=s Journalism,* edited by Herbert Bergman, 30 June 1982

Reviewer for the University of California Press of a proposed anthology, *The AScience Fiction@ of Mark Twain,* edited by David Ketterer, 24 June 1981

NEH panelist, Research Materials: Editions, March 1981 (48 applications)

NEH reviewer, Editions Program, a proposed edition of Edgar Allan Poe=s contributions to the *Broadway Journal,* in two volumes, by Burton R. Pollin, 29 December 1980

Consultant to the University of California Press on a proposed facsimile reprint of the Arion Press typesetting of *Moby-Dick,* illustrated by Barry Moser and typeset from the Northwestern/Newberry Library critical edition (in proof), 30 July 1980

Reviewer for the University of California Press of a proposed edition of Samuel Richardson=s *Clarissa,* edited by Professor Carroll, January 1979

10. SPEECHES, TALKS, LECTURES, INFORMAL PRESENTATIONS, AND INTERVIEWS

"Who Is Mark Twain?," Pacific Union-Club Luncheon discussion, San Francisco, 17 October 2023

Archival exhibit and tour for Professor Jennifer Terry's history class, "History of American Celebrity Culture," 5 October 2023

"Joan of Arc," discussion with the Mark Twain Literary Group,, Olympic Club, San Francisco, 16 February 2023

"Mark Twain's Most Important Letter," brief presentation to the Wellman Group, UC Berkeley Faculty Club, 5 November 2018

Podcast interview for Podcast Workshop sponsored by the Berkeley Advanced Media Institute in the Graduate School of Journalism, 15 June 2018

Archival exhibit and tour for Professor Shelley Fisher Fishkin=s class in American Studies from Stanford, 8 December 2017

Archival exhibit and tour for Professor Diego Pirillo=s class in Italian Studies, UC Berkeley, 9 November 2017

Discussion leader, small exhibit, and lunch with the Mark Twain Luncheon Club Book Club, *The Prince and the Pauper,* Berkeley Faculty Club, 2 November 2017

Interview about APrince Oleomargarine@ on ATop of Mind, with Julie Rose,@ BYU radio, Brigham Young University, Provo, Utah, 13 October 2017

Archival exhibit and tour (3 sections), luncheon talk with slides, for the MS Society, MTP and Berkeley City Club, 19 May 2017

Discussion leader and small exhibit, Mark Twain Luncheon Club Book Club, *Sketches New & Old,* 15 May 2017

Archival exhibit, tour, and lunch for Camilla Smith=s book group of diplomat wives, 13 January 2017

Archival exhibit and tour for Professor Shelley Fisher Fishkin=s class in American Studies from Stanford, 2 December 2016

Archival exhibit and tour for Professor Diego Pirillo=s class in Italian Studies, UC Berkeley, 21 November 2016

Discussion leader and small exhibit for he Mark Twain Luncheon Club Book Club, *The Adventures of Tom Sawyer,* 2 November 2016

Archival exhibit and tour for Charles Faulhaber and the Bohemian Club Library Committee, 31 October 2016

ATales of Archival Research and Publishing Innovation,@ with slides, The Colophon Club, Berkeley City Club, Berkeley, Calif., 16 June 2016

ASecret History of Editing the Autobiography,@ with slides, Berkeley Breakfast Club, Berkeley, Calif., 8 April 2016

Discussion leader and small exhibit for the Mark Twain Luncheon Club Book Club, *Life on the Mississippi,* 30 March 2016

Archival exhibit and tour for Charles Faulhaber and a Phi Beta Kappa group, 1 December 2015

Archival exhibit and tour for Professor Shelley Fisher Fishkin=s class in American Studies from Stanford, 13 November 2015

ASecret History of Editing the Autobiography,@ with slides, Mark Twain Luncheon Club, Berkeley, Calif., 28 October 2015

Archival exhibit, tour, and lunch for five auction winners, benefit for the Berkeley Symphony, 2 October 2015

Reading and discussionof selections from *Roughing It,* University Press Books, Berkeley, Calif., 24 September 2015

Archival exhibit and talk,English honors class, Professor Scott Saul, UC Berkeley, 15 September 2015

Archival exhibit and talk, English honors class, Professor Namwali Serpell, UC Berkeley, 8 September 2015

Interview with Canadian BC, Mark Twain=s lost *Enterprise* work newly collected, 21 May 2015

A>Better Shove This in the Stove,=@with slides, Cal Alumni Club of Rossmoor, Rossmoor, Calif., 17 January 2015

Archival exhibit and talk, English honors class, Professor Katherine Snyder, UC Berkeley, 30 September 2014

Archival exhibit and talk American literature class of Professor Mitch Breitweiser, initiated by his graduate student TA, Juliana Chow, UC Berkeley, 5 August 2014

Archival exhibit and talk for Professor Shelley Fisher Fishkin=s class of eight freshmen from Stanford University, 3 June 2014

Archival exhibit and talk, English honors class, Professor Namwali Serpell, UC Berkeley, 13 November 2013

A>If a Jay Ain=t Human=: Tales from the Mark Twain Papers,@ Glenbrook Historical Society Dinner, Glenbrook, Nevada, 11 August 2013

AMinor Mysteries from the Mark Twain Papers,@ with slides, for St. Paul=s Towers retirement home, Oakland, Calif., 29 May 2013

AInnocents DelayedCBut Not Denied,@ with slides, for the 7th International Conference on the State of Mark Twain Studies, Elmira College, Elmira, N.Y., 3 August 2013

ATales from the Mark Twain Papers,@ with slides, for The Vi in Palo Alto, Palo Alto, Calif., 21 May 2013

Archival exhibit and tour for Helen Meyer and colleagues, 9 May 2013

ANews from the Mark Twain Papers and Project,@ Class of 1958 55th Reunion Luncheon Program, Berkeley, Calif., 20 April 2013

Presentation and discussion for the English class (juniors and seniors) of Ann Marie Slevin, Holy Names High School, Oakland, Calif., 19 March 2013

AMark Twain=s Box of Posthumus Stuff: Four Decades in the Mark Twain Papers,@ Cosmos Club, 1379 Church Street, San Francisco 94114, 8 March 2013

AA Toast to Mark Twain,@ hosted by Susan and Tucker York for the UC Berkeley Library, 63 East 66th Street, New York, N. Y., 24 January 2013

Archival exhibit and talk for Camilla Smith=s book group, 29 October 2012

Archival exhibit and talk Caroline Giers=s ACulture Vultures,@ 18 October 2012

Archival exhibit and talk, English honors class, Professor Scott Saul, UC Berkeley, 20 September 2012

Brief talk at the memorial service for Professor Howard G. Baetzhold, longtime Mark Twain scholar and editor for the Mark Twain Project, Indianapolis, Ind., 8 September 2012

Archival exhibit, talk, and lunch with Mac Laetsch and Camilla Smith, for India=s Consul General, 29 August 2012

A>Better Shove This in the Stove=: Tales from the Mark Twain Papers,@ with slides, for the AWine for Words@ fund raiser for the El Dorado County Main Library, Placerville, Calif., 26 August 2012

AMark Twain in the West,@ five talks as Faculty Lecturer, Golden Gate Tours, Murphys, Grass Valley, Columbia, Calif., and Virginia City, Nevada, 12B17 August 2012

AMark Twain on Racism: Evidence from the MS of *Huckleberry Finn,* and other documents,@ lecture with extensive handout reproducing original documents for NEH sponsored ALandmarks of American History and Culture Workshop for Teachers: *Huck, Jim, and Jim Crow*,@ Mark Twain House and Home, Hartford, Conn., two (2) separate sessions, on 11 and 25 July 2012

Interview about the *Autobiography,* with WOCA, Ocala, Florida, 14 June 2012

Interview about the *Autobiography,* with Frankie Boyer, Lifestyle Talk Radio, BIZ Talk Radio, 11 June 2012

Interview about the *Autobiography,* with KCMN, Colorado Springs, Colorado, 5 June 2012

2 Interviews about the *Autobiography,* (1) WDAD, Indiana, Penn., and (2) WTAX, Springfield, Ill., 4 June 2012

2 Interviews about the *Autobiography,* with (1) WLW-AM, Cincinnati, Ohio; and (2) WGTD, Milwaukee, Wis., 30 May 23012

Interview about the *Autobiography,* with KTTH, Seattle, Wash., 29 May 2012

Interview about the *Autobiography,* with KRLD, Dallas, Texas, 25 May 2012

3 Interviews about the *Autobiography,* with (1) WTKF, Jacksonville, NC; (2) KPCW, Park City, Utah; (3) WMBW, Washington, D.C., 24 May 2012

Interview about the *Autobiography,* with WMJI, Cleveland, Ohio, 22 May 2012

2 Interviews about the *Autobiography,* (1) WHAM, Rochester, N.Y., and (2) WPHM, Detroit, Mich., 18 May 2012

Interview about the *Autobiography,* with WBAL, Baltimore, 11 May 2012

Interview about the *Autobiography,* with JoAnn Griffith, BBC, 6 May 2012

AMark Twain in His Own Words: 100 Years Later,@ with slides, read to the Saratoga Foothill Club at its 15th Annual Public Lecture Series, Saratoga, Calif., 27 March 2012

AOn *Huckleberry Finn,*@ for Richard Hutson=s C136: ATopics in American StudiesCBoys and Girls in the Era of Mark Twain and Henry James,@ Barrows 56, UC Berkeley, 8 March 2012

AGetting to Know Mark Twain,@ with slides, read for the Northern California Association of Phi Beta Kappa, Fred Far Center at Asilomar, Pacific Grove, Calif., 17 February 2012

AMark Twain and Racism: Evidence from the MS of *Huckleberry Finn,*@ Susan Lehman=s Language and Composition AP class, Novato High School, Novato, Calif., 15 February 2012

ARevealing Mark Twain=s Autobiography,@ with slides, read for the Discover Cal Lecture Series at New City Hall, Sacramento, Calif., 9 November 2011

AThe Making of Mark Twain=s Autobiography: Editing a Humorist Is No Laughing Matter,@ with slides, read for the Town and Gown Club, Berkeley, Calif., 7 November 2011

AGetting to Know Mark Twain: 44 Years in the Mark Twain Papers,@ with slides, read for the Discover Cal Lecture Series at the Hyatt La Jolla at Aventine, San Diego, Calif., 2 November 2011

AGetting to Know Mark Twain: 44 Years in the Mark Twain Papers,@ with slides, read for Homecoming and Parents Weekend 2011, Stevens Hall, UC Berkeley, 15 October 2011

A*Finding* Mark Twain=s Autobiography,@ with slides, read for The Big Read/One Book Sacramento 2011, Tsakopoulos Library Galleria, Sacramento Public Library, 29 September 2011

AWhere the Twain Meet: The Enduring Cross-Generational Appeal of *Tom Sawyer*,@ with slides, read at the Kansas City Public Library, Kansas City, Mo., 20 September 2011

AGetting to Know Mark Twain: Forty Years in the Mark Twain Papers,@ with slides, read for the Kensington Public Library, Kensington, Calif., 12 September 2011

A>Finding= Mark Twain=s Autobiography,@ informal presentation for Gardner Combs=s Dinner Party, Faculty Club, UC Berkeley, 22 September 2011

AGetting to Know Mark Twain: 44 Years in the Mark Twain Papers,@ with slides, the keynote address at AMark Twain=s Hannibal: The Clemens Conference,@ Hannibal, Mo, 13 August 2011

Informal talk, AMark Twain *Roughing It* in Tahoe,@ Schacht-Gage Home in Tahoe City, Calif., 30 July 2011

AThe Composition of *Roughing It,*@ with slides, read for AMark Twain and the Culture of Progress,@ an NEH Summer Teacher Institute, Virginia City, Nevada, 13 July 2011

ATen Minutes on Mark Twain,@ for the Wellman Group, Bowker Room of the Faculty Club, UC Berkeley, 6 June 2011

Discussion with illustrations of *Huckleberry Finn* for Judy Webb=s Book Group, Morrison Room of the UC Berkeley Library, 25 May 2011

AFinding Mark Twain=s Autobiography,@ with slides, read for the UC Berkeley Library Advisory Board, Valley Hunt Club, Pasadena, Calif., 22 May 2011

A>Finding= Mark Twain=s Autobiography (Hiding in Plain Sight),@ with slides, read to the Olympic Club=s Speaker Lunch Series, San Francisco, Calif., 15 April 2011

AMark Twain=s Autobiography? (Where Has It Been Hiding?),@ Peninsula Volunteers, Inc, 20th Annual Authors Salon Luncheon, San Jose, Calif., 10 April 2011

A>Finding= Mark Twain=s Autobiography (Hiding in Plain Sight),@ with slides, read for the Discover Cal 2011 lecture series, Hyatt Regency Newport Beach, Newport Beach, Calif., 28 March 2011

A>Finding= Mark Twain=s Autobiography (Hiding in Plain Sight),@ with slides, read for the Pacific-Union Club, San Francisco, Calif., 24 March 2011

A*Finding* Mark Twain=s Autobiography (Hiding in Plain Sight),@ with slides, read for the Osher Lifelong Learning Institute, at the Lafayette Library and Learning Center, Lafayette, Calif., 17 March 2011. Taped by C-SPAN Book TV

A*Finding* Mark Twain=s Autobiography,@ with slides, read for the Contra Costa County Historical Society and the Pittsburg Historical Society, Martinez, Calif., 12 March 2011

A>I=m the only person who has ever found out the right way to build an autobiography,@ with slides, and with McAvoy Lane as Mark Twain, for AAuthors on the Move,@ Sacramento Public Library Foundation, Sacramento, Calif., 5 March 2011

AFinding Mark Twain=s Autobiography,@ with slides, read for a meeting of the Berkeley Foundation Board, Clark Kerr Campus, Berkeley, Calif., 25 February 2011

AFINDING Mark Twain=s Autobiography,@ with slides, read for The Sages, Grove Room at Noon, The Bohemian Club, San Francisco, Calif., 22 February 2011

AEditing a Humorist Is No Laughing Matter: Finding the *Autobiography of Mark Twain*,@ with slides, read at the National Endowment for the Humanities and again in the Capitol Building, Washington, D.C., 16 February 2011

ATales from the Mark Twain Papers, Including the *Autobiography of Mark Twain,*@ with slides, read at the Hammer Museum Program in Billy Wilder theater, Los Angeles, Calif., followed by a conversation on stage with Hal Holbrook and David Kipen as moderator, 8 February 2011

ATen Minutes for the 100 Club,@ talk about the *Autobiography,* Morrison Room of the UC Library, Berkeley,Calif., 7 February 2011

Interview about the *Autobiography,* John Hockenberry and Celeste Headlee, The Takeaway, WNYC, 6 January 2011

AMark Twain: in His Own Words,@ interview by Justin Goldman, *Diablo Magazine,* November 2010

ATrue to Twain,@ interview published in *Southern Inspired Magazine,* October/November 2010, 54B57

Talk to the Bohemian Book Club, San Francisco, Calif., 7 December 2010

Interview about the *Autobiography,* McCarthy and Friends, KPVR St. Louis, Mo., 7 December 2010

Interview about the *Autobiography,* Carole Goldberg, Hartford *Courant,* Hartford, Conn., 6 December 2010

AWho Is Mark Twain? And Does the Autobiography Tell Us?,@ with slides, read for the Walnut Creek Library Foundation, Walnut Creek Library, Walnut Creek, Calif., 2 December 2010

Interview about the *Autobiography,* Diane Rhem Show, WAMU, Washington, D.C., 1 December 2010

AMark Twain=s Autobiography: A Wide-Ranging Gift to Posterity,@ with slides, read at a Smithsonian Resident Associate Program, National Museum of Natural History, Washington, D.C., 30 November 2010

2 Interviews about the *Autobiography,* 30 November 2010: (1) Susan Logue Coster, Voice of America TV, Washington, D.C.; (2) Jane Aikin, Director of the NEH Editions Program, Washington, D.C.

Interview about the *Autobiography,* AMidday with Dan Rodricks@ and Professor Hollis Robbins, WYPR, Baltimore, Maryland, 19 November 2010

Interview about the *Autobiography,* David Bianculli, NPR=s Fresh Air, 18 November 2010 (aired 1 December)

2 Interviews about the *Autobiography,* 16 November 2010: (1) Drake and Zeke, WXMX, Memphis, Tenn.; (2) Brent Cannon, NBC11

2 Interviews about the *Autobiography,* 15 November 2010: (1) Orla Barry, AThe Green Room,@ Newstalk Radio, Ireland; (2) John McChesney, NPR

A>The Final (& Right) Plan=: The Evolution of Mark Twain=s Autobiography,@ with slides, keynote address for AMark Twain at 175: An American Icon Reconsidered,@ Saint Joseph College, Hartford, Conn., 13 November 2010

A>The Final (& Right) Plan=: The Evolution of Mark Twain=s Autobiography,@ with slides, read at the Mark Twain Library, Redding, Conn., 12 November 2010

Interview about the *Autobiography,* Colin McEnroe, WNPR, Hartford, Conn., 11 November 2010

3 Interviews about the *Autobiography,* 10 November 2010: (1) Brent Martin, *Missourinet;* (2) AUp to Date With Steve Kraske,@ KCUR, Kansas City, Mo.; (3) Tony Hicks, *Contra Costa Times,* Walnut Creek, Calif.

A>The Final (& Right) Plan=: The Evolution of Mark Twain=s Autobiography,@ with slides, read at the Central Library of the Kansas City Public Library, Kansas City, Mo., 10 November 2010

AThe Only >True and Reliable= Text of the *Autobiography of Mark Twain,*@Berkeley Breakfast Club, Berkeley, Calif., 5 November 2010

AThe Only >True and Reliable= Text of the *Autobiography of Mark Twain,*@with slides, read at The Stanford Club of San Ramon, San Ramon, Calif., 2 November 2010

AThe Only >True and Reliable= Text of the *Autobiography of Mark Twain,*@ with slides, read at The Hillside Club, Berkeley, Calif., 1 November 2010

Interview about the *Autobiography,* Debra Levi Holtz, San Francisco *Chronicle,* 27 October 2010

Interview about the *Autobiography,* Jeff Glor, CBS Sunday Morning, 17 October 2010

AMark Twain, A Moralist in Disguise,@ Kobe City University of Foreign Studies, Kobe, Japan, 15 October 2010

AMark Twain, A Moralist in Disguise,@ Koka Women=s University, Kyoto, Japan, 13 October 2010

AMark Twain, A Moralist in Disguise,@ Doshisha University, Kyoto, Japan, 12 October 2010

AEditing Mark Twain=s >Box of Posthumous Stuff=: Forty-two Years in the Mark Twain Papers,@keynote address to the annual meeting of the Mark Twain Society in Japan, Keio University, Japan, 8 October 2010

AMark Twain, A Moralist in Disguise,@ Waseda University, Tokyo, Japan, 7 October 2010

AMark Twain in Buffalo,@ with slides, read at the Buffalo Central Library, Buffalo, N.Y., 25 September 2010

2 Interviews about the *Autobiography,* 22 September 2010: (1) David Ross, KALW; (2) Carole Goldberg, Hartford *Courant*

Interview with Joyce Kryszak, 20 September 2010, WBFO, Buffalo, NY

Interview about the *Autobiography,* 13 September 2010, Kurt Anderson, Studio 360, WNYC

Interview about the *Autobiography,* 19 August 2010 (aired 26 September), William Crawley, BBC Radio Ulster

Panel with Susan Gillman and Jerome Loving on AForum,@ 18 August 2010, moderated by Spencer Michels, KQED, Berkeley, Calif.

Interview about the *Autobiography,* 26 July 2010, Jane Henderson, St. Louis *Post Dispatch*

Interview about the *Autobiography,* 16 July 2010 (aired 19 July), Harriett Gilbert, AThe Strand,@ BBC World Service

Interview about the *Autobiography,* 6 July 2010 (aired 7 July), Spencer Michels, PBS Newshour

Interview about the *Autobiography,* 1 July 2010, Jonathan Shipley, *Fine Books & Collections Magazine*

AThe Only True and Reliable Text of the *Autobiography of Mark Twain,*@ read at the ALife and History of Mark Twain@ dinner, Zephyr Cove Resort, Zephyr Cove, Nevada, 12 June 2010

Interview about the *Autobiography,* 1 June 2010, Kathryn Ryan, ANine to Noon,@ Radio New Zealand

2 Interviews about the *Autobiography,* 31 May 2010: (1) Newshour, BBC World Service; (2) Ramona Koval, AThe Book Show,@ Australian BC Radio National

Interview about the *Autobiography,* 28 May 2010, Max Fuzowski, *Newsweek Polska*

Interview about the *Autobiography,* 27 May 2010, Barbara Celis, *El País: el periódico global*

5 Interviews about the *Autobiography,* 26 May 2010: (1) AThe Takeaway,@ WNYC, New York City; (2) McGraw Milhaven, KTRS Radio, St. Louis; (3) James Naughtie, AToday Programme,@ BBC-4 Radio; (4) Derek Davis, 4fm Ireland Radio; (5) Mark and Dave, KEXM, Portland; (6) Tavis Buchan, Lakeside Public Television, WLPR, Chicago

2 Interviews about the *Autobiography* on 25 May 2010: (1) Bob Miller, KPAM, Portland; (2) AAs It Happens,@ NPR, Toronto

5 Interviews about the *Autobiography* on 24 May 2010: (1) Ed Wenck, WIBC, Indianapolis; (2) Gianna Albaum, *The Daily Californian,* Berkeley, Calif.; (3) Tim Parsons, *Tahoe Daily Tribune;* (4) Basil Katz, Reuters; (5) Jarrod Crawford, CBS evening news

AThe *Autobiography of Mark Twain:* An Inside Look.@ Luncheon in the Library, Doe Memorial Library, Berkeley, Calif., 22 May 2010

Interview about the *Autobiography* with Guy Adams, London *Independent,* 21 May 2010 (published 24 May 2010)

AThe Collector and the Editor: Tales from the Mark Twain Papers,@ with slides, read at the opening of an exhibition from a private collection, A>Known to Everyone, Liked by All=: The Business of Being Mark Twain,@ Cornell University Library, Ithaca, N.Y., 23 April 2010 <http://www.cornell.edu/video/robert-hirst-tales-from-the-mark-twain-papers>

AThe *Autobiography of Mark Twain,*@ UC Press Reception, Luxe Hotel, Los Angeles, 22 April 2010

A>Better Shove This in the Stove=: Tales from the Mark Twain Papers.@ Rossmoor Cal Alumni Club, Rossmoor, Calif., 21 April 2010

AMark TwainCA National Treasure,@ panel with Michael Shelden and Jerome Loving for the Annapolis Book Festival at the Key School, Annapolis, Maryland, 17 April 2010

AThe Autobiography of Mark Twain,@ Luncheon in the Library, Morrison Room of the UC Berkeley Library, 16 January 2010

Faculty Lecturer for AMark Twain=s Hawai=i,@ California Alumni Association trip to the Hawaiian Islands, Golden Gate Tours, 4B14 November 2009

AThe *Autobiography of Mark Twain:* Is a Comprehensive Edition Possible?,@ with slides, read at the 6th International Conference on the State of Mark Twain Studies, Elmira College, Elmira, N.Y., 7 August 2009

AMark Twain on Racism: Evidence from the Manuscript of *Huckleberry Finn* and Other Documents,@Lecture with extensive handout reproducing original documents at the ALandmarks of American History and Culture Workshop for Teachers,@ sponsored by NEH at the Mark Twain House and Museum, Hartford, Conn., 29 July 2009

A>Better Shove This in the Stove=: Tales from the Mark Twain Papers.@ Berkeley Breakfast Club, Berkeley, Calif., 24 July 2009

A>Better Shove This in the Stove=: Tales from the Mark Twain Papers@ (twice) for the Northern California Alumni Group and the Redding Library, Redding, Calif., 24 and 25 April 2009

A>Better Shove This in the Stove=: Tales from the Mark Twain Papers,@ Lafayette Historical Society, Lafayette, Calif., 13 May 2008

Talk and small exhibit of original documents at ADinner with Mark Twain,@ a benefit for the Fritz Institute Salon at the home of Bob Alspaugh, Carmel, Calif., 22 March 2008

Talk to the Bohemian Club Book Group about *Huckleberry Finn,* 4 March 2008

A>Better Shove this in the Stove=: Tales from the Mark Twain Papers,@ Cal Club of Joaquin County, Stockton, Calif., 20 February 2008

Talk to Prof. Donald McQuade=s English 100 class, UC Berkeley, 12 February 2008

A>Better Shove This in the Stove=: Tales from the Mark Twain Papers,@ St. Mary=s College of Maryland, St. Mary=s City, Maryland, 7 February 2008

A>Literature of a Low Order, i.e. Humorous=: Mark Twain *vs.* His Editors,@ panel on editing humorists entitled AIf You Have to Explain It, Is It Still Funny?@ Association for Documentary Editing 2007 Annual Meeting, Richmond, Va., 17 November 2007

A>Better Shove This in the Stove=: Tales from the Mark Twain Papers,@ Oakland Rotary Club No. 3, Oakland, Calif., 11 October 2007

Faculty Lecturer for a Bear Treks tour, AMark Twain in the West: A Visit to the Sites of Mark Twain in California and Nevada.@ 1B5 October 2007

AMark Twain and Racism: Evidence from the Manuscript of *Huckleberry Finn,* and Other Documents.@ Informal presentation with an extensive handout to an NEH sponsored workshop for High School Teachers, Mark Twain House and Museum, Hartford, Conn., two separate sessions, 9 and 24 July 2007

Interview for documentary film in the making, AMark Twain and the Holy Land,@ sponsored by Benjamin Shapell, 30 May 2007

A>A Funeral Excursion without a Corpse=: Mark Twain and the Innocents Abroad.@ Informal talk with slides for the 13th meeting of the Mark Twain Luncheon Club, 2 May 2007

A>The Privilege of the Grave,=@ for ADinner in the Library: Tents, Testimonios & Twain,@ 3 November 2006, UC Berkeley Library

Faculty Lecturer for a Bear Treks tour, AMark Twain at Home, a Fall Foliage Tour of the Major Residences of Samuel Clemens,@ 9B19 October 2006

A>An Entirely New Subject=: Why Mark Twain Wrote Life on the Mississippi,@ Mark Twain Reading Club of the San Francisco Olympic Club, San Francisco, Calif., 21 September 2006

Informal discussion for Shelley Fisher Fishkin=s graduate students from Stanford University, Mark Twain Papers, Berkeley, 2 May 2006

A>Like All DCn Fool Printers=: A Glimpse at the Editorial Process,@ Hartford House, Hartford, Connecticut, 2 April 2006

Informal discussion for Kerry Driscoll=s undergraduate class, St. Joseph=s College, Hartford, Connecticut, 31 March 2006

A>He Told the Truth, Mainly=: Why We Still Read Mark Twain.@ King and Low-Heywood Thomas School, Stamford, Connecticut, 30 March 2006

Informal presentation and discussion of Mark Twain=s Papers for newly accepted graduate students in the Department of English, for Department Chair, Elizabeth Abel, 20 March 2006

Informal discussion and exhibit for George Starr=s English 100 class, UC Berkeley,17 February 2006

Informal presentation and exhibit for St. Helena High School Class, Mark Twain Papers, 3 January 2006

Informal presentation with Sharon Goetz of the Mark Twain Project=s ongoing digital project, Modern Language Association annual convention, Washington, D.C., 29 December 2005

Informal talk to the Philanthropic Education Organization, Oakland, California, 9 November 2005

A>Better Shove This in the Stove=: Tales from the Mark Twain Papers,@ Southern Oregon California Alumni Association, Medford, Oregon, 22 September 2005

A>Like All DCd Fool Printers=CA Glimpse at the Editorial Process.@ The 5thh International Conference on the State of Mark Twain Studies, Elmira College, Elmira, N.Y., 6 August 2005

A>Better Shove This in the Stove=: Tales from the Mark Twain Papers,@ Il Cenacolo, San Francisco, California, 26 May 2005

A>Better Shove This in the Stove=: Tales from the Mark Twain Papers,@ President=s and Regents Retiree=s Association (PARRA), Berkeley, California, 4 May 2005

A>Better Shove This in the Stove=: Tales from the Mark Twain Papers,@ Savannah College of Art and Design, Savannah, Georgia, 27 April 2005

Narrator for AA Musical Tribute to Mark Twain,@ with Tim Hockenberry, and Duane Carroll, Music Director and Conductor, Contra Costa Wind Symphony, Hofmann Theatre, Walnut Creek, Calif., 20 March 2005

AFrom Huckleberry Finn to >No. 44, The Mysterious Stranger,=@ UC Retirement Center Program, Berkeley, Calif., 6 December 2004

AMark Twain Becomes a Writer: from Hannibal to San Francisco, 1847B1868,@ UC Retirement Center Program, Berkeley, Calif., 15 November 2004

Narrator for Will Furman=s AMark Twain Comes to San Francisco,@ Seventh Meeting of the Mark Twain Luncheon Club, 7 November 2004

Interviewed by Drew Van de Creek for AMark Twain=s Mississippi River,@ Northern Illinois Universities, <http://dig.lib.niu.edu/twain/video.html#bob>

Small exhibition in MTP for the Massachusetts Institute of Technology Alumni Club of Northern California, 2 October 2004

Presentation and exhibition to Carolyn Sheaff=s group of tour directors, Mark Twain Papers, 25 June 2004

ABetter Shove This in the Stove,@ The Olympic Club, San Francisco, California, 20 May 2004

ABetter Shove This in the Stove,@ Cupertino Rotary Club, Cupertino, California, 5 May 2004

Informal presentation to Shelley Fisher Fishkin=s class from Stanford University, 28 April 2004

ABetter Shove This in the Stove,@ Alameda Rotary Club, Alameda, California, 23 March 2004

Informal talk about Mark Twain to Sarah Chodsko=s reading group, San Francisco, 20 January 2004

AMark Twain=s Letters from San Francisco, 1865B1866,@ Thomas A. Leonard=s Freshman Seminar, 10 November 2003

Brief talk to Mark Twain Papers/Bancroft Library/UC Press reception in The Bancroft Library, 29 October 2003

AEditing Mark Twain: >Like All DCd Fool Printers,=@ George Starr=s English 150 on Mark Twain, 23 October 2003

Brief exhibition, with Victor Fischer, as part of AMark Twain Comes to San Francisco,@ Bohemian Club, San Francisco, 19 October 2003

Talk to freshman seminar, AWriting the High Sierra,@ taught by Gene Rose and Susan Schweik, Bancroft Library, 13 October 2003

AMark Twain and Music,@ with Harriet Elinor Smith and the San Francisco Choral Artists, Sixth Meeting of the Mark Twain Luncheon Club, 8 October 2003

Informal talk to the Class of 1958 reunion Dinner, Hearst Mining Building, UC Berkeley, 3 October 2003

ATales Out of the Mark Twain Archives: Or, >Better Shove This in the Stove,=@ San Jose Rotary Club, San Jose, California, 17 September 2003

ATales Out of the Mark Twain Archives: Or, >Better Shove This in the Stove,=@ Livermore Rotary Club, Livermore, California, 10 September 2003

ATales Out of the Mark Twain Archives: Or, >Better Shove This in the Stove,=@ Richmond Rotary Club, Richmond, California, 22 August 2003

ABetter Shove This in the Stove,@ City Commons Club, Berkeley, California, 20 June 2003

A>Heaven on the Half-Shell=: Mark Twain in California,@ Elder Hostel, Berkeley, California, 13 June 2003

AMining for Nuggets in Mark Twain=s Archives,@ Pleasanton Rotary Club, Pleasanton, California, 22 May 2003

AWhy Publish Mark Twain=s Letters after He Is >Planted=?@ Fifth Meeting of the Mark Twain Luncheon Club, Berkeley City Club, 14 May 2003

A>Better Shove This in the Stove:= Editing Mark Twain=s Papers,@ Los Angeles Corral of the Westerners, Alhambra, California, 9 April 2003

A>Better Shove This in the Stove:= Editing Mark Twain=s Papers,@ Cal Alumni Club of Oakmont, Santa Rosa, California, 26 March 2003

ABetter Shove This in the Stove,@ Hayward Rotary Club, 24 February 2003

ABetter Shove This in the Stove,@ Cal Alumni Club at Rossmoor, 18 January 2003

ABetter Shove This in the Stove,@ San Francisco Rotary Club, 10 December 2002

Brief talk to the Class of 1958 reunion planning meeting, Morrison Library, 24 October 2002

AEditing Mark Twain: >Like All DCd Fool Printers,@ presentation to Linda Morris=s Graduate Seminar from UC Davis, 13 May 2002

A>Better Shove This in the Stove=: Editing Mark Twain=s Papers and Works,@ Cal Alumni Club of Long Beach, 20 March 2002

A>Better Shove This in the Stove=: Editing Mark Twain=s Papers and Works,@ Emeryville Rotary Club, 25 February 2002

Informal presentation on *The Innocents Abroad,* San Francisco Commonwealth Club Book Discussion Group, 28 January 2002

A>Heaven on the Half-Shell,=@ National Council of Jewish Women, Rossmoor, California, 23 January 2002

Brief interview (live) on NBC Weekend Today, talking about Mark Twain=s letters in the Bancroft Library, 13 January 2002

A>Heaven on the Half-Shell=: Mark Twain in California,@ Live From the Bancroft, recorded for KQED, 28 November 2001; broadcast on KQED, 24 January 2002

ARe-editing *Huckleberry Finn,* >Like All DCd Fool printers,=@ Herbert Feinstein=s seminar on Mark Twain, San Francisco State University, 25 October 2001

Panel Discussion and Slides: Selected Photographs and other Images from the Mark Twain Papers, Buffalo and Erie County Public Library, 13 October 2001

Cal Alumni Faculty Lecturer, AMark Twain & the Mississippi River,@ Bear Treks trip down the Mississippi, 8B22 September 2001

ALooking for Mark Twain,@ Reception for Berkeley Alumni Hosted by Sally and Chris Henson, Wilton, Connecticut, 14 June 2001

AHunting for Mark Twain: Letters from San Francisco, 1865B1866,@ San Francisco Historical Society, 8 May 2001

AFrom Definitive Editions to Editing without a Copy-Text,@ Modern Language Association Annual Meeting, 26 December 2000, Washington, D.C.

AMark Twain=s Mysterious Stranger MSS,@ for Alisha Siebers=s English 1B class, UC Berkeley English Department, 3 November 2000

ARe-Editing *Huckleberry Finn,*@ for Herbert Feinstein=s AModern American Novel@ course, San Francisco State University, 24 October 2000

A*Huckleberry Finn* Again,@ Association for Documentary Editing Annual Meeting, Oakland, California, 6 October 2000

A>Those Were the Days!=: Mark Twain in Nevada, 1861B1864@ and A>Heaven on the Half-Shell=: Mark Twain in California, 1864B1868,@ written and recorded for the Wells Fargo sponsored Bancroft Library outreach program, 5 September 2000

ALooking for Mark Twain?,@ for the Solano New and Old Blues, 25 May 2000

Brief guided exhibition of the Mark Twain Papers for the Sundodgers Camp, Bohemian Club, in the Faculty Club and Stone Room, The Bancroft Library, 26 April 2000

AEditing Mark Twain=s Papers,@ for Herbert Feinstein=s English class, San Francisco State University, 23 November 1999

AThe State of the Mark Twain Project,@ The Friends of the Mark Twain Papers, Krouzian and Stone rooms, The Bancroft Library, 17 November 1999

AMark Twain=s Mysterious Stranger MSS,@ for Alisha Siebers=s English classes, UC Berkeley English Department, 11 and 12 November 1999

AMummies, Manuscripts, Tracts and Twain,@ with Anthony S. Bliss, Belvedere-Tiburon Library, 28 October 1999

AEditing Mark Twain: >Like All DCn Fool Printers,=@ McFarlin Fellows, University of Tulsa, 21 October 1999

Two informal presentations (with handouts) about editing Mark Twain, for Gordon Taylor=s undergraduate class and several graduate students at the University of Tulsa, 21 October 1999

AMark Twain in California,@ for a traveling group from the University Club of New York, in San Francisco, 15 October 1999

AMark Twain in San Francisco,@ Society of California Pioneers, San Francisco, 14 October 1999

AMark Twain in the Gold Country,@ Golden Gate Tours, Nevada City, California, 14 September 1999

AMark Twain in California,@ part of a symposium, APacific Visions: The Culture and Environment of Early California,@ sponsored by the Cantor Arts Center, Stanford University, in conjunction with an art exhibition, *Pacific Arcadia: Images of California, 1600B1915,* curated by Claire Perry, 30 April and 1 May 1999

AMark Twain, Zoologist,@ Annual Meeting of the Docent Council of the Oakland Museum of California, Oakland Museum, 26 April 1999

AThe Mysterious Stranger MSS,@ for Alisha Siebers=s UC Berkeley English 1B, Stone Room, The Bancroft Library, 19 April 1999

AHunting for Mark Twain,@ Town & Gown Club, Berkeley, 8 March 1999

A*Roughing It*Cthe Book, Not the Movie,@ Book Night at the Bohemian Club, San Francisco, 2 March 1999

AThe Mark Twain Project at U.C.,@ McCune Room, Kennedy Library, Vallejo, 21 February 1999

AMark Twain, Blue-Jays, and Other Talking Animals,@ Museum Talk, The Bohemian Club, San Francisco, 9 February 1999

ATraveling through Mark Twain: What=s New under the Sun?,@ Ventura County Cal Alumni Club, Camarillo, Calif., 5 November 1998

AEditing Mark Twain=s Papers and Works: >Like All DCd Fool Printers,=@ Annual Meeting of the Association for Documentary Editing, St. Louis, 8 October 1998

ATraveling through Mark Twain: What=s New under the Sun?,@ Cal Homecoming Reunion Weekend, University of California at Berkeley, 25 September 1998

AMark Twain at Large: His Travels Here and Abroad,@ Exhibition of Mark Twain documentary materials for The Bancroft Library, prepared by Lin Salamo, Harriet Elinor Smith, and Robert Pack Browning, opening 25 September 1998

AEverything You Ever Wanted to Know about Mark Twain, but Were Afraid to Ask (with Apologies to Woody Allen),@ Berkeley Breakfast Club, at Spenger=s Grotto, Berkeley, 11 September 1998

Radio discussion of *Huckleberry Finn* on *AirTalk* with Dr. Daniel Victor, hosted by Jonathan L. Kirsch and Larry Mantle, KPCC radio, 20 July 1998, 6:10B7:00 pm

AMark Twain, Archeologist,@ Museum Talk for the Bohemian Club, at Bohemian Grove, 20 July 1998

AEditing Mark Twain,@ Prof. Herbert Feinstein=s senior seminar on Mark Twain, San Francisco State University, 15 July 1998

ARe-editing *Huckleberry Finn,*@ Prof. Herbert Feinstein=s undergraduate course on Mark Twain, San Francisco State University, 13 January 1998

ARe-editing *Huckleberry Finn,*@ Linda Morris=s senior seminar, Department of English, UC Riverside, 21 November 1997

A*Huck Finn* Redux: A New Edition,@ Bancroft Library Roundtable, 20 November 1997

ASkimming the 1993 Edition of *Roughing It:* Do Critics, Editors, and Other Tricksters Know Anything *Now* That They Didn=t Know *Before* 1993?,@ presented at the American Literature Association Symposium on the Trickster, Cal-Neva, Nevada, 10 October 1997

AEditing Mark Twain: >Like All DCd Fool Printers,=@ Homecoming and Reunion Weekend, University of California, Berkeley, 20 September 1997

ARe-editing *Huckleberry Finn,*@ for AMaking American Literatures,@ an NEH sponsored summer seminar for teachers, Donald A. McQuade, Director, 23 July 1997

AEditing Mark Twain,@ for Prof. Herbert Feinstein=s undergraduate class on Mark Twain, San Francisco State University, 8 May 1997

AMark Twain and the Mysterious Printer,@ lecture for the American Printing History Society, San Francisco, 24 April 1997

AEditing Mark Twain: >Like All DCd Fool Printers,=@ presentation for Cal Day, 19 April 1997

AEditing Mark Twain=s Papers and Works, with a Glance at the New Manuscript of *Huckleberry Finn,*@ presentation to George Starr=s English 131, 13 February 1997

AFinding Mark Twain,@ California Studies Association Conference, 7 February 1997

AHuckleberry FinnCAgain,@ address to the Roxburghe Club of San Francisco, 17 September 1996

AEditing Mark Twain=s Papers and Works, with a Glance at the New Manuscript for *Adventures of Huckleberry Finn,*@ Prof. Herbert Feinstein=s graduate seminar on Mark Twain (English 780), San Francisco State University, 25 April 1996

AThe Mark Twain Project: What It Does, and Why,@ Calaveras County Cal Alumni Association, Murphy=s, California, 9 February 1995

Interview by Spencer Michels, AFinallyCMark Twain,@ MacNeil/Lehrer Newshour, aired on 30 January 1995

Interview (with Robert Pack Browning) by Spencer Michels (standing in for Michael Krasne), AForum,@ KQED radio, 21 December 1994

AEditing Mark Twain=s Papers and Works, with a Glance at the New Manuscript for *Adventures of Huckleberry Finn,*@ lecture to Prof. Herbert Feinstein=s English 580: Mark Twain, San Francisco State University, 13 October 1994

AThe Mark Twain Papers and the Works of Mark Twain,@ lecture to Prof. Herbert Feinstein=s English 580: Mark Twain, San Francisco State University, 28 June 1994

Informal talk about editing to Prof. Linda A. Morris=s graduate English course, University of California at Davis, 11 March 1994

Informal talk about the Mark Twain Project to a group of twenty-five high-school teachers from the California Association of Teachers of English, 11 February 1994

AEditing Mark Twain: A Hand-to-Hand (or Hand-to-Mouth?) Endeavor,@ read at the Annual Meeting of the Bibliographical Society of America, 28 January 1994. [A more formal version of this lecture appeared in *Papers of the Bibliographical Society of America* 88 (June 1994): 157B88, listed above.]

AEditing Mark Twain,@ lecture to Prof. Herbert Feinstein=s English 158: American Literature, San Francisco State University, 11 January 1994

AEconomizing the Editions: >What Need One?=@ for a panel called AEditions under Fire,@ organized by the Association for Documentary Editing, MLA Convention, 27 December 1993

AMark Twain and the Mark Twain Papers,@ School of Humanities Summer Sessions lecture for Prof. Herbert Feinstein=s English 580: Mark Twain, San Francisco State University, 21 June 1993

Untitled lecture and exhibition of documents for Prof. Robert Coleman=s graduate class in English, Sonoma State University, 22 March 1993

Informal talk about the Mark Twain Papers to Prof. Frederick Crews=s undergraduate seminar on Mark Twain, University of California at Berkeley, 28 January 1993

AMark Twain and the Mark Twain Papers,@ School of Humanities Special Lecture for Prof. Herbert Feinstein=s English 580: Mark Twain, San Francisco State University, 29 June 1992

AMark Twain Project,@ lecture to Prof. Herbert Feinstein=s English 158: American Literature, San Francisco State University, 3 October 1991

Interview by Ken Kashawahara for ABC Television News, 6 September 1991

AMark Twain Project,@ lecture to Prof. Herbert Feinstein=s undergraduate course on Mark Twain, San Francisco State University, 7 June 1991

AEditing the Works and Papers of Samuel L. Clemens (Known to the Police as >Mark Twain=),@ lecture to the Friends of the Lilly Library, Indiana University, 9 April 1991

AEditing the Papers and Works of Samuel L. ClemensCKnown to the Police as >Mark Twain,=@ informal talk about editing to Prof. Linda A. Morris=s graduate English course, University of California at Davis, 21 February 1991

AEditing the Papers and Works of Samuel L. ClemensCKnown to the Police as >Mark Twain,=@ lecture to The Century Club of California, San Francisco, 9 January 1991

AMark Twain=s Letters: Lean *vs.* Full Annotation, a Test Case@ for a session on AConstructing a Commentary for a Critical Edition: Theory and Practice II,@ MLA Convention, 29 December 1990

Informal talk given at a ANo-Host Technology Luncheon Meeting,@ organized by Czeslaw Jan Grycz, Scholarship and Technology Study Project, at the Faculty Club, University of California at Berkeley, 10 May 1990

AThe Mark Twain Project@ (Robert H. Hirst and Victor Fischer) and AThe Emma Goldman Papers@ (Candace Falk), *Discover Cal* program in the Morrison Reading Room of the Doe Library, University of California, Berkeley, 2 February 1990

ADeveloping Standards for Transcribing and Publishing Personal Letters@ for a session on AManuscripts and Typescripts: Descriptions, Transcriptions, Editions: II,@ sponsored by the Division on Methods of Literary Research, MLA convention, 29 December 1989

Respondent for a panel discussion on ANew Interpretations of the Mark Twain Papers,@ organized and moderated by Maria O. Marotti, MLA convention, 28 December 1989

Lecture about the Mark Twain Project to Prof. Herbert Feinstein=s graduate seminar on Mark Twain, San Francisco State University, 10 October 1989

Lecture about the Mark Twain Project to Prof. Herbert Feinstein=s undergraduate survey course, San Francisco State University, 1 May 1989

AMemory, Speech, and the Reprobate Elect: Background to *Adventures of Huckleberry Finn,*@ one of the WOLM Special Lectures, Spring Series, Santa Rosa Junior College, 26 April 1989

ATranscribing Mark Twain=s Letters: the Origins of >Plain Text,=@ Annual Dickens Project Biography Conference: Letters and Lives, University of California at Santa Cruz, 14 April 1989

Informal discussion and workshop on scholarly editing, sponsored by the CSE at the MLA convention, 30 December 1988

AEditing Mark Twain,@ for the Northern California Fall Workshop AArchives and Publishing,@ Society of California Archivists, at the California Academy of Sciences, San Francisco, 2 December 1988

Informal seminar on editing letters for eight staff members of the University of California Press, including three members of the Faculty Press Committee: on 12, 19, and 26 May, and 7 July 1988

Interview (with Michael Frank) on National Public Radio about the publication of *Mark Twain=s Letters, Volume 1: 1853B1866,* 29 March 1988

Informal talk and exhibition of documents for Prof. Linda A. Morris=s undergraduate seminar on Mark Twain, University of California at Davis, 27 January 1988

Informal workshop on CSE standards and procedures, MLA Convention, 30 December 1987

AMark Twain and the West,@ informal talk to a meeting of the Mark Twain Circle, MLA Convention, 29 December 1987

AEnhancing the Archive You Work In: or, Collecting, Cataloging, and Cadging for a Secondary Archive,@ sponsored by the Executive Committee on Methods of Literary Research, MLA Convention, 28 December 1987

Informal talk for a panel titled A>God First Made Idiots, Just for Practice. Then He Made Editors,=CMark Twain,@ Western University Presses Annual Meeting, Berkeley, 13 October 1987

Informal talk about editing literary manuscripts in a seminar titled AIssues in Publishing Literary Manuscripts,@ organized by the Continuing Education Committee of the Rare Books and Manuscripts Section, Association of College and Research Libraries (ALA), at Stanford University, 24 June 1987

AMark Twain: The Printer in the Penman, & Vice Versa,@ lecture to the members of The Roxburghe Club of San Francisco, 21 April 1987

Informal lecture and exhibition of documents for Prof. Ida Egli=s undergraduate seminar on American literature, Mendocino College (Ukiah), twice: on 5 December and 6 January 1986

Lecture for Prof. Herbert Feinstein=s Mark Twain seminar, San Francisco State University, 5 December 1985

Interview, Channel 4 television in San Francisco, aired 30 November 1985

Interview by Gary Rebstock, Channel 7 television in San Francisco, aired on 29 and 30 November 1985

ARestoring Mark Twain=s Text@ read at the 54th Annual Book Awards Luncheon of the Commonwealth Club, San Francisco, 14 June 1985

ARestoring Mark Twain=s Text,@ an informal talk for Cal Alumni Day, Berkeley, 1 June 1985

Round-table discussion of *Huckleberry Finn* (including Alan Dundes, Wright Morris, and Victor Fischer) for the Annual Meeting of The Friends of The Bancroft Library, 5 May 1985

Interviewed by Bernadette Tansey, California Times Public Affairs radio, aired locally on 28 April 1985

Lecture and exhibition for Prof. Herbert Feinstein=s graduate course in Mark Twain, San Francisco State University, 16 April 1985

Informal lecture about Mark Twain to Jennifer Nold=s high-school senior class (San Francisco), 22 March 1985

Lecture and exhibition of documents to Louis J. Bollen=s class in American humor, Vista College, Berkeley, 20 March 1985

Informal lecture to the Diablo Tuesday Morning Forum, Danville, 12 March 1985

Lecture and exhibition for Prof. Mitchell Breitwieser=s English 151: Mark Twain, University of California at Berkeley, 4 and 8 March 1985

Interview (with William McClung) by Peter Carroll (for Andy Ross) on ABook Talk,@ KPFA radio in Berkeley, 4 February 1985

A>Clear= *versus* >Literal= Texts: The Question of Deletions Intended to Be Read,@ for a session on AEditing Correspondence: Principles and Procedures,@ organized by the Division on Methods of Literary Research, MLA convention, 27 December 1984

Lecture and exhibition of documents for Prof. Richard Bridgman=s English 200 graduate students, University of California at Berkeley, 1 November 1984

Informal report (with Elizabeth H. Witherell) on a statistical survey of documentary editions, part of a session titled AEstablishing, Funding, Managing, and Publishing Editions,@ annual convention of the Association for Documentary Editing, 18 October 1984

Exhibition and panel discussion, AEditing Dickens and Twain,@ for the Dickens and Twain Conference, University of California at Santa Cruz, 12 August 1984

Lecture and exhibition for Michelle Craig=s English 2B, University of California at Berkeley, 21 February 1984

Lecture and exhibition for Louis J. Bollen=s class in American humor, Vista College, Berkeley, 25 January 1984

Informal talk about editing to the Manuscripts Committee of the American Literature section of the Modern Language Association, MLA Convention, 29 December 1983

Interviewed by Nicole Clifton, radio station KALX, Berkeley, 24 October 1983

Informal talk about editing letters to representatives of the University of California Press and the Mark Twain Project, Berkeley, 10 October 1983

Informal talk at a session of the Manuscripts Society=s annual meeting, Berkeley, 27 May 1983

Informal talk to the Colophon Club, San Francisco, 27 April 1983

Lecture and exhibition for Louis J. Bollen=s class in Mark Twain, Vista College, Berkeley, 9 March 1983

Lecture and exhibition for Jackie Cole=s high-school class from Ignacio Valley High, 19 November 1982

Lecture for Prof. Herbert Feinstein=s undergraduate class on Mark Twain, San Francisco State University, 18 November 1982

A>The Language of the Vulgar, the Low-flung, and the Sinful=: Censorship and Self-Censorship in Mark Twain=s Early Works,@ an informal paper presented by invitation at the Caltech/Weingart Conference organized by Jerome J. McGann: ATextual Studies and Their Meaning for Literary Criticism,@ Pasadena, 21B26 March 1982

Lecture for Prof. Herbert Feinstein=s undergraduate class on Mark Twain, San Francisco State University, 29 October 1981

Lecture and exhibition for Jackie Cole=s Ignacio Valley High-school classes, grades 10B12, 27 February 1981

Informal presentation to Cliff Crain=s 6th grade class, Donlon Elementary School, Pleasanton, 3 February 1981

Informal talk and exhibition on *Huck Finn* for Mary Webb=s class on Mark Twain, Berkeley Adult School, 30 September 1980

AEditing Mark Twain: Or, >Why Don=t You Just *Publish* What Mark Twain *Wrote?*=@ read by invitation at the annual meeting of the Mark Twain Memorial in Hartford, 22 May 1980

AThe Scholarly Uses of Modern Editions,@ a paper read at a meeting organized by the CSE, AScholarly Editions: Needs and Uses,@ at the MLA Convention, 29 December 1979

AEditing for the Literary Historians: Some Examples from Mark Twain=s Early Works,@ a paper read in Wheeler Hall by invitation of Ralph W. Rader, Chair, Department of English, University of California at Berkeley, 5 February 1979

⊃

EXHIBIT B

OMB Number: 4040-0003
Expiration Date: 02/28/2025

APPLICATION FOR FEDERAL DOMESTIC ASSISTANCE - Short Organizational

*** 1. NAME OF FEDERAL AGENCY:**
National Endowment for the Humanities

2. CATALOG OF FEDERAL DOMESTIC ASSISTANCE NUMBER:
45.161

CFDA TITLE:
Promotion of the Humanities Research

*** 3. DATE RECEIVED:** Completed Upon Submission to Grants.gov **SYSTEM USE ONLY**

*** 4. FUNDING OPPORTUNITY NUMBER:**
20221130-RQ

*** TITLE:**
Scholarly Editions and Scholarly Translations

5. APPLICANT INFORMATION

* a. Legal Name:
The Regents of the University of California

b. Address:

* Street1: c/o Sponsored Projects Office	Street2: 1608 Fourth Street, Suite 220, MC #5940
* City: Berkeley	County/Parish: Alameda
* State: CA: California	Province:
* Country: USA: UNITED STATES	* Zip/Postal Code: 94710-1749

c. Web Address:
http:// spo.berkeley.edu

* d. Type of Applicant: Select Applicant Type Code(s): H: Public/State Controlled Institution of Higher Educ	* e. Employer/Taxpayer Identification Number (EIN/TIN): 94-6002123
Type of Applicant:	* f. UEI: GS3YEVSS12N6
Type of Applicant:	* g. Congressional District of Applicant: CA-013
* Other (specify):	

6. PROJECT INFORMATION

* a. Project Title:
Mark Twain Project

* b. Project Description:
The Mark Twain Project asks support for a full-scale critical edition of Following the Equator, and for work needed to publish, both in print and on its digital edition, Mark Twain Project Online (MTPO), three major volumes in the Works of Mark Twain series: Pudd'nhead Wilson, The Innocents Abroad, and San Francisco Correspondence 1865-1866. The first two of these are also to be adapted for publication in the Mark Twain Library series, which brings the critically-established texts and explanatory notes to general readers and classrooms. Mark Twain's Letters, Volume 7 is to be prepared for publication on MTPO, along with five other editions already published in print by the UC Press; and the texts of 1,405 Mark Twain letters are to be transcribed, edited, supplied with critical apparatus, and published online. Support is sought for the ongoing management and curation of the Project's textual and image datasets, improvements to the digital infrastructure, development of MTPO's fe

c. Proposed Project: * Start Date: 10/01/2024 * End Date: 09/30/2027

APPLICATION FOR FEDERAL DOMESTIC ASSISTANCE - Short Organizational

7. PROJECT DIRECTOR

Prefix:	* First Name: Robert
Middle Name: H.	
* Last Name: Hirst	Suffix:
* Title: General Editor	* Email: rhirst.mtp@berkeley.edu
* Telephone Number: 510-642-6480	Fax Number: 510-642-6480
* Street1: The Bancroft Library, Room 475	Street2: University of California, Berkeley
* City: Berkeley	County/Parish: Alameda
* State: CA: California	Province:
* Country: USA: UNITED STATES	* Zip/Postal Code: 94720-6000

8. PRIMARY CONTACT/GRANTS ADMINISTRATOR

☐ Same as Project Director (skip to item 9):

Prefix:	* First Name: Jessie
Middle Name:	
* Last Name: Brown	Suffix:
* Title: Contracts and Grants Officer	* Email: jwbrown@berkeley.edu
* Telephone Number: 510-642-8120	Fax Number: 510-642-8236
* Street1: Sponsored Projects Office, UC Berkeley	Street2: 1608 Fourth Street, Suite 220
* City: Berkeley	County/Parish: Alameda
* State: CA: California	Province:
* Country: USA: UNITED STATES	* Zip/Postal Code: 94710-1749

APPLICATION FOR FEDERAL DOMESTIC ASSISTANCE - Short Organizational

9. * By signing this application, I certify (1) to the statements contained in the list of certifications** and (2) that the statements herein are true, complete and accurate to the best of my knowledge. I also provide the required assurances** and agree to comply with any resulting terms if I accept an award. I am aware that any false, fictitious, or fraudulent statements or claims may subject me to criminal, civil, or administrative penalties (U.S. Code, Title 18, Section 1001)

** I Agree ☒

** The list of certifications and assurances, or an internet site where you may obtain this list, is contained in the announcement or agency specific instructions.

AUTHORIZED REPRESENTATIVE

Prefix: * First Name: Jessie	Middle Name:
* Last Name: Brown	Suffix:
* Title: Contract and Grant Officer	* Email: spo_grants_gov@lists.berkeley.edu
* Telephone Number: 510-642-8120	Fax Number: 510-642-8236
* Signature of Authorized Representative: Completed by Grants.gov upon submission.	* Date Signed: Completed by Grants.gov upon submission.

OMB Number: 3136-0134
Expiration Date: 10/31/2024

Supplementary Cover Sheet for NEH Grant Programs

1. Project Director Major Field of Study: Literature: American Literature

2. Institution Information Type: 1330: University

3. Project Funding

Outright Funds	0.00
Federal Match	450,000.00
Total from NEH	450,000.00
Cost Sharing	450,000.00
Total Project Costs	900,000.00

4. Application Information

Will this proposal be submitted to another NEH division, government agency, or private entity for funding? ☐ Yes ☒ No

If yes, please explain where and when:

Type of Application ☒ New ☐ Supplement

If supplement, list current grant number(s).

Primary project discipline: Literature: American Literature

Secondary project discipline (optional):

Tertiary project discipline (optional):

RESEARCH & RELATED BUDGET - Budget Period 1

UEI: GS3YEVSS12N6 Enter name of Organization: The Regents of the University of California

Budget Type: ☒ Project ☐ Subaward/Consortium Budget Period: 1 Start Date: 10/01/2024 E

A. Senior/Key Person

Prefix	First	Middle	Last	Suffix	Base Salary ($)	Months Cal.	Months Acad.	Months Sum.	Requested Salary ($)
	Robert	H.	Hirst		228,800.00	36.00			0.00
Project Role:	PD/PI								
	Blake		Bronson-Bartlett		107,988.00	36.00			188,488.00
Project Role:	Digital Publications Manager								
	Benjamin		Griffin		114,996.00	36.00			205,320.00
Project Role:	Writer/Editor IV								
	Kerry		Driscoll		128,496.00	36.00			235,848.00
Project Role:	Writer/Editor IV								

Additional Senior Key Persons: Add Attachment Delete Attachment View Attachment Total Funds requ Key Persons

Total

B. Other Personnel

Number of Personnel	Project Role	Months Cal.	Months Acad.	Months Sum.	Requested Salary ($)
	Post Doctoral Associates				
	Graduate Students				
	Undergraduate Students				
	Secretarial/Clerical				
	Total Number Other Personnel				Tot

Total Salary, Wages and Fringe

C. Equipment Description

List items and dollar amount for each item exceeding $5,000

Equipment item	Funds Requested ($)

Additional Equipment: Add Attachment | Delete Attachment | View Attachment

Total funds requested for all equipment listed in the attached file

Total Equipment

D. Travel

	Funds Requested ($)
1. Domestic Travel Costs (Incl. Canada, Mexico and U.S. Possessions)	
2. Foreign Travel Costs	
Total Travel Cost	

E. Participant/Trainee Support Costs

	Funds Requested ($)
1. Tuition/Fees/Health Insurance	
2. Stipends	
3. Travel	
4. Subsistence	
5. Other	
Number of Participants/Trainees	**Total Participant/Trainee Support Costs**

F. Other Direct Costs

		Funds Requested ($)
1.	Materials and Supplies	
2.	Publication Costs	
3.	Consultant Services	
4.	ADP/Computer Services	
5.	Subawards/Consortium/Contractual Costs	
6.	Equipment or Facility Rental/User Fees	
7.	Alterations and Renovations	
8.		
9.		
10.		
11.		
12.		
13.		
14.		
15.		
16.		
17.		
	Total Other Direct Costs	

G. Direct Costs

	Funds Requested ($)
Total Direct Costs (A thru F)	899,149.00

H. Indirect Costs

Indirect Cost Type	Indirect Cost Rate (%)	Indirect Cost Base ($)	Funds Requested ($)
Waived Indirect Costs			0.00
		Total Indirect Costs	0.00

Cognizant Federal Agency (Agency Name, POC Name, and POC Phone Number)

I. Total Direct and Indirect Costs

	Funds Requested ($)
Total Direct and Indirect Institutional Costs (G + H)	899,149.00

J. Fee

Funds Requested ($)

K. Total Costs and Fee

	Funds Requested ($)
Total Costs and Fee (I + J)	899,149.00

L. Budget Justification

(Only attach one file.) Budget Justification revision.pdf | Add Attachment | Delete Attachment | View Attachment

RESEARCH & RELATED BUDGET - Cumulative Budget

		Totals ($)
Section A, Senior/Key Person		899,149.00
Section B, Other Personnel		
Total Number Other Personnel		
Total Salary, Wages and Fringe Benefits (A+B)		899,149.00
Section C, Equipment		
Section D, Travel		
1. Domestic		
2. Foreign		
Section E, Participant/Trainee Support Costs		
1. Tuition/Fees/Health Insurance		
2. Stipends		
3. Travel		
4. Subsistence		
5. Other		
6. Number of Participants/Trainees		
Section F, Other Direct Costs		
1. Materials and Supplies		
2. Publication Costs		
3. Consultant Services		
4. ADP/Computer Services		
5. Subawards/Consortium/Contractual Costs		
6. Equipment or Facility Rental/User Fees		
7. Alterations and Renovations		
8. Other 1		
9. Other 2		
10. Other 3		
11. Other 4		
12. Other 5		
13. Other 6		
14. Other 7		
15. Other 8		
16. Other 9		
17. Other 10		

Section G, Direct Costs (A thru F)	899,149.00
Section H, Indirect Costs	0.00
Section I, Total Direct and Indirect Costs (G + H)	899,149.00
Section J, Fee	
Section K, Total Costs and Fee (I + J)	899,149.00

The following attachment is not included in the view since it is not a read-only PDF file.

Upon submission, this file will be transmitted to the Grantor without any data loss.

Budget Justification revision.pdf

OMB Number: 4040-0010
Expiration Date: 11/30/2025

Project/Performance Site Location(s)

Project/Performance Site Primary Location

☐ I am submitting an application as an individual, and not on behalf of a company, state, local or tribal government, academia, or other type of organization.

Organization Name: Regents of the University of California

UEI: GS3YEVSS12N6

* Street1: Bancroft Library, Room 475

Street2: University of California, Berkeley

* City: Berkeley County: Alameda

* State: CA: California

Province:

* Country: USA: UNITED STATES

* ZIP / Postal Code: 94720-6000 * Project/ Performance Site Congressional District: CA-013

Project/Performance Site Location 1

☐ I am submitting an application as an individual, and not on behalf of a company, state, local or tribal government, academia, or other type of organization.

Organization Name:

UEI:

* Street1:

Street2:

* City: County:

* State:

Province:

* Country: USA: UNITED STATES

* ZIP / Postal Code: * Project/ Performance Site Congressional District:

Additional Location(s) Add Attachment Delete Attachment View Attachment

ATTACHMENTS FORM

Instructions: On this form, you will attach the various files that make up your grant application. Please consult with the appropriate Agency Guidelines for more information about each needed file. Please remember that any files you attach must be in the document format and named as specified in the Guidelines.

Important: Please attach your files in the proper sequence. See the appropriate Agency Guidelines for details.

1) Please attach Attachment 1	Narrative.pdf	Add Attachment	Delete Attachment	View Attachment
2) Please attach Attachment 2	Work Plan.pdf	Add Attachment	Delete Attachment	View Attachment
3) Please attach Attachment 3	List of Key Personnel.pdf	Add Attachment	Delete Attachment	View Attachment
4) Please attach Attachment 4	Resumes for Key Personnel.pdf	Add Attachment	Delete Attachment	View Attachment
5) Please attach Attachment 5	Bibliography.pdf	Add Attachment	Delete Attachment	View Attachment
6) Please attach Attachment 6	Samples.pdf	Add Attachment	Delete Attachment	View Attachment
7) Please attach Attachment 7	Appendices (1).pdf	Add Attachment	Delete Attachment	View Attachment
8) Please attach Attachment 8	Table of Past Productivity.pd	Add Attachment	Delete Attachment	View Attachment
9) Please attach Attachment 9		Add Attachment	Delete Attachment	View Attachment
10) Please attach Attachment 10		Add Attachment	Delete Attachment	View Attachment
11) Please attach Attachment 11		Add Attachment	Delete Attachment	View Attachment
12) Please attach Attachment 12		Add Attachment	Delete Attachment	View Attachment
13) Please attach Attachment 13		Add Attachment	Delete Attachment	View Attachment
14) Please attach Attachment 14		Add Attachment	Delete Attachment	View Attachment
15) Please attach Attachment 15		Add Attachment	Delete Attachment	View Attachment

MARK TWAIN PROJECT
Papers • Works • Library

MARK TWAIN PROJECT ONLINE

MARK TWAIN PAPERS
THE BANCROFT LIBRARY, ROOM 475
UNIVERSITY OF CALIFORNIA, BERKELEY

29 November 2023

Significance and Impact

This proposal, if funded, will add substantially to our ongoing critical edition of all Mark Twain's writings, and to scholarship on American history and literature. It will enable us to publish, in print and digitally on Mark Twain Project Online (MTPO), critically edited texts of two large travel books: *The Innocents Abroad* and *Following the Equator*. In addition, we propose to add to MTPO a digital edition based on the three printed volumes of *Mark Twain's Notebooks & Journals*, with high-resolution digital facsimiles of all notebook pages accompanying the fully annotated transcription. Lastly, we propose to publish on MTPO the edited texts of 586 letters written by Mark Twain in 1886, 1887, and 1888, and full annotation for 308 letters written in 1878, the texts of which are already available there.

The Innocents Abroad, a 665-page monster of a book, was Mark Twain's first national and international success, selling more than 75,000 copies in less than two years. It is a riotous inversion of a reverent genre, the pilgrimage to Europe and the Holy Land, and a bold declaration of American independence from the traditions and monuments of the Old World. The manuscript that served as printer's copy is lost, but can be largely reconstructed from his travel letters to three American newspapers; he clipped and revised these to make up more than half the book. We include all the original illustrations, custom-made maps of the journey, biographies and photographs of his fellow passengers, and of course full annotation of the text—important features, considering that nearly every page refers to the art, architecture, history, religion, and literature of Europe and the Middle East. Textual apparatus for the edition will appear only on MTPO, and the Mark Twain Library edition, for students and the general reader, will include all but the long introduction. The edition is enriched by extensive use of unique materials collected by the editors, including the originals or copies of seven travel diaries by fellow passengers on the excursion.

Following the Equator: A Journey Around the World (1897) is Mark Twain's account of his 1895–96 lecture tour, mostly to outposts of the British Empire. Visiting Australia, New Zealand, India, and South Africa, he set down his reactions to travel and life in the far-flung parts of the *fin de siècle* Empire, and his evolving take on European imperialism. In newspaper interviews he called the English "a merciful people, the best kind of people for colonizing the globe" (SLC 1896); yet the smooth surface of *Following the Equator* is repeatedly ruptured by horror at the colonists' destructive work. His publishers censored, edited, and abridged the book, and no edition embodying the author's full intentions has ever been available. Thanks to the survival of the original manuscript and printer's copy typescript in the Berg

Collection of the New York Public Library, the text can be restored by collating these documents.

MTPO's freely available, richly annotated, and searchable texts have been recognized by the MLA and the research community as valuable contributions to the study of Mark Twain and nineteenth-century America. Elise Hanrahan, to take just one example, describes how using it enabled her to spell out the distinct, historical stages by which Mark Twain changed his views on women's suffrage over the years (Hanrahan 2019; excerpt in Appendix D). Ten years ago we embarked on a compromise designed to speed up publication of letters, publishing them online, accurately transcribed but *without* annotation, while fully intending to add annotation in the future as staff and funding permit. Continuing this policy, we propose publication of three more years of Mark Twain's letters (1886–88), amounting to 586 texts. Annotation, which is absolutely required to maximize the value of these documents, will be added later—as we have in fact just done for the 1876–77 letters—and at present we propose to annotate some 308 letters, their texts already online, from the year 1878.

In April 2022, the NEH awarded the Project a Challenge Grant (CHA-286607-23) for the redesign and rebuild of its digital infrastructure. The four-year term of this grant, which was first funded on 14 September 2023, will allow us to migrate from our current MTPO website platform (XTF) and MS Access database, both rapidly obsolescing some fifteen years after MTPO was created. (The Library IT department has just notified us that it will soon be unable to continue its support for this old technology.) MTPO is not only a crucial public-facing resource, it is the repository of new documents, new information produced by the Project's editors over many years. The work of modernizing and carefully migrating the content of MTPO will occupy two staff members (Catapano and Bronson-Bartlett) for almost a third of their time. But this is a necessary expense for survival: MTPO2, our modernized, streamlined website and data-management infrastructure, will permit us to maintain the site at greatly reduced cost, and it will also allow us to publish more frequently, much more of our vast store of metadata about Mark Twain's writings and letters.

Anticipating its completion in 2027, we propose to create a digital edition of *Mark Twain's Notebooks & Journals*. We already have TEI-XML encoded texts of the three printed volumes (published 1975–79), which are awaiting post-processing and proofreading. We recently raised $50,000 to pay for high-quality digital scans of all forty-six notebooks in the Mark Twain Papers (as well as the four in other collections), and we now have these scans. These facts create an opportunity: the chance to publish a digital rendering of the transcribed notebooks, enhanced by high-resolution digital facsimiles of the originals—the ideal way to publish any original manuscript, which cannot be fully captured by transcription. This is also an opportunity to update the 1975–79 transcriptions themselves by rendering them in plain text, the method invented by Project editors ten years after the notebooks were published in print.

By the end of 2027, the Project will have migrated the entire contents of MTPO to the new website, which is designed to enable new types of content and open new paths in research. It will make publicly available comprehensive and updatable catalogs of Mark Twain's writings and letters. With access to this information provided by MTPO, and through publication in data repositories of the underlying data in open formats, in accordance with FAIR (Findable, Accessible, Interoperable, Reusable) Principles (Wilkinson et al. 2016), users will be able to find and analyze accurate information about any of his writings, activities, and correspondents; it will serve as the first and only comprehensive Mark Twain bibliography, recording even false attributions when they occur.

History of the Project and Productivity

The aim of this project is to create, maintain, correct, and update a permanent, globally accessible resource for the life and writings of Mark Twain. The editors intend to locate, edit, annotate, and publish reliable texts for everything Mark Twain wrote that survives in some documentary form. Since 1967 we have edited, for publication by the University of California Press, thirty volumes in what is recognized as the standard scholarly edition. Samuel L. Clemens was immensely prolific, and the editions published so far contain less than half of his known writings—his letters, notebooks, novels, travel books, sketches, essays, and autobiography. They include just six of his twelve best-known books—*Huckleberry Finn, Connecticut Yankee, Tom Sawyer, Roughing It, The Prince and the Pauper,* and *Pudd'nhead Wilson*—as well as roughly three-fifths of his notebooks, one-fifth of his personal and business letters, four-fifths of his unpublished literary manuscripts (including the *Autobiography*), and about one-tenth of his sketches, essays, and journalism. All but the first volume (*Satires & Burlesques,* 1967) and the *Autobiography of Mark Twain* (2010–15) have been inspected and approved by the Modern Language Association's Center for Editions of American Authors (CEAA) or by its successor, the Committee on Scholarly Editions (CSE). (We intend to submit the *Autobiography* volumes to the CSE for review as soon as time and staffing permit.) Two of the volumes have won awards from the Modern Language Association (*Roughing It* in 1995, and *Mark Twain's Letters, Volume 6,* in 2003). The first volume of the *Autobiography* received three publishing awards; it also sold more than 500,000 copies in just over a year, and may be said to have earned what Mark Twain called the only approval "worth having"—"the Great Public's" (SLC 1871).

Since 1982 the Project has also issued nine volumes in a series of readers' editions, the Mark Twain Library. These reprints exactly duplicate the edited text (except where they correct it), including its original illustrations, explanatory notes, maps, and other supplementary materials, while omitting the long introductions and most of the textual apparatus. They are widely used by general readers and in college classrooms. Our revised edition of *Huckleberry Finn* has consistently ranked among UC Press's "Top 10 paperbacks (by copies sold)." The Press has sold a total of 93,949 copies of that title in the nineteen years since its publication in 2001, an improvement on the record of our previous edition of that title, published in 1985, which sold only 79,720 copies over sixteen years, for a grand total of 172,421. *Tom Sawyer* has sold 69,104 copies; *Connecticut Yankee* 35,295 copies; and *Roughing It* 22,122 copies. (A bibliography of all Mark Twain Project publications since 1967, and a record of copies sold to date, will be found in the Appendices.) Those are remarkable numbers; especially considering that all of those works are in the public domain, which means that our editions compete with numerous, less expensive reprints. The impact of our publications has also been extended by commercial publishers who license the texts—among them Penguin Classics, Random House, The Library of America, W. W. Norton, and Everyman's Library (Alfred A. Knopf). This includes texts we have prepared but not yet published ourselves—for example, the more than 130 Mark Twain letters edited by the Project published in *The Letters of Mark Twain and Joseph Hopkins Twichell* (University of Georgia Press, 2017). UC Press has licensed translations of Mark Twain Project texts into at least a dozen languages, with the *Autobiography* alone being translated into Chinese, Croatian, Czech, French, German, Italian, Japanese, Portuguese, and Russian.

Despite more than fifty years of intensive editorial activity, there are still dozens of works, long and short, and thousands of letters still to come. Partly for that reason, since 2001 the Project has focused much of its effort on MTPO, which is intended to make freely available *all* of our edited texts—past, present, and future.

MTPO launched officially on 2 November 2007 with the contents of the six volumes of *Mark*

Twain's Letters. The CSE approved it as a scholarly electronic edition in 2009. Since then we have added born-digital texts for an additional 1366 letters (1876–1883) and two additional years of annotation (1876–77). Our goal by the end of the current grant period (October 2024) is to add texts and apparatus notes for Mark Twain's letters for the years 1884 and 1885 (680 letters). By then we will also have published online all seventeen of the previously published volumes in "The Works of Mark Twain" and "Mark Twain Papers" series, save only three volumes of Notebooks. With the digital edition of the *Notebooks & Journals* proposed here, we are drawing near the goal of making all our print editions available to the public for free on MTPO. We urge reviewers of this application to visit MTPO and see what has been accomplished so far.

We are now entering the third year of a three-year NEH grant made principally in support of editorial work on three critical editions: *Pudd'nhead Wilson*, *The Innocents Abroad*, and *Letters, Volume 7*. The print and online editions of *Pudd'nhead Wilson* are both on track to be published within the grant period, with editor Griffin now reading final proofs for a print publication in April, 2024. The *Pudd'nhead* edition was granted the MLA's seal identifying it as an Approved Edition, with the CSE vetter calling it "a towering and long-awaited achievement" which "will infuse new information into Twain studies and will generate considerable knowledge and interest among readers of American literature" (Olsen-Smith 2022). Editorial work on *The Innocents Abroad* is in a very advanced state and it too will be completed within the grant period.

The content of the *Letters* volume comprised updated texts and new annotation for two years' worth of letter texts (1876–77) already present on MTPO. Because UC Press declined to publish the print volume unless we could provide a subsidy of $30,000, we published *Letters 7* only online at MTPO; this was done in November 2022. As of October 2023, MTPO has also added texts and apparatus notes of 198 letters written in 1883. Letters written in 1884 are nearly complete and are awaiting staged release, totaling another 300 letters, and we expect to finish post-processing, proofreading, and publishing letters from the year 1885 (380 letters) before September 2024. The plan of work aimed at the publication of letter texts through 1887, but this proved too ambitious a goal for our present staff, which early in 2023 was reduced by one editor and one administrative assistant. Of the five "legacy" volumes from the Works of Mark Twain proposed in that plan, three have been released on MTPO: *Early Tales & Sketches* (volumes 1 and 2) and *What Is Man?* The two remaining volumes (*Hannibal, Huck and Tom* and *Satires and Burlesques*) are being prepared for timely release in the summer of 2024.

Collaborators

All positions are full-time. For collaborators' shares in specific tasks during designated time periods, please see the Work Plan (attachment 2).

N.B.: during the current grant period we lost the services of one full-time editor, Lisa Cardyn, as well as the services of (and funding for) our administrative assistant, whom we have not been allowed to replace. These losses constitute a significant curtailment of our ability to meet our stated editorial goals.

Blake Bronson-Bartlett, Ph.D., is an associate editor at the Mark Twain Project, where he edits and publishes electronic texts on Mark Twain Project Online. Before joining the Project's staff, he taught American literature at the University of Iowa and worked for the Walt Whitman Archive. His most recent scholarship can be found in *Handwriting in Early America* (2023) and in the forthcoming *Oxford Handbook of Walt Whitman* (2024).

In the period of the proposed grant, Blake is slated to work on revising, pre-processing, and post-processing the texts of the Mark Twain Project's *Notebooks & Journals* edition, for publication on MTPO by the end of the grant period; and to perform the same functions for texts of Mark Twain's letters written 1886–88. He will also collaborate with Terry Catapano in developing MTPO2's features and user interface.

Terence H. Catapano, MA, MLS, is Digital Publications Manager at the Mark Twain Project. He has worked in the digital library programs of Columbia University Libraries and the New York Public Library. He also served as the Chair of the Society of American Archivists Schema Development Team responsible for the development of Encoded Archival Description (EAD3) XML schema, on the Editorial Board of the Metadata Encoding and Transmission Standard (METS), as advisor to the Walt Whitman Archive, and as Digital Lead for the Making and Knowing Project. He has overseen the Project's digital activities since 2017.

In the proposed work plan Terry is tasked, alongside Blake Bronson-Bartlett, with creating the *Notebooks & Journals* module of MTPO2, which will display scans of the original notebook pages alongside a corrected, plain-text transcription. Most of his time, however, is devoted to developing and maintaining the datasets which underpin our digital publications and the editorial work that goes into them.

Kerry Driscoll, Ph.D., is an Associate Editor at the Mark Twain Project. She is Professor of English emerita at the University of St. Joseph in West Hartford, Connecticut, where she served as department chair for fifteen years. She is the author of *Mark Twain among the Indians and Other Indigenous Peoples* (2018) and numerous articles about Mark Twain. She has served as president of the Mark Twain Circle of America and is a contributing editor of the *Mark Twain Annual*.

Kerry is co-editor, with Ben Griffin, of the Project's edition of *Following the Equator*. In the proposed grant period she is to contribute both to the editing of the text and creation of annotations. She will also research and write annotation for Mark Twain's 1878 letters, and assist in proofreading *The Innocents Abroad*.

Benjamin Griffin, Ph.D., has been an Associate Editor at the Mark Twain Project since 2005. He is

editor or co-editor of the three volumes of the *Autobiography of Mark Twain* (2010–2015), *Mark Twain's "A Family Sketch"* (2014), *Mark Twain's Civil War* (2019), and the three-text edition of *Pudd'nhead Wilson* (to be published April 2024). He has taught a seminar on "Mark Twain and Textual Editing" in UC Berkeley's English Department and is the author of numerous scholarly articles.

In the period of the proposed grant most of Ben's time is allotted to editing (with Kerry Driscoll) *Following the Equator.* He has already made a lot of progress toward establishing the text and building the apparatus and editorial supplements (annotation, introduction, and appendices). He is also to help annotate Mark Twain's letters from 1878.

Robert H. Hirst, Ph.D., has been General Editor of the Mark Twain Project and Curator of the Mark Twain Papers since 1980. As General Editor he has overseen the editing and publication of thirty-nine major editions of the author's works and papers, and a host of subsidiary publications. He has served the MLA's Committee on Scholarly Editions as chair, as member, and as a vetter. In 2013 he received the John Tuckey Lifetime Achievement Award for contributions to Mark Twain studies.

Bob is the project director and has overall responsibility for its success. (Unlike the four collaborators listed above, his salary is paid by the UC Library and NEH funds are not sought.) In the proposed grant he is scheduled to work on fundraising and administrative functions; on supervision of the associate editors' work; and on late-stage publication tasks relating to *The Innocents Abroad.* As PI he commits 60% of his time to our current grant (RQ-279810-22) and to this proposal, and 40% to the challenge grant (CHA-286607-23) which complements it and runs concurrently with it.

Methods and Execution

Digital methodology for MTPO is discussed in "Final Product and Dissemination," below. The editorial methods developed for the print volumes of Mark Twain's writings are applied, with adaptations where needed, to the electronic edition.

(a) Document search, control, and selection.

The systematic search for Mark Twain's letters and literary manuscripts has been active and comprehensive, but it is, and must remain, ongoing. Between 1982 and 1984 the editors conducted a complete canvass by mail of all known or suspected repositories of letters. This canvass was repeated in 2001 in preparation for the electronic edition. The development of electronic catalogs by libraries, and of digitized newspapers by half a dozen commercial sites, has greatly expanded our reach. Auction houses now routinely post photofacsimiles of their wares, which can be found and printed as the basis for letter and manuscript texts. We make good use of aggregating sites like ArchiveGrid and WorthPoint to find what we might otherwise have missed. As a result, we find, on average, three new letters (or better sources for known letters) *every week*. The Project has extensive contacts with more than 500 repositories as well as dozens of private collectors and manuscript dealers. It has access to a private collection of some 25,000 auction catalogs. Our bibliographic control of Mark Twain's letters is done through the continually updated Unified Database, initially based on the *Union Catalog of Clemens Letters* and the *Union Catalog of Letters to Clemens* created by Paul Machlis (Machlis 1986 and 1992).

All of the original Mark Twain manuscripts in The Bancroft Library have been microfilmed, and these microfilms, previously available only for interlibrary borrowing, have been published. In addition, the Project maintains, for its own internal research, the following resources: a file of Mark Twain's marginalia; a file organized by subject; a chronological file of secondary documents; a file of book dealer and auction house catalogs; a file of correspondence with more than 500 repositories holding relevant materials; a file of the kinds of stationery Mark Twain used and when; a file used to identify non-authorial handwritings that appear on Mark Twain documents; a file of critical articles about Mark Twain and related matters; and a rapidly expanding file of photographs, arranged chronologically in viewing-print albums.

(b) Transcription, emendation, and regularization.

In publishing literary works, we aim to establish the text as the author intended it at a specific time, say, upon submission to the publisher. Even where no manuscript for a text survives, the textual documents provide sound evidence for restoring the author's preferred spellings when these have been corrupted by the transmission process; for recognizing censorship or adaptation to fit particular publication circumstances; and for rejecting punctuation and other variants demonstrably produced by the typesetter and proofreader. As it happens, Mark Twain's habits as a writer and a regulator of his publications are unusually well documented. We know, for example, that he found fault with spelling the same word in more than one way within a given text; that knowledge is the basis for cautious emendation to restore, as needed, his nearly invariable consistency in spelling. We scrupulously record and publish the choices between variants that produce the edited text, even more thoroughly than before, now that textual apparatus can be published on MTPO rather than in the printed book.

In publishing documents that were not intended for publication, such as letters and notebooks, the Project has used, since 1988, a system called plain text, invented by the editors. The most recent rationale for plain text ("Guide to Editorial Practice") fills twenty-nine closely printed pages in *Letters, Volume 6*, so it seems unwise to summarize it here (it is also included on MTPO). Suffice it to say that

plain text requires the editor who transcribes an original document to simultaneously maximize the transcription's fidelity and its legibility, departing from the original as little as possible, but when obliged to rely on non-originals (printings, transcripts, or paraphrases), to change *them* as needed, in order to restore, as much as may be, the lost original. Plain-text transcriptions therefore include all of the words transmitted by the letter, whether ordinary text, canceled text, postmarks, or printed letterhead, and they signal all insertions and preserve all errors that can be intelligibly transcribed. Whenever the transcription must change, or omit something in, the source text, the change is recorded in a textual apparatus (displayed, in MTPO's "Interactive View" mode, by clicking a hyperlink that calls up the relevant entry in a window side by side with the main text). The texts of letters are never regularized or modernized.

Plain text, although developed for print, has proven adaptable to the online environment. Plain text produces, not a type-facsimile (which would require line-for-line transcription) but a very highly inclusive transcription, limited to specific intentional categories that can be intelligibly rendered, even as it aims at maximum inclusiveness and legibility. It records, for example, not that a sentence has had a curly line drawn through it, but that the sentence has been *deleted*. This approach aligns with TEI-XML, which functions similarly. Although the full version of the TEI schema that we adopted—with well-defined local guidelines in place—can handle all the editorial requirements of plain text, HTML/CSS previously lacked the ability to replicate all aspects of the manuscript transcriptions we routinely publish in the print volumes. As web technology has advanced, it has become possible to render rich XML markup with greater sensitivity.

(c) Annotation.

In our print volumes, private documents and literary works are provided with two kinds of annotation: *explanatory notes* designed to explain what the text means or refers to, and *textual notes* designed to explain why the edited text at any given point reads as it does, and not another way. For printed literary works both kinds of notes are placed at the back, keyed to the text by page and line but with no overt sign in the text itself (so-called "clear text"). For private documents in printed format, such as notebooks and letters, the explanatory notes appear either at the foot of the page or the end of each letter, and highly detailed textual notes are relegated to the back. On MTPO both kinds of notes appear in a window immediately to the right of the text, and are hyperlinked to it, greatly easing access to the annotation. As already noted, we plan to publish letters far in advance of the explanatory annotation that will eventually accompany them. That they require annotation is clear: among other reasons, it has been the experience of the editors that letters cannot even be transcribed with accuracy, nor arranged in their true chronology, until their content has been fully understood. (The role of explanatory notes in assisting the editor, rather than the reader, is not as well recognized as it ought to be.) If we earn continued support, we will gradually add annotation to the online letter texts, as here proposed for the year 1878.

(d) Accuracy.

The procedures long employed for our print volumes have been adapted for our electronic edition. To verify for publication any transcription of a Mark Twain text, the Project routinely deploys two teams of proofreaders and permits no doubling (i.e., no one forms part of more than one team reading a given text). It also carries out at least three single-person readings of individual texts, including, when possible, at least one against the original documents. We also experiment continuously with ways to reduce the number of separate readings needed—testing the results for error by repeated readings of random samples. The factual contents of notes and introductions are independently checked by an editor who took no hand in writing them.

Final Product and Dissemination

The UC Regents' exclusive right to publish, both in print and electronically, all Mark Twain texts that are still protected by copyright is ensured by a legal agreement of 1982 between the Mark Twain Foundation, as owner of the copyright, and the Regents. The agreement is valid for the life of the copyright (through 2047). A separate agreement signed in 2002 grants UC exclusive electronic rights to the same materials, and those rights survive the contract itself.

Volumes printed and published by the UC Press typically sell 2,000 copies over ten years, the outstanding exception to that pattern being the first volume of the *Autobiography,* which sold half a million copies in less than two years. Royalty income from the sale of printed volumes is divided between the Mark Twain Foundation and the Project according to how much of the copyrighted text is owned by the Foundation.

As a critical edition enhanced by rich cross-referencing, MTPO encompasses TEI-XML files, their associated images (inline illustrations, photographs, manuscript facsimiles), and several types of descriptive metadata that yoke together these pieces of content and enable a reader to access them. MTPO's processes are underpinned by XML and related tools, such as Extensible Stylesheet Language Transformation (XSLT) scripts and XQuery. MTPO complies with digital library and publishing standards, adhering to accepted open standards and schemas, including Text Encoding Initiative (TEI) P5. Editors continue to use oXygen to encode texts in TEI-XML. Our arrangement with UC Berkeley Library's IT and Digital and Collaborative Services Office, headed by Lynne Grigsby, relies upon the expertise of those bodies to maintain the public MTPO site's server, as well as development spaces for internal use; the Mark Twain Project handles all development of XSLT, JavaScript, and CSS, both to ensure MTPO's functionality and to create the niceties of pseudo-typesetting required to render our plain text transcription online. Most of the works were originally released as TEI P4 and have been converted to P5.

Work Plan

These are the Project's objectives for the period October 2024–September 2027. Please see also Attachment 2, which breaks down these tasks, by collaborator, into six-month periods.

1. Complete editorial work on the text, annotations, appendices, and textual apparatus for *Following the Equator*, to be submitted for print publication and provided to MTPO by the end of the grant period.
2. Revise the text of *Notebooks & Journals, Volumes 1–3* for publication on MTPO, and coordinate the displayed text with existing scans of the original documents.
3. Pre-process, convert, post-process, and test the digital edition of *Notebooks & Journals* for release on MTPO by the end of the grant period.
4. Create full annotation for 308 Mark Twain letters written in 1878, for publication on MTPO by the end of the grant period.
5. Proofread page, revised, and final proofs for *The Innocents Abroad,* to be published in print in the spring of 2026.
6. Pre-process, convert, post-process, and test electronic files of *The Innocents Abroad* and publish on MTPO in the spring of 2026.
7. Prepare edited texts and apparatus notes for 586 Mark Twain letters, written 1886–88, for publication on MTPO by the end of the grant period.
8. Develop and curate MTP's metadata, image, and textual datasets, including improvement of their underlying digital infrastructure, accessibility, and reusability both internally and by others.
9. Improve and develop MTPO's features and interface, balancing its sustainability with the adoption of modern web technologies and integration of new features.

Work Plan

TASKS	Oct 2024–Mar 2025	Apr 2025–Sept 2025	Oct 2025–Mar 2026	Apr 2026–Sept 2026	Oct 2026–Mar 2027	Apr 2027–Sept 2027
Complete editorial work on the text, annotations, appendices, and textual apparatus for *Following the Equator*	Griffin 80% Driscoll 30%	Griffin 80% Driscoll 30%	Griffin 80% Driscoll 30%	Griffin 80% Driscoll 30%	Griffin 80% Driscoll 30% Hirst 50%	Griffin 80% Driscoll 30% Hirst 50%
Revise the text of *Notebooks & Journals, Volumes 1–3* for publication on MTPO, and coordinate the displayed text with existing scans of the original documents.	Bartlett 40% Catapano 20%	Bartlett 40% Catapano 20%	Bartlett 30% Catapano 20%	Bartlett 30% Catapano 20%	Bartlett 40% Catapano 20%	Bartlett 40% Catapano 20%
Pre-process, convert, post-process, and test the digital edition of *Notebooks & Journals* for release on MTPO by the end of the grant period.	Bartlett 20% Catapano 10%	Bartlett 20% Catapano 10%	Bartlett 10% Catapano 10%	Bartlett 10% Catapano 10%	Bartlett 20% Catapano 10%	Bartlett 20% Catapano 10%
Create full annotation for 308 Mark Twain letters written in 1878, for publication on MTPO by the end of the grant period.	Driscoll 30% Griffin 20%	Driscoll 30% Griffin 20%	Driscoll 30% Griffin 20%	Driscoll 30% Griffin 20%	Driscoll 70% Griffin 20%	Driscoll 70% Griffin 20%
Proofread page, revised, and final proofs for *The Innocents Abroad,* to be published in print in the spring of 2026.	Hirst 50% Driscoll 40%	Hirst 50% Driscoll 40%	Hirst 50% Driscoll 40%	Hirst 50% Driscoll 40%		
Pre-process, convert, post-process, and test electronic files of *The Innocents Abroad* and publish on MTPO in the spring of 2026.			Bartlett 20%	Bartlett 20%		
Pre-process, convert, post-process, and test the texts and apparatus notes for Mark Twain's letters written 1886–88.	Bartlett 20%	Bartlett 20%	Bartlett 20%	Bartlett 20%	Bartlett 20%	Bartlett 20%

Work Plan

TASKS	Oct 2024– Mar 2025	Apr 2025– Sept 2025	Oct 2025– Mar 2026	Apr 2026– Sept 2026	Oct 2027– Mar 2027	Apr 2027– Sept 2027
Development and curation of MTP's metadata, image, and textual datasets, including experimentation with their digital infrastructure, improvements in accessibility and innovative reuse both internally and by others.	Catapano 50%	Catapano 50%	Catapano 50%	Catapano 50%	Catapano 50%	Catapano 50%
Improve and develop MTPO's features and interface, balancing its sustainability with the adoption of modern web technologies and integration of new features.	Catapano 20% Bartlett 20%	Catapano 20% Bartlett 20%	Catapano 20% Bartlett 20%	Catapano 20% Bartlett 20%	Catapano 20% Bartlett 20%	Catapano 20% Bartlett 20%
Fundraising; public relations; administrative functions; reviewing, guiding, revising editors' work	Hirst 50%	Hirst 50%	Hirst 50%	Hirst 50%	Hirst 50%	Hirst 50%

List of Key Personnel

NAME	INSTITUTION
Bronson-Bartlett, Blake	University of California, Berkeley
Catapano, Terence H.	University of California, Berkeley
Driscoll, Kerry	University of California, Berkeley
Griffin, Benjamin	University of California, Berkeley
Hirst, Robert H. (Project Director)	University of California, Berkeley

Advisory Board

Crews, Frederick C.	University of California, Berkeley
MacKie-Mason, Jeffrey	University of California, Berkeley
Millgate, Michael	University of Toronto
Schmidt, Eric	University of California Press
Starr, George A.	University of California, Berkeley
Tanselle, G. Thomas	Guggenheim Foundation
Kate Donovan	University of California, Berkeley

Résumés for Key Personnel

BLAKE BRONSON-BARTLETT

The Bancroft Library, Room 475, UC Berkeley: bronson@berkeley.edu

EDUCATION

Ph.D. (English), University of Iowa, 2014.
B.A. (English/French), CUNY, Hunter College, 2006, *magna cum laude.*

EMPLOYMENT

Associate Editor, Mark Twain Project, The Bancroft Library, UC Berkeley, 2019– .
Visiting Assistant Professor, University of Iowa, Iowa City, 2016–2019.
Post-Doctoral Guest Lecturer, Technische Universität Dortmund, Germany, 2014–2016. Graduate Teaching Assistant, University of Iowa, Iowa City, 2010–2013.

HONORS AND AWARDS

Post-Doctoral Teaching Fellowship, Technische Universität Dortmund, Germany, 2014–2016.
Ballard/Seashore Dissertation-Year Fellowship, University of Iowa, 2013–2014.
Andrew W. Mellon Foundation Summer Research Fellowship, University of Iowa, 2011. Ann Morse Scholarship for Study Abroad, University of Iowa, 2008.
Romance Languages Prize for Academic Excellence, CUNY Hunter College, 2006.
René Taupin Scholarship for Study Abroad, CUNY Hunter College, 2005.

ARTICLES AND BOOK CHAPTERS

"Whitman's Paginator: A Case Study in the Interpretation of Mutant Books," *The Oxford Handbook of Walt Whitman*, ed. Kenneth M. Price and Stefan Schöberlein (Oxford: Oxford University Press, 2024), 115–39.
"Graphite Time," *Handwriting in Early America: A Media History*, ed. Mark Alan Mattes (Amherst: University of Massachusetts Press, 2023), 181–195.
"The California and Hawaii Notebooks: Pencils, Pocket Notebooks, and the Messiness of Mark Twain," *Mark Twain Annual* 20 (2022), 70–87.
"*The Mysterious Stranger*'s Crisis of Duplicates: Incompletion and the Vexed Transmission of Twain's Late Writings," *Mark Twain Annual* 18 (2020), 40–64.
"Writing with Pencils in the Antebellum U.S.: Language, Instrument, Gesture," *American Literature* 92.2 (June 2020), 199–227.
"On the Digital *Mabbott Poe*: 'Source-Research,' Text Editing, and Media History," *Poe Studies* 51 (2019), 110–35.
"From Loose Leaves to Readymades: Manuscript Books in the Age of Emerson and Whitman," *J19* 6.2 (2018), 259–83.

DIGITAL PROJECT

"Mabbott Poe: A Digital Resource for the Study of Edgar Allan Poe and the Editing of His Collected Writings by Thomas Ollive Mabbott" (https://mabbottpoe.org/)

TRANS-LATIONS

Morisseau-Leroy, Félix. *Antigòn (excerpt)*. With Robert Fernandez. *Intranslation* (September 2017).

Mallarmé, Stéphane. *Azure: Poems and Selections from the "Livre."* With Robert Fernandez (Middletown, CT: Wesleyan University Press, 2015). Reviews: Alex Ross for *The New Yorker* (April 11, 2016); Jerome Keeler for *The Volta Blog* (June 20, 2016).

SELECTED CONFERENCE PRESENTATIONS

"The Pencil's Progress: A Defense of Messy Handwriting." Day at Dumbarton (The National Society of the Colonial Dames of America/Dumbarton House, Washington, DC), April 28, 2022.

"Graphite Time: The Pencil's Pasts, Presents, and Futures." The Futures of Handwriting, University of Louisville, KY, April 12, 2019.

"Formatting 'Words' in Color: Marking Up Whitman's Most Vibrant Notebooks." Digital Antiquarian Conference and Workshop. American Antiquarian Society, Worcester, MA, 2015

TEACHING

Visiting Assistant Professor, University of Iowa, Iowa City, 2016–2019.

Post-Doctoral Guest Lecturer, Technische Universität Dortmund, Germany, 2014–2016.

Graduate Teaching Assistant, University of Iowa, Iowa City, 2010–2013.

TERRY CATAPANO

The Bancroft Library, Room 475, UC Berkeley: thc4@berkeley.edu

EDUCATION

M.L.S., Rutgers University, School of Communication, Information, and Library Studies, 1999.

M.A. (English), Columbia University, 1994.

B.A. (Comparative Literature), Columbia University, 1987.

EMPLOYMENT

Digital Publications Manager, Mark Twain Project, The Bancroft Library, UC Berkeley, August 2017– .

Librarian, Libraries Digital Program Division, Columbia University, New York, NY, 2003–17.

Digital Library Project Consultant, The New York Botanical Garden, Bronx, NY; The Pierpont Morgan Library, New York; Institute Advanced Technology in the Humanities; Charlottesville, VA; The New York Academy of Medicine, New York; The American Museum of Natural History, New York, 2002–9.

Electronic Text Manager, Digital Library Program, The New York Public Library, New York, NY, 2000–2002.

AWARDS

Andrew W. Mellon Fellowship, Massachusetts Historical Society, for research on the textual history of Cotton Mather's *Magnalia Christi Americana*, 1999–2000.

PUBLICATIONS

Viktor Senderov, Kirin Simov, Nico Franz, Pavel Stoev, Terry Catapano, Donat Agosti, Guido Sautter, Robert A. Morris, Lyubomir Penev (2018) "OpenBiodiv-O: Ontology of the OpenBiodiv Knowledge Management System," *Journal of Biomedical Semantics*. doi: 10.1186/13326-017-0174-5

Jeremy A. Miller, Donat Agosti, Lyubomir Penev, Guido Sautter, Teodor Georgiev, Terry Catapano, David Patterson, David King, Serrano Pereira, Rutger Aldo Vos, Soraya Sierra, "Integrating and Visualizing Primary Data from Prospective and Legacy Taxonomic Publications," *Biodiversity Data Journal*, 3 (2015) doi: 10.3897/BDJ.3.e5063

Robert Guralnick, et al., "Community Next Steps for Making Globally Unique Identifiers Work for Biocollections Data," *ZooKeys*, 494:133–154 (2015) doi:10.3897/zookeys.494.9352.

Gregor Hagedorn, Terry Catapano, Anton Güntsch, Daniel Mietchen, Dag Endresen, Soraya Sierra, Quentin Groom, Jordan Biserkov, Falko Glöckler & Robert Morris, "Best practices for stable URIs" (2013): http://wiki.probiosphere.eu/wiki/Best practices for stable URIs.

Jeremy Miller, Torsten Dikow, Donat Agosti, Terry Catapano, et al., "From Taxonomic Literature to Cybertaxonomic Content," *BMC Biology*, 10:87 (2012) doi:10.1186/1741-7007-10-87.

Lyubo Penev, Terry Catapano, Donat Agosti, et al., "Implementation of TaxPub, an NLM DTD Extension for Domain-specific Markup in Taxonomy, from the Experience of a Biodiversity Publisher," *Journal Article Tag Suite Conference (JATS-Con) Proceedings*. Bethesda (MD): National Center for Biotechnology Information (US); (2012) http://www.ncbi.nlm.nih.gov/books/NBK100351/.

Hilmar Lapp, Robert A. Morris, Terry Catapano et al., "Organizing Our Knowledge

of Biodiversity," *ASIST Bulletin* 37 (4) (2011), 38–42.

PROFESSIONAL ACTIVITIES

Technical Lead: The Making and Knowing Project (http://www.makingandknowing.org/), 2015– .

Member: ArchivesSpace Technical Advisory Committee (TAC): 2015–2019.

Chair: Society of American Archivists Schema Development Team; member, Technical Subcommittee for Encoded Archival Description (ex-officio), 2010–15.

Metadata Encoding and Transmission Standard (METS) Editorial Board, 2008–17.

Chief Editor: TaxPub extension of Journal Archiving TagSet (JATS).

Consultant: Social Networks and Archival Context Project (Andrew W. Mellon Foundation Reference # 11200692), University of Virginia, 2012–15.

Consultant: National Science Foundation Grant "Fine-Grained Semantic Markup of Descriptive Data for Knowledge Applications in Biodiversity Domains" (NSF Award #0849982), 2009–12.

Consultant: National Science Foundation Grant "The Hymenoptera Ontology: Part of a Transformation in Systematic and Genome Science" (NSF Award #: 0850223), 2009–12.

Advisor: *Walt Whitman's Annotations* (2011–2014; 2018–2019, National Endowment for the Humanities Award #PW50772-11; PW-253797-17). PI: Matthew Cohen, University of Texas, Austin.

Vice President Plazi Verein: A nonprofit organization with the mission of promoting and supporting open access to digital scientific data and literature through legal advocacy and development of digital tools and services.

Mentor/Administrator: Google Summer of Code 2008 (for Plazi Verein).

Editor: taxonX, XML schema for encoding of taxonomic descriptions.

Consultant: National Science Foundation grant "Collaborative Research: Development of New Digital Library Applications in the Context of a An Ontology for – iosystematics Information Using the Literature of Entomology (Ants)," awarded to American Museum of Natural History.

Advisor: IMLS National Leadership Grant for Libraries (2005–7) funded project "Interoperability of Metadata" awarded to University of Nebraska (Walt Whitman Archive), Brown University and University of Virginia.

Co-editor: EAD 2002 Schema (with SAA/EADWG/EAD Schema Working Group).

Editorial Board Member: Research Library Group, Cultural Materials Alliance – Description Advisory Group, 2003–4.

Advisor: IMLS National Leadership Grant for Libraries (2002–4) funded project "A Virtual Archive of Whitman's Manuscripts."

C. F. W. Coker Award for Description, Society of American Archivists, 2006.

Trainer: Text Encoding Initiative Guidelines workshop, Text Encoding Initiative Members Meeting, Chicago, October 10, 2002.

KERRY DRISCOLL

The Bancroft Library, Room 475, UC Berkeley: kerrydriscoll@berkeley.edu

EDUCATION

Ph.D. (English), State University of New York, Buffalo, 1984.
M.A. (English), State University of New York, Buffalo, 1982.
B.A. (English, *magna cum laude*), University of Connecticut, Storrs, 1977.

EMPLOYMENT

Editor, Mark Twain Project, The Bancroft Library, UC Berkeley, 2019– .
Professor of English (Emerita), University of Saint Joseph, West Hartford, CT, 1990–1993; 1994–2018.
Senior Fulbright Lecturer, Dept. of English and American Studies, University of Heidelberg, Germany, 1993–1994.
Assistant Professor of English, Elmira College, Elmira, NY, 1985–86; 1987–1990.
Junior Fulbright Lecturer, Department of English and American Studies, University of Heidelberg, Germany, 1986–1987.

AWARDS

Scholar in Residence, Center for Mark Twain Studies at Quarry Farm, Elmira, NY, 2018.
Reverend John J. Stack Teaching Excellence Award, University of St. Joseph, May 2011.
NEH Faculty Fellowship, January–December 2007 for work on book manuscript, *Mark Twain among the Indians*, a designated "We, the People" project promoting knowledge and understanding of American history and culture.
Choice 1988 Outstanding Academic Book Award for *William Carlos Williams and the Maternal Muse*.

PUBLICATIONS

"Mark Twain's Masculinist Fantasy of the West." *Mark Twain Annual* (2022) 20: 100–114.
Mark Twain among the Indians and Other Indigenous Peoples. Berkeley: University of California Press, 2018.
"Race and Ethnicity: Native Americans," in *Mark Twain in Context*, ed. John Bird, Cambridge University Press, 2020.
"Tribute to Victor Fischer," *Mark Twain Annual*, No. 14, 2016, 1–2.
"Privacy and Society in a Manner Conjoined," *Mark Twain Annual*, No. 13, 2015: 195–97.
"The Anarchy of Imagination," *Mark Twain Annual*, No. 8, 2010: 19–21.
"The Fluid Identity of 'Petrified Man,'" *American Literary Realism*, 41:3 (2009): 214–31.
"Mark Twain's Music Box: Livy, Cosmopolitanism, and the Commodity Aesthetic," in *Cosmopolitan Twain*, edited by Ann Ryan and Joseph McCullough. Columbia: University of Missouri Press, 2008: 140–86.
"Man Factories' and the 'White Indians' of Camelot: Re-reading the Native Subtext of *A Connecticut Yankee in King Arthur's Court*," *Mark Twain Annual*, No. 2, 2004: 6–25.
Critical Afterword and Endnotes, Mark Twain's *A Tramp Abroad*. New York: Modern Library, 2003: 343–68.
Endnotes, Mark Twain's *The Innocents Abroad*. New York: Modern Library, 2003:

495–523.

" 'Only Heedlessly a Savage': Mark Twain's 'Indian' Identity," *Mark Twain Journal* (Korea) 6, Winter 2001: 5–17.

William Carlos Williams and the Maternal Muse. Ann Arbor: UMI Research Press, 1987.

PROFESSIONAL ACTIVITIES

Liaison, Mark Twain Center for Transatlantic Studies, currently in development at former US Army Base in Heidelberg, Germany.

Member, Board of Trustees, Mark Twain House and Museum, 2017– .

President, Mark Twain Circle of America, 2016–2018.

Vice-President, Mark Twain Circle of America, 2014–2016.

Executive Coordinator, Mark Twain Circle of America, 2005–2011.

Co-Chair, 8th International State of Mark Twain Studies Conference, Elmira College, 3–6 August 2017.

Guest Curator, "Travel is Fatal to Prejudice: Mark Twain's Journeys Abroad," Mark Twain House and Museum, Hartford, March 2015–March 2016.

Book Review Editor, *Mark Twain Annual*, 2013–2019. Contributing

Editor, *Mark Twain Annual*, 2007– .

Speaker: "Historicizing Injun Joe," Conference Keynote, Hannibal, MO, July 2019.

Speaker: "Mark Twain and the Native Other," LeMoyne College, Syracuse, NY, March 2018.

Speaker: "'My Love and Patriarchal Blessing': Mark Twain and the Saturday Morning Club of Hartford," 8th International Conference on the State of Mark Twain Studies, Elmira College, NY, August 2017.

Speaker: "Mark Twain and Governor Davey's Proclamation," 7th International Conference on the State of Mark Twain Studies, Elmira College, NY, August 2013.

Roundtable Participant: "Mark Twain and Comparative Racial Formation," C19 (Conference for 19th Century American Literature), Berkeley, CA, April 2012.

BENJAMIN GRIFFIN

The Bancroft Library, Room 475, UC Berkeley: bgriffin@berkeley.edu

EDUCATION

M.S.L.S., Catholic University of America, 2004.
Ph.D. (English), Cambridge University, 1997.
M.Phil. (Medieval and Renaissance Studies), Cambridge University, 1993.
B.A. (English), *summa cum laude*, UC Berkeley, 1990.

EMPLOYMENT

Associate Editor, Mark Twain Project, The Bancroft Library, UC Berkeley, 2005– .
Lecturer, English Department, UC Berkeley, 2018.
Editor, Early English Books Online, University of Michigan Libraries, Ann Arbor, 2004–5.
Rare Books Cataloger, Folger Shakespeare Library, Washington DC, 2001–2003.
Catalog Editor, Bauman Rare Books, Philadelphia, 1999–2001.
Lecturer, English Department, UCLA, 1998–1999.

AWARDS

Distinguished Lecturer, Center for Mark Twain Studies, Elmira College, 2014.
UC Berkeley Spot Award for Outstanding Service, 2011.
Fletcher Jones Foundation Fellowship, Huntington Library, 1999.
Leslie Wilson Research Scholarship, Magdalene College, Cambridge, 1993–1996.
Overseas Research Scholarship and Bursary, 1992–1995.
Phi Beta Kappa, elected 1990.
Kraft Scholarship Prize for Freshmen, UC Berkeley, 1987.

MTP EDITIONS

Editor, *Pudd'nhead Wilson: A Tale by Mark Twain. Critical Edition*. Forthcoming from University of California Press.
Associate editor, *Mark Twain's San Francisco Correspondence 1865–1866*. With Richard E. Bucci. Forthcoming from University of California Press.
Editor, *Autobiography of Mark Twain, Volume 3*. With Harriet Elinor Smith. University of California Press, 2015.
Editor, *A Family Sketch and Other Private Writings by Mark Twain: Livy Clemens; Susy Clemens*. University of California Press, 2014.
Editor, *Autobiography of Mark Twain, Volume 2*. With Harriet Elinor Smith. University of California Press, 2013.
Associate editor, *Autobiography of Mark Twain, Volume 1*. With Harriet Elinor Smith. University of California Press, 2010.
Contributing editor, *Mark Twain's Letters, 1876–1880*. Mark Twain Project Online, 2007.

OTHER PUBLICATIONS

" 'That's Where the Work Is': An Interview with Dr. Benjamin Griffin" (interviewed by Takuya Kubo), *Mark Twain Studies* 6 (2023), 52–60.
Mark Twain's Civil War: "The Private History of a Campaign That Failed." The Bancroft Library and Heyday Books, 2019.
"Written under the Pseudonym of 'Sam Clemens': An Address to the Japan Mark Twain Society," *Mark Twain Studies* 5 (2019), 15–23.
"Aaron's Name," *Shakespeare Quarterly* 68 (Fall 2017), 296–99.
"Mark Twain's First Caricaturist: Edward Jump," *Twainquotes.com*, 2017:

http://www.twainquotes.com/MTFirstCaricature.html

"A Dialogue on the *Autobiography*." With Victor Fischer. In *Mark Twain and Youth: His Life and Writings*, eds. Kevin Mac Donnell and R. Kent Rasmussen (London: Bloomsbury Academic, 2016).

"Twins of Genius—Not!," *Twainquotes.com*, 2015: http://www.twainquotes.com/TwinsOfGeniusNot.html

"Mark Twain's Apocrypha: Infant Jesus and Young Satan," *Mark Twain Annual* 14 (2016), 7–19.

"Unveiling Mark Twain's *Family Sketch*," *Mark Twain Annual*, 11 (2013), 109– 12.

"American Laughter: Nietzsche Reads *Tom Sawyer*," *New England Quarterly* 83 (2010), 129–41.

"Emending Caliban's 'Scamels'," *Notes and Queries* n.s. 53 (2006), 494–95. Republished in *Shakespearean Criticism*, vol. 155 (Detroit: Gale, 2014), 237–38.

"Moving Tales: Narrative Drift in Oral Culture and Scripted Theater," *New Literary History* 37 (2006), 725–38.

"Mark Twain on the English University: A New Letter," *Magdalene College Magazine* n.s. 50 (2006): 95–99.

Playing the Past: Approaches to English Historical Drama, 1385–1600 . Woodbridge: D. S. Brewer (2001).

"The Breaking of the Giants: Historical Drama in Coventry and London," *English Literary Renaissance*, 29 (1999), 3–21.

"The Birth of the History Play: Saint, Sacrifice, and Reformation," *Studies in English Literature*, 39 (1999), 217–37.

"Marring and Mending: Treacherous Likeness in Two Renaissance Controversies," *Huntington Library Quarterly* 60 (1999), 363–80.

"*Locrine* and the Babington Plot," *Notes and Queries* n.s. 44 (1997): 37–40.

"Nashe's Dedicatees: William Beeston and Richard Lichfield," *Notes and Queries* n.s. 44 (1997): 47–49.

Annual reviews, Shakespeare editions and textual studies, *Year's Work in English Studies* vols. 74 (1996) and 75 (1997).

TEACHING Research Seminar: "Mark Twain," UC Berkeley English Department, 2018.
Humanities, X145 ("Joyce's *Ulysses*"), UC Berkeley Extension, 2008.
English 4 ("Critical Reading and Writing"), Department of English, UCLA, 1999.
English 95B ("History of World Drama"), Department of English, UCLA, 1998.
English 142A ("Shakespeare: Early"), Department of English, UCLA, 1998–1999.
English 142B ("Shakespeare: Later"), Department of English, UCLA, 1998–1999.

RECENT TALKS AND PAPERS: MLA Convention, San Francisco; Mark Twain Luncheon Club, Berkeley; 8th International Conference on Mark Twain Studies, Elmira, NY; Mark Twain Society of Japan, Kanazawa; Colégio do Sagrado Coração de Maria, Lisbon; Mark Twain Library, Redding, CT; Mark Twain House and Museum, Hartford, CT; The 2nd Clemens Conference, Hannibal, MO; Elmira College (NY) Center for Mark Twain Studies; Berkeley Breakfast Club; Rotary Club, Oakland, CA; 92nd Street Y, NY; etc.

ROBERT H. HIRST

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EDUCATION

Ph.D. (English), University of California, Berkeley, 1976.
M.A. (English), University of California, Berkeley, 1965.
B.A. (English), Harvard University, 1963.

EMPLOYMENT

Head, and Curator, Mark Twain Papers; also, General Editor, Mark Twain Project, The Bancroft Library, University of California, Berkeley, 1980– .
Adjunct professor, Department of English, University of California, Berkeley, 1996–2013.
Assistant professor, Department of English, UCLA, 1976–1979.
Principal editor, Senior editor, Editor, and Editorial assistant, Mark Twain Papers, The Bancroft Library, University of California, Berkeley, 1966–1976.

AWARDS

John Tuckey Lifetime Achievement Award for Contributions to Mark Twain Studies, Elmira College, NY, 2013.
Honorary D. Litt., Elmira College, NY, 2010.
Thomas A. Tenney Award to Robert H. Hirst and the staff of the Mark Twain Project, Mark Twain Circle of America, 2008.
Certificate of Merit to Robert H. Hirst and the Mark Twain Project, Mark Twain Circle of America, 1994.

PUBLICATIONS

As General Editor, Mark Twain Project:

The Innocents Abroad, forthcoming; *San Francisco Correspondence 1865–1866*, forthcoming; *Autobiography of Mark Twain*, Volume 3. 2015; *A Family Sketch and Other Private Writings by Mark Twain: Livy Clemens; Susy Clemens*. 2014; *Autobiography of Mark Twain*, Volume 2, 2013; *Autobiography of Mark Twain*, Volume 1, 2010; *Letters Newly Published, Part 1*, 2010 (MTPO); *Who Is Mark Twain?* HarperStudio, 2009; *Mark Twain's Book of Animals*. 2009; *Mark Twain's Letters, 1876–1880*. 2007 (MTPO); *Mark Twain Project Online*, 2007–present; *Is He Dead? A Comedy in Three Acts*, 2003; *Mark Twain's Helpful Hints for Good Living: A Handbook for the Damned Human Race*, 2004; *Adventures of Huckleberry Finn*, Rev. ed., 2003; *Mark Twain's Letters, Volume 6*, 2002; *Microfilm Edition of Mark Twain's Manuscript Letters Now in the Mark Twain Papers*, 2002; *Microfilm Edition of Mark Twain's Literary Manuscripts Available in the Mark Twain Papers*, 2002; *Microfilm Edition of Mark Twain's Previously Unpublished Letters*, 2002; *Adventures of Huckleberry Finn*, rev. ed., 2001; *Mark Twain Papers: Index to the Microfilm*, 1999; *Mark Twain's Letters, Volume 5*, 1997; *Roughing It*, rev. ed., 1996; *Mark Twain's Letters, Volume 4*, 1995; *Roughing It*. Rev.ed., 1993; *Union Catalog of Letters to Clemens*, 1992; *Mark Twain's Letters, Volume 3*, 1991; *Mark Twain's Letters, Volume 2*, 1990; *Huck Finn and Tom Sawyer among the Indians*, 1989; *Mark Twain's Letters, Volume 1*, 1988; *Adventures of Huckleberry Finn*, 1988; *Union Catalog of Clemens Letters*, 1986; *Adventures of Huckleberry Finn*, 1985; *A Connecticut Yankee in King Arthur's Court*, 1983; *The Prince and the Pauper*, 1983; *Tom Sawyer Abroad & Tom Sawyer, Detective*, 1982; *The Adventures of Tom Sawyer*, 1982; *No. 44, The Mysterious Stranger*, 1982; *Early Tales & Sketches, Volume 2*, 1981.

Co-editor:

The Innocents Abroad, forthcoming; *San Francisco Correspondence*, forthcoming; *Early Tales & Sketches, Volume 2*, 1981; *Early Tales & Sketches, Volume 1*, 1979.

Author:

"A Note on the Text" in each of 29 volumes of the Oxford Mark Twain. General Editor, Shelley Fisher Fishkin. Oxford University Press, NY, 1996. "Editing Mark Twain, Hand to Hand, 'Like All D—d Fool Printers,' " *PBSA* 88 (June 1994): 157–88; "Note on the Text," *Adventures of Huckleberry Finn*, illustrated by Barry Moser, foreword by Henry Nash Smith (Berkeley, Los Angeles, London: University of California Press, 1986), 415–17; "The Mark Twain Project: 'The Most Significant Ongoing Editorial Enterprise in the Country,'" *The General Library Faculty Newsletter*, October 1983: 2–3; "The Unmarked Twain," *California Monthly* 92 (July 1982): 15–17; "Mark Twain Becomes a Writer," *Wilson Quarterly* 4 (Autumn 1980): 168–81; " 'He Trimmed & Trained & Schooled Me': How Bret Harte Edited *The Innocents Abroad*": accepted by David Erdman for 1979 publication in *Bulletin of Research in the Humanities*, but never published; "The Making of *The Innocents Abroad*: 1867–1872," Ph.D. diss., 1975, Department of English, University of California, Berkeley: accepted in 1979 by the University of Nebraska Press, but never published.

Co-author:

The Grangerford-Shepherdson Feud. With Edgar Marquess Branch. Berkeley: The Friends of The Bancroft Library, 1985.

"William E. James's Stereoscopic Views of the *Quaker City* Excursion." With Brandt Rowles. *Mark Twain Journal* 22 (Spring 1984): 15–33.

PROFESSIONAL ACTIVITIES

Chair, Committee on Scholarly Editions (CSE) of the Modern Language Association (MLA): two consecutive terms, 1996–2000 and 2000–2001.

Project faculty member for "Literature and Writing," an NEH-sponsored summer seminar for high-school teachers at Illinois State University, Normal, IL, directed by R. L. Tarr and R. Fortune, 27–31 July 1998.

Member of the Publications Committee, Bibliographical Society of America, 1995–1997.

Advisory Board, 1995–2001, *Oxford Reader's Companion to Mark Twain*, ed. Camfield.

Council member, Bibliographical Society of America, 1994–97, 1997–2000.

CSE vettor or consultant for editions of: Robinson Jeffers; Robert Duncan; Thomas Carlyle; William James, John Dewey; W. D. Howells.

Executive Committee on Methods of Literary Research of the MLA, 1986–1990.

Consultant to the Library of America, 1986–1992, for *Mark Twain's Collected Tales, Sketches, Speeches: 1852–1890* and *Collected Tales, Sketches, Speeches: 1891–1910*, ed. Louis J. Budd. New York: Literary Classics of the U.S., 1992.

Member, Committee on Scholarly Editions (CSE) of the MLA, 1985–1989. Advisory Board, Charles Sanders Peirce Edition Project, Indianapolis, 1985–2015. NEH reviewer and panelist, from time to time, between 1980 and 2017.

Bibliography

This list gathers: (1) key primary documents to be drawn on in making the proposed editions; (2) selected scholarly contributions that are touchstones for our editorial approach; and (3) full references for documents referred to elsewhere in this Narrative.

1. Key primary documents

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——. 1867–68. Letters from Mark Twain to the San Francisco *Alta California*, New York *Herald*, and New York *Tribune*. 82 letters in all. Microfilms in the Mark Twain Papers.

——. 1869. *The Innocents Abroad; or, The New Pilgrims' Progress*. Hartford: American Publishing Company.

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2. Selected scholarly contributions

Bowers, Fredson. 1975. *Essays in Bibliography, Text, and Editing*. Charlottesville: Bibliographical Society of the University Press of Virginia.

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Bucci, Richard. 2003–2004. "Tanselle's 'Editing without a Copy-Text': Genesis, Issues, Prospects." *Studies in Bibliography* 56: 1–44.

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Edwards, Philip. 1984. "The Function of Commentary." In G. B. Shand and Raymond C. Shady, eds., *Play-Texts in Old Spelling: Papers from the Glendon Conference* (New York: AMS Press), 97–103.

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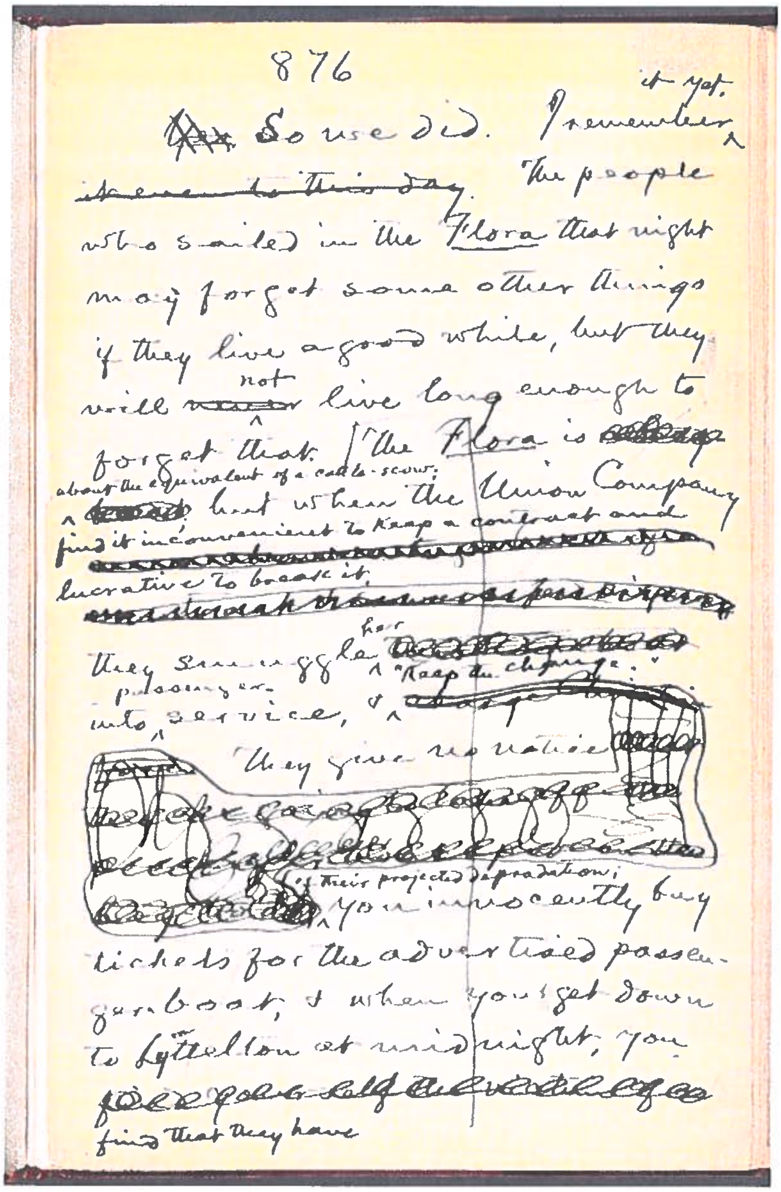
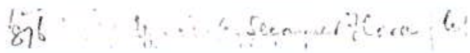
Olsen-Smith, Steven. 2022. "CSE Vetter Report: Mark Twain, *Pudd'nhead Wilson* Manuscript and Revised Versions." Copy sent by Steven Olsen-Smith to Benjamin Griffin, 20 August 2022.



The snippet below is from a memo by A
Chatto, Clemens's London publisher, lis
passages in the *Following the Equator* n
which he proposed to suppress, among
highly critical account of a rough journe
steamer. (There are twenty-two such su
passages in all.) Clemens was urged by
delete the "libelous" passage, and obey
it has never appeared in any British or
Commonwealth edition. Only MS p. 876
here; the transcription, on the next pag
the text of p. 877. The ◊ denotes a char
yet deciphered by the editors.



Above: from Andrew Chatto's memo: "8
Union Co Steamer Flora (libelous?)" (Un
Virginia, Albert and Shirley Small Specia
Collections Library).

Left: *Following the Equator* manuscript p
(New York Public Library, Berg Collectio

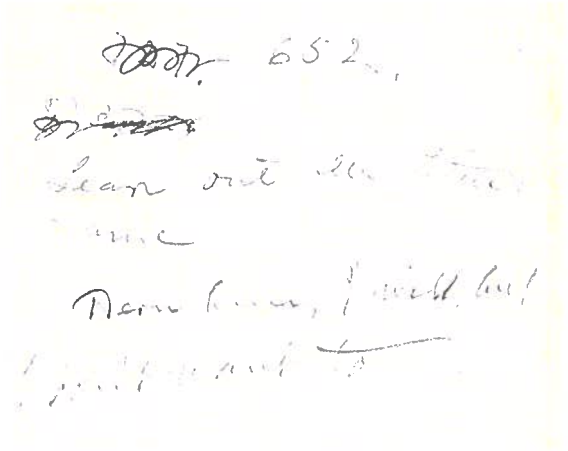
In place of a table of variants, our web edition will feature a full transcription of the entire MS; in this passage, the transcription reveals the true extent of Clemens's indignation.

[*Sunday, 17th.* Sailed last night in the *Flora*, from Lyttelton.]

~~Yes, s~~ S o we did. I remember ~~it even to this day.~~ it yet. The people wh sailed in the *Flora* that night may forget some other things if they live a good wh but they will ~~never~~ not live long enough to forget that. ~~The *Flora* is a hog-boat; about the equivalent of a cattle-scow; a◊◊◊ ◊◊◊◊◊ ◊◊ to g◊◊ back of a contract a s◊◊◊et a fe◊d sixpence,~~ ~~but when the Union Company find it inconvenient to ke contract and lucrative to break it, they smuggle this hog-boat her into passeng service, and charge Christian fare. "keep the change." They give no notice that they are going to take off the passenger-boat and put on the hog-boat; of their projected depredation; you innocently buy tickets for the advertised passenger b and when you get down to Li y ttelton at midnight, you find yourself the victim c cold swindle: they have find that they have substituted the hog-boat. It scow.~~ [*o verso*: ~~Substituted it~~ | They have plenty of good boats, but no competition—and tl is the trouble. | over again] ~~It is too late now to make other arrangements, if you have engagements ahead.~~

~~It is a powerful company, it has a monopoly, and everybody is afraid of i including the government's representative, who stands at the end of the stage pla to tally the passengers and see that no boat receives a greater number than the law allows her to carry. This conveniently blind representative saw the hog-boat rece nearly dou scow receive a number which was far in excess of that hog-boat's it privilege, and winked a politic wink and said nothing. The passengers bore with meekness the cheat which had been put upon~~ [. . .]

Before one of Clemens's books faced the publisher's censorship, it faced (with his approval and connivance) the domestic Olivia, regularly edited his manuscripts before they were sent to the printer. The only substantial documentation of her wo note-pages (in the Mark Twain Papers) on which she critiqued *Following the Equator*, querying irreverence, rudeness, anc notes, and Mark Twain's characterful replies, will be fully transcribed and annotated in the Mark Twain Project edition. O transcribed in normal type, Clemens's replies in **bold**.

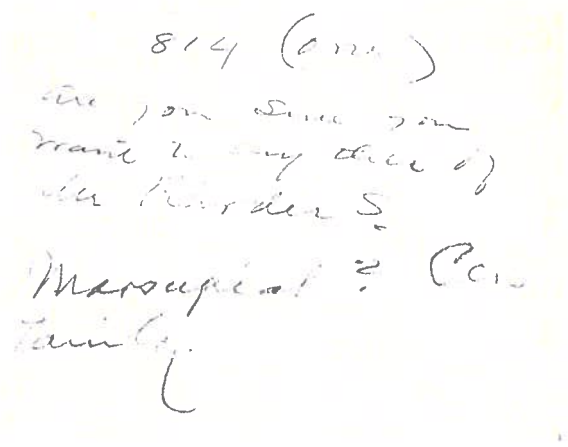


~~727.~~ 652.

Leave out Mr Little's name

Dern him, I will, but I don't want to

In the MS, Clemens quoted fron high-flown speech by William Li Ballarat in Victoria (Australia), Clemens party had visited late i Clemens took Olivia's advice, de on reconsideration, however, he decision and exposed Mr. Little of posterity.

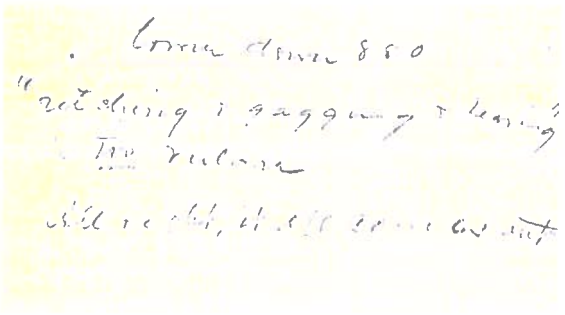


814 (over)

Are you sure you want to say this of Mr Rhodes?

Marsupial? Certainly.

Clemens left unaltered his refer Rhodes as one of "the principal Southern Hemisphere." *But it n Olivia's query that moved him t putting himself on the same lev* the latest marsupial. Also, I mig have the largest pocket of them nothing in that."



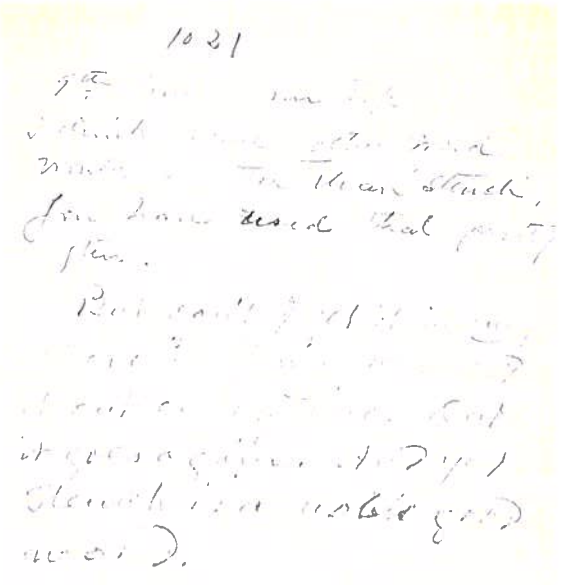
lower down 880

"retching & gagging & heaving" is *too* vulgar

All right, it all comes out

From his description of the seasi the Flora *(see the preceding Sam "it all comes out"—evidently inc shipboard dialogue:*

"Boo-oo-*oork!* ~~Oh,~~ oh, m-m-y "*Mom*ma! *mom*ma! oh, momm oh!"

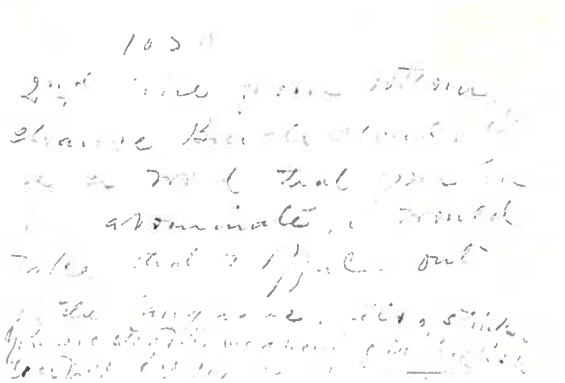


1021

9th line from top
I think some other word would be better than "stench", you have used that pretty often.

But can't I get it in *any*-where? You've knocked it out every time. Out it goes again. And yet stench is a noble good word.

Clemens altered 'repulsive as a s a shroud'. *In the surviving manu but one other* 'stench'—*itself a r original* 'stink', *to which Olivia all the manuscript material has s have been other "stenches" in cl*

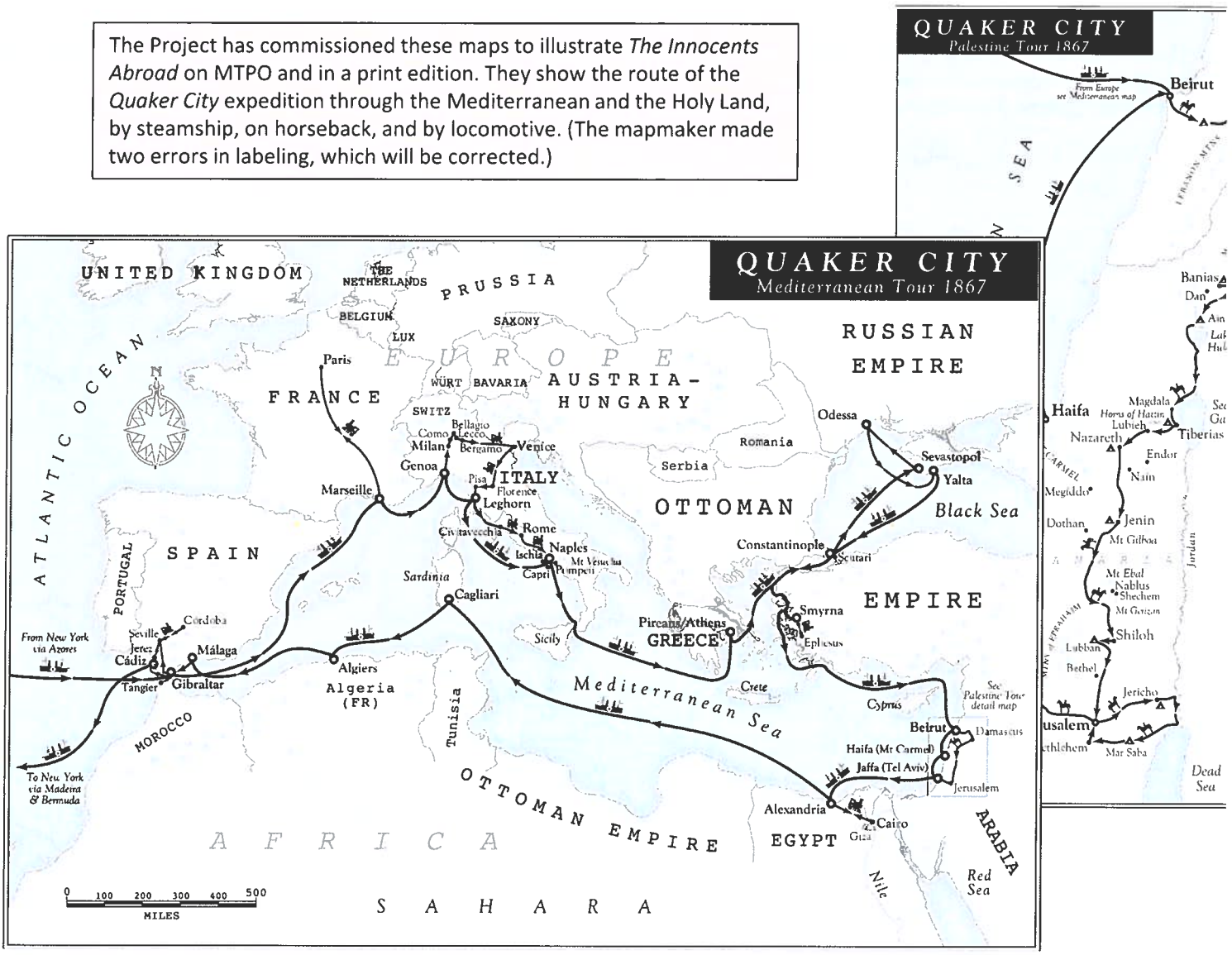


1050
2nd line from bottom.
Change Breechclout. It is a word that you love & I abominate. I would take that & offal out of the language. Also, stink.

You are steadily weakening the English tongue, Livy.

The manuscript's list of Indian p real and burlesque titles, had inc Breechclout of Buggheree." *It is objected to "breechclout," while recognizing—the other word.*

The Project has commissioned these maps to illustrate *The Innocents Abroad* on MTPO and in a print edition. They show the route of the *Quaker City* expedition through the Mediterranean and the Holy Land, by steamship, on horseback, and by locomotive. (The mapmaker made two errors in labeling, which will be corrected.)



3[d] Jan 1865 returned with Jim Gillis, by way of Angel's & Robinson's Ferry, to Jackass Hill.

<Miner's cabin, Jackass>
<*miner's*> miner's cabin in Jackass:[7]
<B> No planking on the floor; <[-]> old <punks> bunks, pans & <tra> traps of all kinds—Byron Shakspeare, Bacon Dickens, & every kinds of only first class Literature[8]

The "Tragedian" & the Burning Shame. No women admitted[9] [#]

[7] In this entry, probably a description of Jim Gillis' cabin, and in the succeeding three entries Mark Twain experimented with shorthand, combining symbols with script letters when he did not know the appropriate notation. Letters that appear in italics in these entries are transliterations of the original shorthand.

[8] In "An Unbiased Criticism" (*Californian*, 18 March 1865, reprinted in SSix, pp. 158–165), Mark Twain would comment that "in most of those little camps they have no libraries, and no books to speak of, except now and then a patent-office report, or a prayer-book, or literature of that kind, in a general way, that will hang on and last a good while when people are careful with it, like miners; but as for novels, they pass them around and wear them out in a week or two." Some of the "first class Literature" noted here may have been borrowed at nearby Tuttletown, which Billy Gillis recalled had "a Literary Society, with a membership of three hundred, having a library of near a thousand volumes of standard prose and poetical works" (Gillis, *Gold Rush Days with Mark Twain*, p. 11).

[9] In his Autobiographical Dictation of 26 May 1907 (*MTE*, p. 361), Mark Twain recalled: "In one of my books—*Huckleberry Finn*, I think—I have used one of Jim's impromptu tales, which he called 'The Tragedy of the Burning Shame.' I had to modify it considerably to make it proper for print, and this was a great damage. As Jim told it, inventing it as he went along, I think it was one of the most outrageously funny things I have ever listened to. How mild it is in the book, and how pale; how extravagant and how gorgeous in its unprintable form!" The Tragedian may have been Jim Gillis, or possibly a character in a Shakespearean burlesque portrayed by Dick Stoker, who did appear in a private performance of the "Burning Shame" while Mark Twain was on Jackass Hill. On 26 January 1870, in a letter to Jim Gillis, Mark Twain remembered Stoker's part in that dramatization: "Wouldn't I love to take old Stoker by the hand, & wouldn't I love to see him in his great speciality, his wonderful rendition of 'Rinaldo' in the 'Burning Shame!'" (Edward L. Doheny Memorial Library, Saint John's Seminary, Camarillo, Calif.). All of the elements of this entry recur in *Huckleberry Finn* where the King and Duke perform "The King's Camelopard or The Royal Nonesuch," the expurgated version of the "Burning Shame," and also appear as "*World-Renowned Tragedians*" in renditions of ridiculously incongruous Shakespearean quotations.

The *Notebooks and Journals* make up volumes in the published Mark Twain series (1975-79). Its transcriptions w as being highly accurate; since then, the Project has developed "plain text responsible and more detailed transc protocol. We propose to put a revise digital manuscript images, on the sec iteration of Mark Twain Project Onlir

At left is a sample page from the prir (Volume 1, 1975).

Page 4b shows the prototype for the *Notebooks & Journals* on MTPO2, wit updated transcription on the left, an facsimile of the notebook page in a p window on the right. The key for ider types of linked information on the le the screen includes a toggle, which d hides the page numbers of the printe volume (here, "MTP:N&J1_70"), to a referencing. In the prototype, the co the whole notebook are scrollable on web page. The link for the annotatior "sticky," so always available. Please n only a piece of the annotation could l this sample page.

Page 4c shows a sample of XML mark these Notebook entries.

printed volume page number "MTP: N&J1_70" (i.e., Mark Twain Project: Notebooks & Journals, volume 1, page 70) (See page break toggle below.)

Manuscript page number "MS: N4_leaf_004r" (i.e., Manuscript: Notebook 4, leaf 4, recto)

fingernail of di that opens pop digital facsimil

endnote key

Editorial Notes

are indicated by superscript numbers.

Apparatus Notes

Ⓣ = Textual Notes

Ⓔ = Emendations

toggle printed volume page numbers

Turn page breaks from print volume on/off ☑

toggle line breaks to help users read MS facsimile

Turn MS linebreaks on/off ☑

Back to Top

[MS: N4_leaf_004r]

[MTP: N&J1_70]

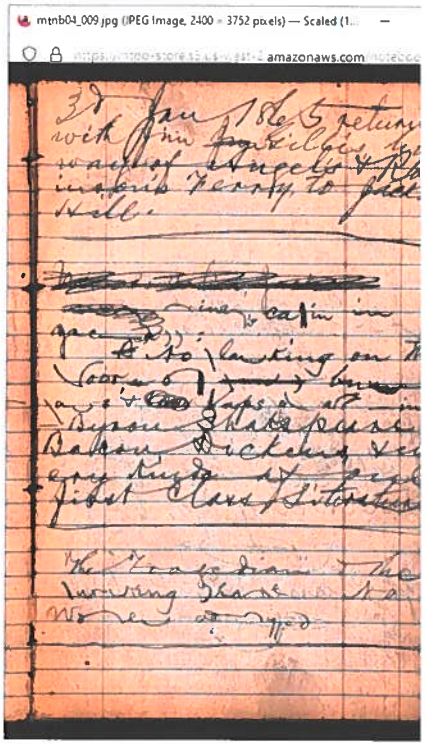
3 [1]Jan 1865 returned with Jim Gillis, by way of Angel's & Robinson's Ferry, to Jackass Hill.

~~Miner's cabin, Jackass~~

~~miner's~~ *miner's cabin in Jackass:*[7]

Ⓣ No *planking on the floor;* ~~[–]~~ *old* ~~*punks*~~ *bunks, pans &* ~~*tra*~~ *traps of all kinds* —Byron Shakspeare, Bacon Dickens, & every kinds of only ~~first class~~ Literature[8]

The "Tragedian" & the ~~*Burning*~~ Sha*me*. No wo*men* ad*mitted*[9]



Superscript blue numbers link to editorial notes at bottom of the page (no "apparatus notes" for this notebook page).

[9] In his Autobiographical Dictation of 26 May 1907 (*MTE*, p. 361), Mark Twain recalled: "In one of my books—*Huckleberry Finn*, I think—I have used one of Jim's impromptu tales, which he called 'The Tragedy of the Burning Shame.' I had to modify it considerably to make it proper for print, and this was a great damage.

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<p>3<hi rend="superscript">d</hi> Jan 1865 returned<lb/>
with Jim Gillis, by <lb/>
way of Angel's &amp;amp; <choice><orig>Rob-<lb/>
inson's</orig><reg>Robinson's</reg></choice> Ferry, to Jackass<lb/>
Hill.</p>
<milestone unit="section" rend="plainrule" />
<p><del>Miner's cabin, Jackass</del></p>
<p><del><hi rend="italic">m</hi>in<hi rend="italic">er's</hi></del> <hi rend="italic">m</hi>ine<hi rend="italic">r</hi>'s ca<hi rend="italic">b</hi>in in <lb/>
Jac<hi rend="italic">k</hi>a<hi rend="italic">ss</hi>;<note type="ed" resp="#MTP" n="7" place="foot" xml:id="la0244">In this entry, probably a description of Jim Gillis' cabin, a
succeeding three entries Mark Twain experimented with shorthand, combining symbols with script letters when he did not know the appropriate notation. Letters that appear in italics in t
are transliterations of the original shorthand.</note></p>
<p rend="text-indent:2">&lt;<del>B</del> No <hi rend="italic">plan</hi>king on the<lb/>
<hi rend="italic">floor</hi>; <del><corr>-</corr></del> <hi rend="italic">old</hi> <del><hi rend="italic">punks</hi></del> <hi rend="italic">bunks</hi>, <lb/>
<hi rend="italic">pans</hi> &amp;amp; <del>tra</del> <hi rend="italic">tr</hi>aps <hi rend="italic">of all kind</hi>s<lb/>
—Byron Shakspeare.<lb/>
Bacon Dickens, &amp;amp; <choice><orig>ev-<lb/>
ery</orig><reg>every</reg></choice> kinds of only <lb/>
first class Literature<note type="ed" resp="#MTP" n="8" place="foot" xml:id="la0245">In "An Unbiased Criticism" (<hi rend="italic">Californian</hi>, 18 March 1865, reprinted in
#bib00149 type="dbquery" rend="new"><hi rend="italic">SSix</hi></ref>, pp. 158–165), Mark Twain would comment that "in most of those little camps they have no libraries, and no boo
of, except now and then a patent-office report, or a prayer-book, or literature of that kind, in a general way, that will hang on and last a good while when people are careful with it, like mine
novels, they pass them around and wear them out in a week or two." Some of the "first class Literature" noted here may have been borrowed at nearby Tuttle-town, which Billy Gillis recal
Literary Society, with a membership of three hundred, having a library of near a thousand volumes of standard prose and poetical works" (Gillis, <hi rend="italic">Gold Rush Days with M
Twain</hi>, p. 11).</note></p>
<milestone unit="section" rend="plainrule" />
<p>The "Tragedian" &amp;amp; the <lb/>
<hi rend="italic">Burning</hi> Sha<hi rend="italic">me.</hi> No<lb/>
wo<hi rend="italic">men</hi> ad<hi rend="italic">mitt</hi>ed<note type="ed" resp="#MTP" n="9" place="foot" xml:id="la0246">In his Autobiographical Dictation of 26 May 1907
corresp="#bib00014" type="dbquery" rend="new"><hi rend="italic">MTE</hi></ref>, p. 361), Mark Twain recalled: "In one of my books—<hi rend="italic">Huckleberry Finn</hi>, I think—I
one of Jim's impromptu tales, which he called 'The Tragedy of the Burning Shame.' I had to modify it considerably to make it proper for print, and this was a great damage. As Jim told it, i
he went along, I think it was one of the most outrageously funny things I have ever listened to. How mild it is in the book, and how pale, how extravagant and how gorgeous in its unprintal
Tragedian may have been Jim Gillis, or possibly a character in a Shakespearean burlesque portrayed by Dick Stoker, who did appear in a private performance of the "Burning Shame" w
Twain was on Jackass Hill. On 26 January 1870, in a letter to Jim Gillis, Mark Twain remembered Stoker's part in that dramatization: 'Wouldn't I love to take old Stoker by the hand, &amp;amp;
ove to see him in his great speciality, his wonderful rendition of 'Rinaldo' in the 'Burning Shame!' " (Edward L. Doheny Memorial Library, Saint John's Seminary, Camarillo, Calif.). All of t
of this entry recur in <hi rend="italic">Huckleberry Finn</hi> where the King and Duke perform "The King's Camelopard or The Royal Nonesuch," the expurgated version of the "Burning S
also appear as <hi rend="italic">"World-Renowned Tragedians"</hi> in renditions of ridiculously incongruous Shakespearean quotations.</note></p>
<milestone unit="section" rend="plainrule" />

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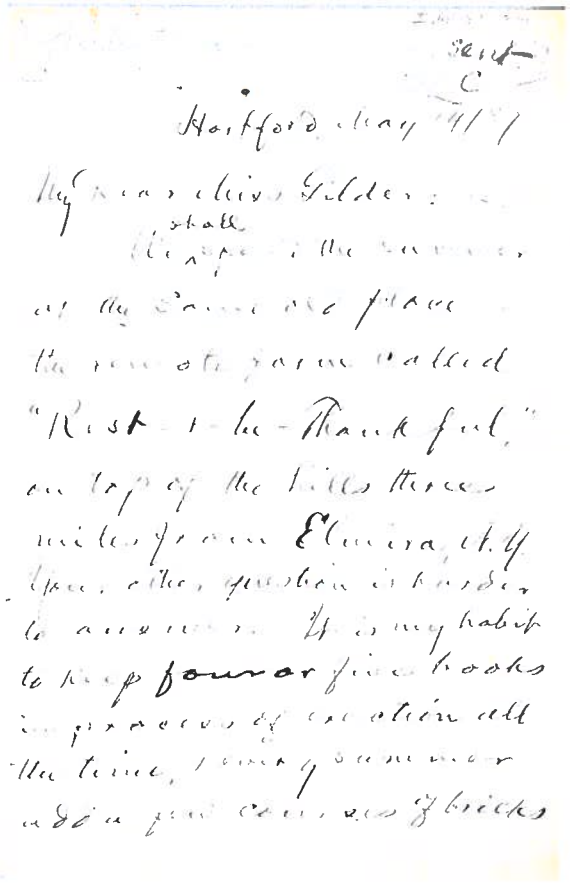
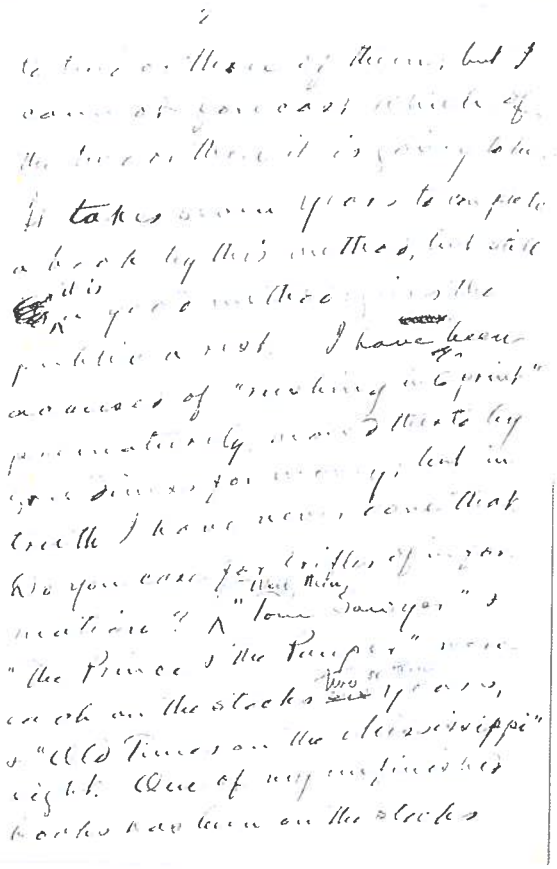
<pb type="MTP" xml:id="qlc_xw4_cyb" edRef="N&amp;J1" n="71" />
```

XML-encoded text underlying the sample page from the digital edition of *Notebooks & Journals*.

Clemens's letter to Jeannette L. Gilder, the editor of *The Critic* and a personal friend, was never sent; but he must have thought discussion of his writing methods, for he preserved the MS and corrected it as if he were considering publication. Since the MS Twain Papers, we will be able to present a digital facsimile alongside the transcription.

To Jeannette L. Gilder
14 May 1887 • Hartford, Conn.
(MS draft: CU-MARK, *UCCL* 03572)





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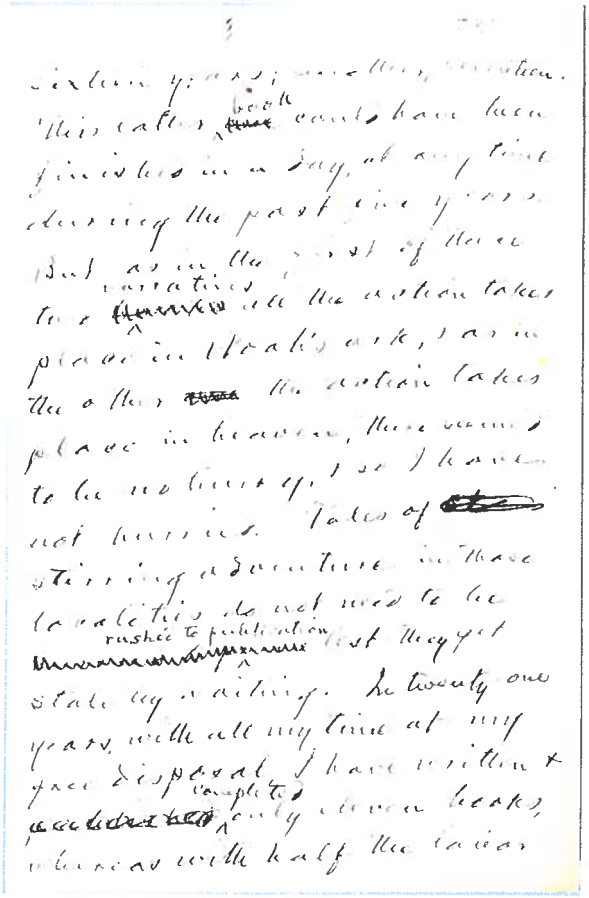
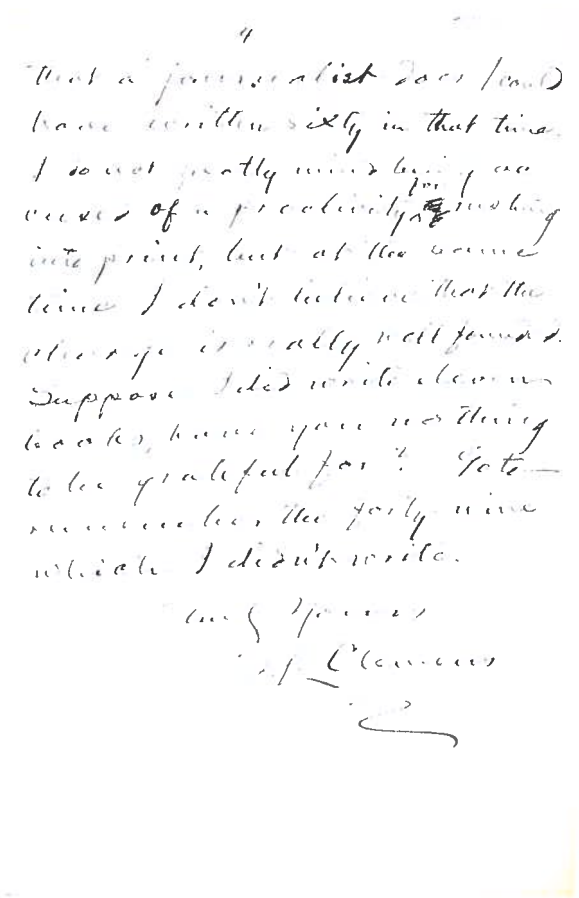
Letter Texts 1886–88





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The following attachment is not included in the view since it is not a read-only PDF file.

Upon submission, this file will be transmitted to the Grantor without any data loss.

Appendices (1).pdf

Past Productivity

The left-hand column reproduces the Plan of Work approved by NEH for our current grant (RQ-279810-22). All work planned for the proposed grant period, from October 2024 to September 2027, is explained in detail in Attachment 2.

TASKS from RQ-279810-22	COMMENTS as of November 2023
Pre-process, convert, post-process, and test *Letters 7* for release on MTPO in the spring of 2022	DONE.
Proofread page, revised, and final proofs for *Pudd'nhead Wilson* for print publication in the fall of 2022	DONE, one year late.
Pre-process, convert, post-process, and test *Pudd'nhead Wilson* for release on MTPO in the spring of 2023	To be completed in the spring of 2024, one year late.
Prepare and proofread the Mark Twain Library edition of *Pudd'nhead Wilson*	UC Press has decided, despite our protests, not to publish a Mark Twain Library version of *Pudd'nhead,* but instead to issue the full scholarly edition in paper covers as well as boards. We doubt that this will get the edition into classrooms, and so will continue to urge a Mark Twain Library version of the texts. Stay tuned.
Proofread page, revised, and final proofs for *Innocents Abroad* for print publication in the late fall of 2022	Delayed by more than a year. We now expect proofs in late 2024, with publication the following spring.
Pre-process, convert, post-process, and test *Innocents Abroad* for release on MTPO in the late spring of 2023	Publication on MTPO must wait for print publication to be completed, so likely 2025.
Prepare and proofread the Mark Twain Library edition of *Innocents Abroad*	Likewise, 2025.
Complete the checking of texts, apparatuses, notes, and introduction for *S. F. Correspondence* for submission to the Press in the fall of 2023	The edition's nonresident editor, Richard Bucci, continues to find and edit new texts for this collection. Partly because of the recent loss of personnel, we decided to postpone further work in the Berkeley office until *Innocents Abroad* has been completed. The volume is, however, in a very advanced state.
Proofread page, revised, and final proofs for *S. F. Correspondence* for print publication by the end of the grant period	

Past Productivity

Identify and collate relevant documents in preparation for establishing the critical text for *Following the Equator*	DONE.
Transcribe, edit, proofread, and prepare apparatuses for letter texts written in 1883–1887	DONE through 1885.
Post-process and test letter texts written 1883–1887 for publication on MTPO by the end of the grant period	Done through 1883; 1884–85 will be completed during the current grant period; 1886–87 have had to be postponed to the current proposal.
Pre-process, convert, post-process, and test *What Is Man?; Hannibal, Huck & Tom; Satires & Burlesques;* and *Early Tales and Sketches, Volumes 1* and *2* for release on MTPO by the end of the grant period	Three of the five have been completed; the remaining two will be completed before the end of the grant period.
Manage and curate MTP's metadata, image, and textual datasets, including improvement of their underlying digital infra-structure, accessibility, and reusability both internally and by others	An intricate, ongoing challenge needed to make the transition to a new website a success.
Continuously improve and develop MTPO's features and interface, balancing its sustainability with the adoption of modern web technologies and integration of compelling new features	See the sample pages from *Notebooks & Journals.*
Optimize workflows to prepare digital texts and data for release on MTPO	We are now using Google Docs and Google Sheets to track work at the XML-encoding, proofreading, revision, and publication stages. This workflow strategy has proven successful with full-time staff and our graduate student assistant since 2022.
Fundraising; public relations; administrative functions; reviewing, guiding, revising editors' work	We succeeded in raising more than $450,000 in matchable gifts for the editorial grant, and somewhat more than $130,000 in matchable gifts for the challenge grant.

Appendix A: Copies Sold, as of 30 June 2023

WORKS AND PAPERS

Letters to His Publishers (1967)	4.255
Which Was the Dream? (1967)	5.683
Satires & Burlesques (1967)	6.262
Mysterious Stranger Manuscripts (1969)	17.231
Correspondence with H. H. Rogers (1969)	3.651
Hannibal, Huck & Tom (1969)	4.979
Fables of Man (1972)	4.264
Roughing It (1972)	19.861
What Is Man? (1973)	3.571
Notebooks & Journals 1 (1975)	3.243
Notebooks & Journals 2 (1975)	3.346
A Connecticut Yankee (1979)	2.301
The Prince and the Pauper (1979)	2.621
Early Tales & Sketches 1 (1979)	2.785
Notebooks & Journals 3 (1980)	2.181
The Adventures of Tom Sawyer &c (1980)	2.373
Early Tales & Sketches 2 (1981)	2.319
Letters 1: 1853–1866 (1988)	5.030
Adventures of Huckleberry Finn (1988)	1.863
Letters 2: 1867–1868 (1990)	3.012
Letters 3: 1869 (1992)	2.953
Roughing It, ***revised*** (1993)	1.152
Letters 4: 1870–1871 (1995)	1.674
Letters 5: 1872–1873 (1997)	1.601
Letters 6: 1874–1875 (2002)	1.078
Adventures of Huckleberry Finn, ***revised*** (2003)	1.675
**Autobiography of Mark Twain 1* (2010)	521.510
‡*Autobiography of Mark Twain 2* (2013)	44.444
Autobiography of Mark Twain 3 (2015)	19.646

MARK TWAIN LIBRARY

No. 44, The Mysterious Stranger (1982/2004)	32.479
‡*The Adventures of Tom Sawyer* (1983/2010/2021)	72.279
Tom Sawyer Abroad & TS, Detective (1983/2004)	14.210
A Connecticut Yankee (1984/2002)	35.384
The Prince and the Pauper (1984/2002)	17.882
Adventures of Huckleberry Finn (1985)	79.720
Huck and Tom among the Indians (1989/2003)	10.251
Roughing It (1996/2003)	21.052
†*Adventures of Huckleberry Finn,* ***revised*** (2001/2010/2021)	97.453

OTHER

The Mysterious Stranger (1969/2005)	17.275
The Devil's Race-Track (1980/2005)	15.263
Huckleberry Finn, Pennyroyal Press (1985)	11.501
Microfilm Edition, Literary Manuscripts (2001)	—
Microfilm Edition, Manuscript Letters (2001)	—
Microfilm Edition, Prev. Unpub. Letters (2001)	—
Is He Dead? (2003)	7.182
†*Mark Twain's Helpful Hints* (2004)	24.459
Who Is Mark Twain? (2009)	34.309
Mark Twain's Book of Animals (2010)	5.993
Autobiography 1, ***reader's edition*** (2012)	16.874
Dear Mark Twain (2013)	1.553
A Family Sketch (2014)	2.258

[Totals include e-book sales.]

* UC Press's bestselling book of all time.
† Among the Press's top 10 bestselling books of all time.
‡ Among the Press's top 25 bestselling books of all time.

Royalties: The original 1962 contract entitled the Mark Twain Foundation (as copyright holder) to a royalty of 10% of the list price on the first 5,000 copies sold, 12.5% on the next 5,000, and 15% on all copies in excess of 10,000. The 1982 revised contract specified the same royalties but required them to be divided between the Mark Twain Foundation and The Bancroft Library, according to how much of the material published in any given volume was under copyright to the Foundation. For some volumes, like the expensive-to-produce *Letters* series, the Press has contracted to pay royalties only when sales reach several thousand copies. Until the publication of the first volume of the *Autobiography* in 2010, royalties on all of our books payable to The Bancroft Library averaged around $7,500 per annum. We do not expect any current or future volume to match the record of the *Autobiography, Volume 1.* The federal share (roughly 50%) of royalties from the *Autobiography* is currently being spent on project expenses not paid for by the current grant, including salaries and benefits for several staff members.

Appendix B: Bibliography of Project Publications

Published by University of California Press, except where otherwise stated.

Adventures of Huckleberry Finn. Revised edition. Ed. Victor Fischer and Lin Salamo, with the late Walter Blair. **Works of Mark Twain.** 2003. At *Mark Twain Project Online.* 2009.

Adventures of Huckleberry Finn. Revised edition. Ed. Victor Fischer and Lin Salamo, with the assistance of Harriet Elinor Smith and the late Walter Blair. **Mark Twain Library** (cloth and paperback). 2001 and (with additional material for the 125th anniversary edition) 2010.

Adventures of Huckleberry Finn. Ed. Walter Blair and Victor Fischer, with the assistance of Dahlia Armon and Harriet Elinor Smith. **Works of Mark Twain.** 1988. [Out of print: superseded by the 2003 edition.]

Adventures of Huckleberry Finn. Ed. Walter Blair and Victor Fischer. **Mark Twain Library** (cloth and paperback). 1985. [Out of print: superseded by the 2001 edition in the Mark Twain Library.]

Adventures of Huckleberry Finn. Illustrated by Barry Moser; foreword by Henry Nash Smith; note on the text by Robert H. Hirst. Pennyroyal Press/California Edition. 1985.

The Adventures of Tom Sawyer; Tom Sawyer Abroad; Tom Sawyer, Detective. Ed. John C. Gerber, Paul Baender, and Terry Firkins. **Works of Mark Twain.** 1980.

The Adventures of Tom Sawyer. Foreword and notes by John C. Gerber; text established by Paul Baender. **Mark Twain Library** (cloth and paperback). 1983, 2002; augmented 135th anniversary edition, 2010 (also at *Mark Twain Project Online,* 2017).

Autobiography of Mark Twain, Volume 1. Ed. Harriet Elinor Smith. Associate eds.: Benjamin Griffin, Victor Fischer, Michael B. Frank, Sharon K. Goetz, and Leslie Myrick. **Mark Twain Papers.** 2010. At *Mark Twain Project Online,* with textual commentaries, 2010.

Autobiography of Mark Twain, Volume 1. Reader's Edition, with Mark Twain's text and a brief new introduction. Ed. Harriet Elinor Smith. Associate eds.: Benjamin Griffin, Victor Fischer, Michael B. Frank, Sharon K. Goetz, and Leslie Myrick. 2012.

Autobiography of Mark Twain, Volume 2. Ed. Benjamin Griffin and Harriet Elinor Smith. Associate eds.: Victor Fischer, Michael B. Frank, Sharon K. Goetz, and Leslie Myrick. **Mark Twain Papers.** 2013. At *Mark Twain Project Online,* with textual commentaries and other additional material, 2013.

Autobiography of Mark Twain, Volume 3. Ed. Benjamin Griffin and Harriet Elinor Smith. Associate eds.: Victor Fischer, Michael B. Frank, Amanda Gagel, Sharon K. Goetz, Leslie Diane Myrick, and Christopher M. Ohge. **Mark Twain Papers.** 2015. At *Mark Twain Project Online,* with textual commentaries and other additional material, 2015.

A Connecticut Yankee in King Arthur's Court. Ed. Bernard L. Stein; intro. Henry Nash Smith. **Works of Mark Twain.** 1979.

A Connecticut Yankee in King Arthur's Court. Ed. Bernard L. Stein. **Mark Twain Library** (cloth and paperback). 1984, 2002, and 2010.

Dear Mark Twain: Letters from His Readers. Ed. R. Kent Rasmussen, with foreword by Ron Powers; texts established by the Mark Twain Project. **Jumping Frogs** (hardcover). 2013.

The Devil's Race-Track: Mark Twain's Great Dark Writings. The Best from "Which Was the Dream?" and "Fables of Man." Ed. John S. Tuckey. Reprints texts from the Mark Twain Papers (cloth

and paperback). 1981 and 2005.

Early Tales & Sketches, Volume 1 (1851–1864). Ed. Edgar Marquess Branch and Robert H. Hirst, with the assistance of Harriet Elinor Smith. **Works of Mark Twain.** 1979.

Early Tales & Sketches, Volume 2 (1864–1865). Ed. Edgar Marquess Branch and Robert H. Hirst, with the assistance of Harriet Elinor Smith. **Works of Mark Twain.** 1981.

A Family Sketch and Other Private Writings, by Mark Twain, Livy Clemens, and Susy Clemens. Ed. Benjamin Griffin. **Jumping Frogs** (hardcover). 2014.

Huck Finn and Tom Sawyer among the Indians, and Other Unfinished Stories. Ed. Dahlia Armon, Walter Blair, Paul Baender, William M. Gibson, and Franklin R. Rogers. **Mark Twain Library** (cloth and paperback). 1989, 2011. At *Mark Twain Project Online.* 2009.

The Innocents Abroad. Ed. Robert Hirst and Harriet Elinor Smith. Associate eds.: Michael B. Frank, Amanda Gagel, and Christopher M. Ohge. **Mark Twain Papers**, forthcoming. At *Mark Twain Project Online,* with textual commentaries and other additional material, forthcoming.

Is He Dead? A Comedy in Three Acts. Ed. with foreword, afterword, and notes by Shelley Fisher Fishkin; text established by the Mark Twain Project. **Jumping Frogs** (cloth and paperback). 2003.

Letters Newly Published, Part 1. Ed. Victor Fischer, Michael B. Frank, Sharon K. Goetz, and Harriet Elinor Smith. At *Mark Twain Project Online.* 2010.

Letters Newly Published, Part 2. Ed. Victor Fischer, with Michael B. Frank, Amanda Gagel, Sharon K. Goetz, Leslie Myrick, and Harriet Elinor Smith. At *Mark Twain Project Online,* forthcoming.

Mark Twain at Large: His Travels Here and Abroad. An Exhibition from the Mark Twain Papers of The Bancroft Library, University of California, Berkeley. 25 September to 11 December 1998. Ed. Lin Salamo, Harriet Elinor Smith, and Robert Pack Browning. Design by Mary Scott. Berkeley: The Bancroft Library, UC Printing Services. 1998.

Mark Twain Project Online. Ed. the Mark Twain Project. http://www.marktwainproject.org/. Launched 2 November 2007.

Mark Twain's Book of Animals. Ed. with introduction, afterword, and notes by Shelley Fisher Fishkin; texts established by the Mark Twain Project. **Jumping Frogs** (cloth and paperback). 2009.

Mark Twain's Civil War: "The Private History of a Campaign That Failed." Ed. Benjamin Griffin. Berkeley: The Bancroft Library (limited edition); Berkeley: Heyday (trade edition). 2019.

Mark Twain's Fables of Man. Ed. John S. Tuckey, Kenneth M. Sanderson, and Bernard L. Stein. **Mark Twain Papers.** 1972.

Mark Twain's Hannibal, Huck & Tom. Ed. Walter Blair. **Mark Twain Papers.** 1969.

Mark Twain's Helpful Hints for Good Living: A Handbook for the Damned Human Race. Ed. Lin Salamo, Victor Fischer, and Michael B. Frank. **Jumping Frogs.** 2004.

Mark Twain's Letters, 1876–1880. Ed. Victor Fischer, Michael B. Frank, and Harriet Elinor Smith, with Sharon K. Goetz, Benjamin Griffin, and Leslie Myrick. At *Mark Twain Project Online.* 2007.

Mark Twain's Letters, 1881–1882. Ed. Victor Fischer, Michael B. Frank, Sharon K. Goetz, and Harriet Elinor Smith, with Amanda Gagel, Benjamin Griffin, Leslie Myrick, and Christopher Ohge. At *Mark Twain Project Online,* forthcoming.

Mark Twain's Letters to His Publishers, 1867–1894. Ed. Hamlin L. Hill. **Mark Twain Papers.** 1967.

Mark Twain's Letters, Volume 1: 1853–1866. Ed. Edgar Marquess Branch, Michael B. Frank, Kenneth M. Sanderson, Harriet Elinor Smith, Lin Salamo, and Richard Bucci. **Mark Twain Papers.**

1988. At *Mark Twain Project Online*. 2007.

Mark Twain's Letters, Volume 2: 1867–1868. Ed. Harriet Elinor Smith, Richard Bucci, and Lin Salamo. **Mark Twain Papers.** 1990. At *Mark Twain Project Online*. 2007.

Mark Twain's Letters, Volume 3: 1869. Ed. Victor Fischer, Michael B. Frank, and Dahlia Armon. **Mark Twain Papers.** 1992. At *Mark Twain Project Online*. 2007.

Mark Twain's Letters, Volume 4: 1870–1871. Ed. Victor Fischer, Michael B. Frank, and Lin Salamo. **Mark Twain Papers.** 1995. At *Mark Twain Project Online*. 2007.

Mark Twain's Letters, Volume 5: 1872–1873. Ed. Lin Salamo and Harriet Elinor Smith. **Mark Twain Papers.** 1997. At *Mark Twain Project Online*. 2007.

Mark Twain's Letters, Volume 6: 1874–1875. Ed. Michael B. Frank and Harriet Elinor Smith. **Mark Twain Papers.** 2002. At *Mark Twain Project Online*. 2007.

Mark Twain's Mysterious Stranger Manuscripts. Ed. William M. Gibson. **Mark Twain Papers**. 1969.

Mark Twain's Notebooks & Journals, Volume I (1855–1873). Ed. Frederick Anderson, Michael B. Frank, and Kenneth M. Sanderson. **Mark Twain Papers.** 1975.

Mark Twain's Notebooks & Journals, Volume II (1877–1883). Ed. Frederick Anderson, Lin Salamo, and Bernard L. Stein. **Mark Twain Papers.** 1975.

Mark Twain's Notebooks & Journals, Volume III (1883–1891). Ed. Robert Pack Browning, Michael B. Frank, and Lin Salamo; General Editor, Frederick Anderson. **Mark Twain Papers.** 1979.

Mark Twain's Satires & Burlesques. Ed. Franklin R. Rogers. **Mark Twain Papers.** 1967.

Mark Twain's Which Was the Dream? and Other Symbolic Writings of the Later Years. Ed. John S. Tuckey. **Mark Twain Papers.** 1967.

Microfilm Edition of Mark Twain's Literary Manuscripts Available in the Mark Twain Papers, The Bancroft Library, University of California, Berkeley. 2001.

Microfilm Edition of Mark Twain's Manuscript Letters Now in the Mark Twain Papers, The Bancroft Library, University of California, Berkeley. 2001.

Microfilm Edition of Mark Twain's Previously Unpublished Letters. 2001.

The Mysterious Stranger Manuscripts. Ed. William M. Gibson. **Mark Twain Papers** (paperback). 1969 and 2005.

No. 44, The Mysterious Stranger. Foreword and notes by John S. Tuckey; text established by William M. Gibson and the staff of the Mark Twain Project. **Mark Twain Library** (cloth and paperback). 1982, 2004, and 2010.

The Prince and the Pauper. Ed. Victor Fischer and Lin Salamo, with the assistance of Mary Jane Jones. **Works of Mark Twain.** 1979.

The Prince and the Pauper. Foreword and notes by Victor Fischer and Michael B. Frank; text established by Victor Fischer. **Mark Twain Library** (cloth and paperback). 1983, 2002, and 2010.

Pudd'nhead Wilson: Manuscript and Revised Versions, with "Those Extraordinary Twins." Edited by Benjamin Griffin. **Works of Mark Twain.** Forthcoming in April 2024.

Roughing It. Introduction and explanatory notes by Franklin R. Rogers; text established and textual notes by Paul Baender. **Works of Mark Twain.** 1972. [Superseded by the 1993 edition.]

Roughing It. Introduction and explanatory notes by Franklin R. Rogers; text established by Paul Baender. Works of Mark Twain (paperback). 1973. [Out of print: superseded by the Mark

Twain Library edition (1996).]

Roughing It. Revised edition. Ed. Harriet Elinor Smith, Edgar Marquess Branch, Lin Salamo, and Robert Pack Browning. **Works of Mark Twain.** 1993. At *Mark Twain Project Online,* 2016.

Roughing It. Revised edition. Ed. Harriet Elinor Smith, Edgar Marquess Branch, Lin Salamo, and Robert Pack Browning. **Mark Twain Library.** 1996, 2002, and 2010.

San Francisco Correspondence, 1865–1866. Ed. Richard Bucci and Benjamin Griffin. **Works of Mark Twain**, forthcoming. At *Mark Twain Project Online,* forthcoming.

Tom Sawyer Abroad & Tom Sawyer, Detective. Foreword and notes by John C. Gerber; text established by Terry Firkins. **Mark Twain Library** (cloth and paperback). 1983, 2004, and 2011.

Union Catalog of Clemens Letters. Ed. Paul Machlis. University of California Publications: Catalog and Bibliographies, Volume 1. Printed text and microfiche supplement. 1986.

Union Catalog of Letters to Clemens. Ed. Paul Machlis, with the assistance of Deborah Ann Turner. University of California Publications: Catalog and Bibliographies, Volume 8. Printed text and microfiche supplement. 1992.

What Is Man? and Other Philosophical Writings. Ed. Paul Baender. **Works of Mark Twain.** 1973.

Who Is Mark Twain? Ed. Robert H. Hirst. New York: HarperStudio. 2009.

Appendix C: Statement of Funding Received

This table includes the original grant for the Works from the U.S. Office of Education (USOE) to John Gerber at the University of Iowa; the several grants from the Center for Editions of American Authors (CEAA), which were actually re-grants from NEH, to the University of California (UC); and all direct grants from NEH to UC. The column headed UC Cost Sharing includes: state monies spent on salaries and benefits; gift monies raised by the Friends of the Bancroft Library to be matched by NEH; and indirect costs forgiven by UC.

	Works of Mark Twain		**Mark Twain Papers**		
Year	USOE/NEH	UC	CEAA/NEH	UC	Cumulative
1964–65	$182,401	---	---	---	$182,401
1965–66	---	---	---	---	182,401
1966–67	---	---	$21,803	$16,735	220,939
1967–68	---	---	21,800	16,780	259,519
1968–69	---	$9,813	6,000	48,146	323,478
1969–70	---	10,352	21,500	48,685	404,015
1970–71	---	10,873	18,534	49,206	482,628
1971–72	---	11,672	30,835	50,005	575,140
	NEH				
1972–73	$10,211	$12,767	$47,627	$51,100	$696,845
1973–74	32,451	13,450	49,749	51,783	844,278
1974–75	43,009	15,596	86,580	53,929	1,043,392
1975–76	47,454	16,682	97,888	16,682	1,222,098
			NEH		
1976–77	$60,000	$18,797	$123,110	$18,797	$1,442,802
1977–78	178,870	75,055	333,083	80,291	2,110,101
Subtotal:	554,396	195,057	858,509	502,139	2,110,101

Works of Mark Twain, Mark Twain Papers, and Mark Twain Project Online

		NEH Federal Matching	UC Cost Sharing	UC Share of Total	Cumulative Total
Subtotal:	$1,382,905	$30,000	$697,196	33%	$2,110,101
1980–82	250,000	125,000	356,473	49%	2,841,574
1982–84	249,511	225,131	515,064	52%	3,831,280
1984–86	250,000	173,000	550,644	57%	4,804,924
1986–88	200,000	350,159	1,216,356	69%	6,571,439
1988–90	170,000	235,000	711,443	64%	7,687,882
1990–92	160,000	290,000	958,659	68%	9,096,541
1992–93	90,000	150,000	526,655	70%	9,863,196
1993–95	160,000	300,000	926,969	67%	11,250,165
1995–98	160,000	268,221	859,496	67%	12,537,882
1998–99	120,000	150,000	404,184	60%	13,212,066
1999–2001	160,000	288,000	737,497	62%	14,397,563
2001–03	160,000	75,000	927,130	80%	15,559,693
2003–06	100,000	400,000	1,365,093	73%	17,424,786
2006–08	100,000	500,000	991,405	62%	19,016,191
2008–10	200,000	200,000	1,027,552	72%	20,443,743
2010–12	200,000	200,000	392,614	50%	21,236,357
2012–14	250,000	200,000	904,794	67%	22,591,151

2014–16	$250,000	$200,000	$1,891,849	81%	$24,933,000
2016–18	350,000	350,000	1,864,734	73%	27,497,734
2018–20	350,000	350,000	2,069,990	75%	30,267,724
2020–21	50,000	125,000	1,176,590	87%	31,619,314
2021–24	---	450,000	3,975,803	89%	36,045,117
TOTALS:	5,362,416	5,634,511	25,048,190	---	36,045,117
NEH Total: $10,996,927			**UC Total: $25,048,190**		

NATIONAL ENDOWMENT FOR THE Humanities

Budget Form

Applicant Institution: *The Regents of the University of California*
Project Director: *Robert H. Hirst*
Project Grant Period: *10/1/2024 through 9/30/2027*

click for Budget Instructions

	Computational Details/Notes	(notes)	Year 1		Year 2		Year 3	Project Total
			10/01/2024-09/30/2025		10/01/2025-09/30/2026		10/01/2026-09/30/2027	
1. Salaries & Wages								
Writer/Editor IV, Benjamin Griffin	Annual salary: $114,996	74%	$85,097	50%	$59,223	50%	$61,000	$205,320
Writer/Editor IV, Blake Bronson-Bartlett	Annual salary: $107,988	70%	$75,592	50%	$55,614	50%	$57,282	$188,488
Writer/Editor IV, Kerry Driscoll	Annual salary: $128,496	79%	$101,512	50%	$66,175	50%	$68,161	$235,848
2. Fringe Benefits								
Staff	42.8%		$112,222		$77,473		$79,797	$269,492
3. Consultant Fees								
4. Travel								
5. Supplies & Materials								
6. Subawards								
7. Other Costs								

8. Total Direct Costs	**Per Year**		$374,422		$258,485		$266,240	$899,147
9. Total Project Costs								**$899,147**
10. Project Funding		**a. Granted from NEH**					Federal Matching Funds:	$450,000
							Outright:	
							TOTAL NEH AWARD:	**$450,000**
		b. Cost Sharing						
							Third-Party Contributions:	
							Gifts	$450,000
12. Total Project Funding							**Project Funding:**	**$900,000**

Budget Justification

Personnel / Role on Project:
Benjamin Griffin: Writer/Editor IV (50% effort, Yrs. 1&2, 30% effort Yr.3)
Blake Bronson-Bartlett: Writer/Editor IV (48% effort, Yr. 1; 50% effort, Yrs. 2&3)
Kerry Driscoll: Writer/Editor IV (40% effort, Yr. 1; 30% effort, Yrs. 2&3)

Salaries:
Salary figures are projected. The dollar amount shown includes editorial staff costs and takes into account the University's policy on merit increases for career personnel.[1]

(Year 1):
Benjamin Griffin ($9,583/month * 50%) * 12 months = $57,498
Blake Bronson-Bartlett ($8,999/month * 48%) * 12 months = $51,834
Kerry Driscoll ($10,708/month * 40%) * 12 months = $51,398

(Year 2):
Benjamin Griffin ($9,870/month * 50%) * 12 months = $59,223
Blake Bronson-Bartlett ($9,269/month * 50%) * 12 months = $55,614
Kerry Driscoll ($11,029/month * 30%) * 12 months = $39,705

(Year 3):
Benjamin Griffin ($10,166/month * 30%) * 12 months = $36,600
Blake Bronson-Bartlett ($9,547/month * 50%) * 12 months = $57,282
Kerry Driscoll ($11,359/month * 30%) * 12 months = $40,896

Composite benefit rate @ 42.8% for staff personnel (Year 1):
Benjamin Griffin ($9,583/month * 50% * CBR benefits 42.8%) * 12 months = $24,609
Blake Bronson-Bartlett ($8,999/month * 48% * CBR benefits 42.8%) * 12 months = $22,185
Kerry Driscoll ($10,708/month * 40% * CBR benefits 42.8%) * 12 months = $21,999

Composite benefit rate @ 42.8% for staff personnel (Year 2):
Benjamin Griffin ($9,870/month * 50% * CBR benefits 42.8%) * 12 months = $25,346
Blake Bronson-Bartlett ($9,269/month * 50% * CBR benefits 42.8%) * 12 months = $23,803
Kerry Driscoll ($11,029/month * 30% * CBR benefits 42.8%) * 12 months = $16,993

Composite benefit rate @ 42.8% for staff personnel (Year 3):
Benjamin Griffin ($10,166/month * 30% * CBR benefits 42.8%) * 12 months = $15,664
Blake Bronson-Bartlett ($9,547/month * 50% * CBR benefits 42.8%) * 12 months = $24,517
Kerry Driscoll ($11,359/month * 30% * CBR benefits 42.8%) * 12 months = $17,502

No travel or supplies have been budgeted.

The remainder of salaries and benefits for the three editors listed above, and for editor Terence Catapano, will be paid through applicant contributions (i.e. individual and foundation gifts) to be raised over the three-year period (2024–2027). In addition, indirect costs totaling $257,067 will be included in the project's cost share.

Total cost share for the Mark Twain Project, for years 2024–2027, will be $2,956,703.

- Foundation gifts[2]: $225,000
- Individual gifts[3]: $1,200,000

---

[1] Years 2 & 3 assume a 3% average annual merit increase.

[2] Based on the previous two years' dollar amounts. Gifts recur annually.

[3] Based on the previous two years' individual donor gifts received. Ninety-five percent of the total gifts are recurring.

Budget Justification

Personnel / Role on Project:
Robert H. Hirst: General Editor/Project Manager (60% effort)
Blake Bronson-Bartlett: Writer/Editor IV (70% effort)
Terence Catapano: Digital Publications Manager (70% effort)
Kerry Driscoll: Writer/Editor IV (100% effort)
Benjamin Griffin: Writer/Editor IV (100% effort)

Salaries:
Salaries are projected. 30% of the salaries of staff members Bronson-Bartlett and Catapano will be paid from the existing Challenge Grant. The dollar amount shown includes editorial staff costs and takes into account the University's policy on merit increases for career personnel.[1]

(Year 1):
Blake Bronson-Bartlett ($8,999/month * 70%) * 12 months = $75,592
Terence Catapano ($9,577/month * 70%) * 12 months = $80,447
Kerry Driscoll ($10,708/month * 100%) * 12 months = $128,496
Benjamin Griffin ($9,583/month * 100%) * 12 months = $114,996

(Year 2):
Blake Bronson-Bartlett ($9,269/month * 70%) * 12 months = $77,860
Terence Catapano ($9,864/month * 70%) * 12 months = $82,858
Kerry Driscoll ($11,029/month * 100%) * 12 months = $132,348
Benjamin Griffin ($9,870/month * 100%) * 12 months = $118,440

(Year 3):
Blake Bronson-Bartlett ($9,547/month * 70%) * 12 months = $80,195
Terence Catapano ($10,159/month * 70% *) 12 months = $85,336
Kerry Driscoll ($11,359/month * 100%) * 12 months = $136,308
Benjamin Griffin ($10,166/month * 100%) * 12 months = $121,992

Composite benefit rate @ 42.8% for staff personnel (Year 1):
Blake Bronson-Bartlett ($8,999/month * 70% * CBR benefits 42.8%) * 12 months = $32,353
Terence Catapano ($9,577/month * 70% * CBR benefits 42.8%) * 12 months = $34,431
Kerry Driscoll ($10,708/month * 100% * CBR benefits 42.8%) * 12 months = $54,996
Benjamin Griffin ($9,583/month * 100% * CBR benefits 42.8%) * 12 months = $49,218

Composite benefit rate @ 42.8% for staff personnel (Year 2):
Blake Bronson-Bartlett ($9,269/month * 70% * CBR benefits 42.8%) * 12 months = $33,324
Terence Catapano ($9,864/month * 70% * CBR benefits 42.8%) * 12 months = $35,463
Kerry Driscoll ($11,029/month * 100% * CBR benefits 42.8%) * 12 months = $56,645
Benjamin Griffin ($9,870/month * 100% * CBR benefits 42.8%) * 12 months = $50,692

Composite benefit rate @ 42.8% for staff personnel (Year 3):
Blake Bronson-Bartlett ($9,547/month * 70% * CBR benefits 42.8%) * 12 months = $34,323
Terence Catapano ($10,159/month * 70% * CBR benefits 42.8%) * 12 months = $36,523
Kerry Driscoll ($11,359/month * 100% * CBR benefits 42.8%) * 12 months = $58,340
Benjamin Griffin ($10,166/month * 100% * CBR benefits 42.8%) * 12 months = $52,213

No travel or supplies have been budgeted.

PI Robert Hirst's salary (a total of $796,800, and benefits, $274,099 – he will supervise the proposed grant 60% of his time during the grant period) will be paid on state general funds.

The remainder of salaries and benefits for the three editors listed above will be paid through applicant contributions (i.e. individual and foundation gifts) to be raised over the three-year period (2024-2027). In addition, indirect costs totaling $705,354 will be included in the project's cost share.

Total cost share for the Mark Twain Project, for years 2024-2027, will be $2,929,662.

Applicant's Contribution Derivation:

$2,384,287 – Applicant's direct cost contributions.
$953,715 – Indirect costs (40%) on Applicant's direct cost contributions and Third Party contributions, which are all direct costs.
$180,000 – Waived indirect costs (40%) on Federal Matching Funds, which are all direct costs.
$2,384,287 – Total Applicant's Contributions.

Potential Sources of Funds:
- Foundation gifts[2]: $225,000
- Individual gifts[3]: $1,200,000

[1] Years 2 & 3 assume a 3% average annual merit increase.
[2] Based on the previous two years' dollar amounts. Gifts recur annually.
[3] Based on the previous two years' individual donor gifts received. Ninety-five percent of the total gifts are recurring.

EXHIBIT C

NATIONAL ENDOWMENT FOR THE HUMANITIES

August 28, 2024

Jessie Brown
Contract and Grant Officer
Sponsored Projects Office
University of California, Berkeley
1608 Fourth Street, Suite 220
Berkeley, CA 94710-1749

Application Number: RQ-300297

Dear Ms. Brown:

Congratulations! I am pleased to inform you that application RQ-300297 entitled "Mark Twain Project" under the direction of Robert H. Hirst has been approved to receive an offer for funding. The National Endowment for the Humanities (NEH) offers the University of California, Berkeley support for this project in an amount not to exceed $450,000.00 in federal matching funds, subject to the following condition:

NEH offers to provide federal matching funds of up to $450,000 on condition that (a) an equal amount of eligible non-federal, third-party gifts is raised and either certified or forwarded to NEH by June 30, 2027, and (b) sufficient funds allocated for matching purposes are available in the Division of Research Programs. It should be noted that this offer may be withdrawn at any time by the chair of NEH. Please see the Federal Matching Fund Guidelines (available at https://www.neh.gov/grants/manage/federal-matching-funds-guidelines) for details on the eligibility of gifts and their certification.

We anticipate that the federal matching funds for this project will be provided incrementally during the period of performance. Recipients are nevertheless encouraged to certify all eligible gifts as soon as possible so that NEH will be able to amend the award as soon as matching funds become available for this project.

If you wish to accept this offer of support, your response to the above condition(s) and the Gift Certification Form must be submitted via eGMS Reach, NEH's online electronic grant management system no later than June 30, 2027. Instructions for accessing eGMS Reach can be found below. Please note that the Endowment's review of the material requested and the preparation of the award documents require approximately four weeks.

NEH is making available to you our online electronic grant management system, eGMS Reach. You will be able to view offer and award letters, view and submit reports, receive alerts and notifications regarding the grants you manage, and send messages to NEH staff to raise questions and concerns.

When accessing eGMS Reach for the first time, go to https://reach.neh.gov/, click the Sign In Help link, and follow the on screen instructions. An e-mail message will be sent to you with a link to select a password.

This "offer" letter does not constitute an award. It formally communicates the level of funding recommended for the project and the conditions that must be met before an award will be issued by NEH. Should you have any questions concerning this offer of support, please feel free to contact Peter Scott at pscott@neh.gov, or Jason Boffetti at jboffetti@neh.gov.

NEH staff look forward to working with you.

Sincerely,

Shelly C. Lowe (Navajo)
Chair

EXHIBIT D

CERTIFICATION OF GIFTS/PLEDGES

Public control number 3136-0134, expiration date October 31, 2024

FAIN: RQ-300297

Recipient Organization: The Regents of the University of California

Report Number:

Date Submitted: 10/31/2024

Donor Category	Number of Donors	Amount Given
Individuals	76	$ 314,503.50
Corporations or businesses		$
Public or private foundations	6	$ 135,512.50
Labor unions, associations		$
Nonfederal government units		$
Affiliated groups		$
Special events, benefits		$
Other		$
Total amount		$ 450,016

The amount certified in this letter includes pledges in the amount of $

☐ Documentation attached for pledges certified?

For General Support Grants to State Humanities Councils only

The matching funds released by this certification will be used as follows:

Regrants $ All other categories $

I certify that the total amount has been received in the form of a gift or gifts which have been donated to my organization; meet the criteria for eligibility established by NEH; will be expended for grant purposes during the grant period; and that documentation that substantiates the amounts, sources, eligibility and expenditure of the gifts will be retained for three years following the submission to NEH of the final financial report for this grant. If pledges are included in the total, I certify that (1) the pledges are legally enforceable, (2) the donors are obligated to pay the pledges during the grant period, and (3) the immediate release of matching funds is necessary to carry out grant activities.

Institutional Grant Administrator: Sabina Gafarova, Assistant Director , Sponsored Projects Office

Sabina Gafarova Digitally signed by Sabina Gafarova Date: 2024.10.31 16:56:57 -07'00'

If you are using this form outside the NEH's electronic Grants Management System (eGMS), enter the name of the Institutional Grant Administrator (IGA) in the field above. Print a copy for the IGA's signature, scan the signed copy, and e-mail it to grantmanagement@neh.gov.

Public reporting burden for this collection of information is estimated to average 30 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other suggestions for reducing this burden to NEH Office of Grant Management, Washington, D.C. 20503, grantmanagement@neh.gov.

bConnected powered by Google

Sabina Gafarova <sabina_g@berkeley.edu>

Gifts certification for Library NEH award - PI Bob Hirst

Sabina Gafarova (AOR) <sabina_g@berkeley.edu> Thu, Oct 31, 2024 at 5:01 PM
To: Mark Hemhauser <mhemhauser@berkeley.edu>
Cc: John Orbon <jorbon@berkeley.edu>, Gabrielle Gillard <ggillard@berkeley.edu>, Robert Hart Hirst <rhirst@library.berkeley.edu>, Elizabeth Friedman <efbranoff@berkeley.edu>, Heidi S Hallett <hhallett@berkeley.edu>

Hi All,

I have obtained PI's certification and signed and submitted the Certification of Gifts form and certified by the Library and PI to NEH. We now wait for NEH's response

Sabina

---------- Forwarded message ---------
From: **Robert H. HIRST** <rhirst@library.berkeley.edu>
Date: Tue, Oct 29, 2024 at 2:21 PM
Subject: certification for MTP
To: Sabina Gafarova <sabina_g@berkeley.edu>

I certify that the total amount has been received in the form of a gift or gifts which have been donated to my organization; meet the criteria for eligibility established by NEH; will be expended for grant purposes during the grant period; and that documentation that substantiates the amounts, sources, eligibility and expenditure of the gifts will be retained for three years following the submission to NEH of the final financial report for this grant. If pledges are included in the total, I certify that (1) the pledges are legally enforceable, (2) the donors are obligated to pay the pledges during the grant period, and (3) the immediate release of matching funds is necessary to carry out grant activities."

Donor Category	Number of Donors	Amount Given
Individuals	76	$314,503.50
Public or private foundations	6	$133,512.50

Sabina Gafarova, MPA
Assistant Director
Sponsored Projects Office
University of California, Berkeley
Phone: (510)-664-4460
Fax: (510)-642-8236
Twitter: BerkeleySPO

On Tue, Oct 29, 2024 at 1:26 PM Mark Hemhauser <mhemhauser@berkeley.edu> wrote:

> Sabina,

Attached please find the spreadsheet with the CADS and CalAnswers General Ledger data from which we compiled the matching gifts. There is a pivot table that calculates the total donations from individuals and foundations. The form is completed, but not signed. We will need to get the PI, Bob Hirst, to sign off on certifying. He is currently out of the office.

Mark

Mark Hemhauser
Financial Analyst, The Library
110 Doe Library
University of California, Berkeley
Berkeley, CA 94720-6000

510-664-4310

On-Site Tuesday, Friday
Remote Monday, Wednesday, Thursday

On Tue, Oct 29, 2024 at 12:59 PM John Orbon <jorbon@berkeley.edu> wrote:

> Thank you. Good to know the cut-off for the possibility of having to provide details is 5K. If we are required to do so, we'll work with our colleagues in UDAR to determine the most efficient approach to this, and what can be shared and what can't.
>
> John Orbon
> **Senior Director of Development**
> University Library | UC Berkeley
> 131 Doe Library | Berkeley, CA 94720-6000
> P: 510-643-4715 | M: 510-207-1180
> Pronouns: he/they
>
> ***"Give me a library, and I'll build a university about it."***
> ***— Benjamin Ide Wheeler, UC president, 1899-1919***
>
> On Tue, Oct 29, 2024 at 12:38 PM Sabina Gafarova (AOR) <sabina_g@berkeley.edu> wrote:
>
> > Hi Mark,
> >
> > I have attached last year's form where the second page has definitions of each category. To answer your question - if the funds are coming from "charitable foundation", it's a non-profit and would be under "public or private foundations". If the funds came from a business account, a private, for-profit company, it will be categorized under corporations and businesses.
> >
> > Also, FYI heads up - I saw in one of the messages from the NEH contracts officer that they request back-ups for every gift over $5,000 in value. Just FYI to make sure you have them ready in case NEH comes back requesting those after we finally certify to NEH.
> >
> > Sabina
> > ---
> >
> > Sabina Gafarova, MPA
> > Assistant Director
> > Sponsored Projects Office
> > University of California, Berkeley
> > Phone: (510)-664-4460
> > Fax: (510)-642-8236
> > Twitter: BerkeleySPO
> >
> > On Tue, Oct 29, 2024 at 12:29 PM Mark Hemhauser <mhemhauser@berkeley.edu> wrote:
> >
> > > Hi John,
> > >
> > > You are saying that these Donors are pass-throughs for private individuals who put money into the accounts to go to the Mark Twain Project?

Vanguard Charitable Endowment Program
Bank of America Charitable Gift Fund
The Schwab Fund for Charitable Giving
Goldman Sachs Philanthropy Fund
Fidelity Charitable Gift Fund
Vanguard Charitable Endowment Program
Shell Oil Company Foundation Inc

Mark

Mark Hemhauser
Financial Analyst, The Library
110 Doe Library
University of California, Berkeley
Berkeley, CA 94720-6000

510-664-4310

On-Site Tuesday, Friday
Remote Monday, Wednesday, Thursday

On Mon, Oct 28, 2024 at 5:43 PM John Orbon <jorbon@berkeley.edu> wrote:

> To me, those are gifts directed by individual donors, an so not businesses.
>
> But Sabina may have a more formal / informed answer
>
> Kindly,
> John
>
> John Orbon
> **Senior Director of Development**
> University Library | UC Berkeley
> 131 Doe Library | Berkeley, CA 94720-6000
> P: 510-643-4715 | M: 510-207-1180
> Pronouns: he/they
>
> ***"Give me a library, and I'll build a university about it."***
> ***— Benjamin Ide Wheeler, UC president, 1899-1919***
>
> On Mon, Oct 28, 2024 at 5:15 PM Mark Hemhauser <mhemhauser@berkeley.edu> wrote:
>
> > John or Sabina,
> >
> > Could either of you help me understand how to categorize a business such as Vanguard or Bank of America that has donated through its charitable foundation? Is that a foundation or a business donor? I don't see any definitions on NEH's website about this form.
> >
> > Thanks!
> > Mark
> >
> > Mark Hemhauser
> > Financial Analyst, The Library
> > 110 Doe Library
> > University of California, Berkeley
> > Berkeley, CA 94720-6000

510-664-4310

On-Site Tuesday, Friday
Remote Monday, Wednesday, Thursday

On Thu, Oct 24, 2024 at 10:25 AM John Orbon <jorbon@berkeley.edu> wrote:

> Dear Mark,
>
> I think we were able to move things along quite a bit yesterday in a conversation with Sabina from SPO, and Andrew from UDAR.
>
> The note below outlines the requirement for our certifications (LBO, then Bob's), and subsequently SPO's for submission to NEH.
>
> Sabina said that we do not have to send proof for each individual donor/gift at this time. That step was required by NEH last year, but is a second level requirement reserved for some, not all, certifications in a given year.
>
> In our discussion yesterday we also learned that should this second-level proof at the donor/gift level be required again this year, UDAR will help us by pulling a report rather than you or Gigi having to pull individual records for dozens or hundreds of MTPP gifts.
>
> Mark, when you're back in the office, please take a look at Sabina's email (attached) for the information needed, and requisite language for LBO's certification.
>
> Thank you to all involved,
> John
>
> John Orbon
> **Senior Director of Development**
> University Library | UC Berkeley
> 131 Doe Library | Berkeley, CA 94720-6000
> P: 510-643-4715 | M: 510-207-1180
> Pronouns: he/they
>
> ***"Give me a library, and I'll build a university about it."***
> ***— Benjamin Ide Wheeler, UC president, 1899-1919***
>
> ---------- Forwarded message ---------
> From: **Sabina Gafarova (AOR)** <sabina_g@berkeley.edu>
> Date: Wed, Oct 23, 2024 at 4:36 PM
> Subject: Re: Gifts certification for Library NEH award - PI Bob Hirst
> To: John Orbon <jorbon@berkeley.edu>
> Cc: Andrew Besson <abesson@berkeley.edu>, Robert Hart Hirst <rhirst@library.berkeley.edu>
>
> Hi John and Andrew,
>
> It was nice talking to you and mapping the plan to get the NEH certifications done. Per our conversation, attached is the form that SPO needs your respective certifications for, as well as PI's, after yours and before SPO signs and submits this to NEH. The certification language that I need in your respective emails would be from the form:
>
> "I certify that the total amount has been received in the form of a gift or gifts which have been donated to my organization; meet the criteria for eligibility established by NEH; will be expended for grant purposes during the grant period; and that documentation that substantiates the amounts, sources, eligibility and expenditure of the gifts will be retained for three years following the submission to NEH of the final financial report for this grant. If pledges are included in the total, I certify that (1) the pledges are legally enforceable, (2) the donors are obligated to pay the pledges during the grant period, and (3) the immediate release of matching funds is necessary to carry out grant activities."
>
> Also, I will actually need the breakdown on the "Donor Category" of funding as outlined on the form please as well. You could put in your emails a list of total funding per its "category" and specify the amount next

to each type as per the form. For example:

Donor Category	Number of Donors	Amount Given
Individuals	50	$200,000
Corporations or businesses	xx	$xx
Public or private foundations	xx	$xx

Please let me know if you have any questions and thanks for your help

Sabina

Sabina Gafarova, MPA
Assistant Director
Sponsored Projects Office
University of California, Berkeley
Phone: (510)-664-4460
Fax: (510)-642-8236
Twitter: BerkeleySPO

On Wed, Oct 23, 2024 at 1:51 PM John Orbon <jorbon@berkeley.edu> wrote:

> Thank you, Sabina. I've reviewed the page, with particular attention to the certification requirements and am looking forward to talking with you and Andrew.
>
> John Orbon
> **Senior Director of Development**
> University Library | UC Berkeley
> 131 Doe Library | Berkeley, CA 94720-6000
> P: 510-643-4715 | M: 510-207-1180
> Pronouns: he/they
>
> ***"Give me a library, and I'll build a university about it."***
> ***— Benjamin Ide Wheeler, UC president, 1899-1919***
>
> On Wed, Oct 23, 2024 at 1:36 PM Sabina Gafarova (AOR) <sabina_g@berkeley.edu> wrote:
>
> > Hi John,
> >
> > I see you put a meeting on our calendars to go over NEH requirements to certify cost sharing gifts in the amount of $450,000 for PI Hirst's NEH award. Please review the following information regarding NEH gifts certification requirements, what and how needs to be certified prior to our meeting https://www.neh.gov/grants/manage/federal-matching-funds-guidelines
> >
> > Sabina
> > ---
> >
> > Sabina Gafarova, MPA
> > Assistant Director
> > Sponsored Projects Office
> > University of California, Berkeley
> > Phone: (510)-664-4460
> > Fax: (510)-642-8236
> > Twitter: BerkeleySPO

EXHIBIT E

---------- Forwarded message ---------
From: **Grant Notification** <Grant_Notifications@nehemail.onmicrosoft.com>
Date: Wed, Apr 2, 2025 at 8:36 PM
Subject: Notice of Grant Termination – Effective April 2, 2025
To: sabina_g@berkeley.edu <sabina_g@berkeley.edu>

Ms. Sabina Gafarova,

We regret to inform you that your NEH grant has been terminated. Please see the attached grant termination notice.

With Regards,
Michael McDonald
Acting Chairman, National Endowment for the Humanities

EXHIBIT F

NATIONAL ENDOWMENT FOR THE HUMANITIES

NATIONAL ENDOWMENT FOR THE HUMANITIES
NOTICE OF GRANT TERMINATION

April 2, 2025

Ms. Sabina Gafarova

Regents of the University of California, Berkeley

Dear NEH Grantee,

This letter provides notice that the National Endowment for the Humanities (NEH) is terminating your federal grant (Grant Application No. RQ30029725) effective April 2, 2025, in accordance with the termination clause in your Grant Agreement.

Your grant no longer effectuates the agency's needs and priorities and conditions of the Grant Agreement and is subject to termination due to several reasonable causes, as outlined in *2CFR§200.340.* NEH has reasonable cause to terminate your grant in light of the fact that the NEH is repurposing its funding allocations in a new direction in furtherance of the President's agenda. The President's February 19, 2025 executive order mandates that the NEH eliminate all non-statutorily required activities and functions. *See Commencing the Reduction of the Federal Bureaucracy*, E.O. 14217 (Feb. 19, 2025). Your grant's immediate termination is necessary to safeguard the interests of the federal government, including its fiscal priorities. The termination of your grant represents an urgent priority for the administration, and due to exceptional circumstances, adherence to the traditional notification process is not possible. Therefore, the NEH hereby terminates your grant in its entirety effective April 1, 2025.

Please remember that your obligations under the Grant Agreement continue to apply. Additionally, an audit may be conducted by the NEH after the termination of your grant.

Please contact Grant_Notifications@nehemail.onmicrosoft.com with only urgent questions.

Sincerely,

/s/ Michael McDonald

Michael McDonald
Acting Chairman, National Endowment for the Humanities
400 7th Street S.W., Washington, DC 20506

EXHIBIT G

Berkeley
UNIVERSITY OF CALIFORNIA

Angela R. Ford
Executive Director
Sponsored Projects Office
1608 Fourth Street. Suite 220
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arford@berkeley.edu
https://spo.berkeley.edu/

April 30, 2025

Submitted via email

Senior Deputy Chairman
National Endowment for the Humanities
400 7th Street, SW
Washington, DC 20506

RE: Appeal of Termination of Award No. RQ-300297-25

Dear Senior Deputy Chairman:

I write on behalf of the Regents of the University of California, Berkeley ("UC"), in regards to the termination of Award No. RQ-300297-25 (the "Award"). UC greatly values its partnership and decades long strong working relationship with the National Endowment for the Humanities ("NEH") but in this instance has no choice but to appeal the termination, which is not justified and should be reversed. The amount under dispute represents funds that the University has not yet received from the government under this Award. This includes amounts not yet expended by the University and amounts properly incurred before the Award termination date but which have not yet been reimbursed in accordance with 2 C.F.R. § 200.343. The amount in dispute for this Award is $450,000.

We are grateful for our opportunities to support NEH priorities to examine the human condition, promote civics education, and understand our cultural heritage. As you know, UC researchers have led and contributed to NEH-supported work for decades. We hope to continue this longstanding partnership.

Background

On April 2, 2025, UC received a letter from Michael McDonald, Acting Chairman of NEH, announcing the termination of this Award (the "Letter"). The Letter stated:

Your grant no longer effectuates the agency's needs and priorities and conditions of the Grant Agreement and is subject to termination due to several reasonable causes, as outlined in *2 CFR § 200.340.* NEH has reasonable cause to terminate your grant in light of the fact that the NEH is repurposing its funding allocations in a new direction in furtherance of the President's agenda. The President's February 19, 2025 executive order mandates that the NEH eliminate all non-statutorily required activities and functions. *See Commencing the Reduction of the Federal Bureaucracy,* E.O. 14217 (Feb. 19, 2025). Your grant's immediate termination is necessary to safeguard the interests of the federal government, including its fiscal priorities. . . . [D]ue to exceptional circumstances,

adherence to the traditional notification process is not possible. Therefore, the NEH hereby terminates your grant in its entirety effective April 1, 2025.

The Letter was signed by Mr. McDonald but sent from an email account unaffiliated with NEH and believed to be associated with the Department of Government Efficiency ("DOGE").[1]

As described below, the termination of this Award is unjustified.[2]

Argument

I. Section 200.340 Does Not Permit Termination of the Award

Although the letter cites 2 C.F.R. § 200.340 as authority for termination of this Award, that provision does not permit a termination of this nature under the rationale offered. Thus, the termination is unlawful and violates the Administrative Procedure Act. 5 U.S.C. § 706(2)(A) (authorizing courts to set aside agency action that is "arbitrary, capricious, an abuse of discretion, or otherwise not in accordance with law"); *see International Dark-Sky Ass'n, Inc. v. FCC*, 106 F.4th 1206, 1220 (D.C. Cir. 2024) (An agency action based on a flawed interpretation of a statute or regulation is "contrary to law.").

We assume NEH relies specifically on 2 C.F.R. § 200.340(a)(4), providing an award may be terminated by an awarding agency if it "no longer effectuates the program goals or agency priorities." That reliance is misplaced.

First, that provision is not designed for the sort of sweeping funding terminations NEH has imposed on UC (and other universities across the country). The preamble to the final rule adopting the language at issue offers two scenarios in which termination pursuant to "agency priorities" might be appropriate: First, where "following the issuance of a Federal award, . . . additional evidence reveals that a *specific* award objective is ineffective at achieving program goals"; and second, where "additional evidence . . . cause[s] the Federal awarding agency to significantly question the feasibility of the intended objective of the award, such that it may be in the interest of the government to terminate." Guidance for Grants and Agreements, 85 Fed. Reg. 49,506, 49,507-

[1] The Letter was sent via email from Grant_Notifications@nehemail.onmicrosoft.com. The Letter also instructs recipients to send "only urgent questions" to this email address. Email addresses of NEH personnel, on the other hand, generally end with "@neh.gov." *See* https://www.neh.gov/about/staff (linking to contact information for staff members, each of whom has an "@neh.gov" address).

[2] Although no statute or regulation requires UC to exhaust any administrative appeal process, the University is filing this appeal in accordance with Section XIII of the General Terms and Conditions for Awards to Organizations. *See* https://www.neh.gov/sites/default/files/General%20Terms%20and%20Conditions%20for%20AwAwar%20to%20Organizations_FFRMS%20removed_3.13.25.pdf (for awards issued October 1, 2024, or later); https://www.neh.gov/sites/default/files/Gen%20T%26C%20Awards%20Issued%20between%20Jan%201%2C%2022%2C%20and%20Sept%2030%2C%202024.pdf (for awards issued between January 1, 2022, and September 30, 2024).

49,508 (Aug. 13, 2020) (emphasis added). Both examples plainly contemplate an award-level assessment of alignment with evolving agency priorities.

No such analysis was done here. Nor was a single agency priority or program goal identified. The Letter speaks only in generalities, stating the Award "no longer effectuates the agency's needs and priorities and conditions of the Grant Agreement and is subject to termination due to several reasonable causes" but identifies none of the foregoing. It further states "NEH is repurposing its funding allocations in a new direction" but fails to define any such direction. This obviously boiler-plate discussion does not explain why the feasibility of *this* project's objective is now questionable, or what specific aspects of *this* project are misaligned with agency priorities. *See FCC v. Prometheus Radio Project*, 592 U.S. 414, 423 (2021) (agency action must be both "reasonable and reasonably explained"); *see also* 2 C.F.R. § 200.341 (requiring a notice of termination to "include the reasons for termination").

Perhaps realizing it failed to identify such priorities in its termination notices, NEH published a post hoc explanation of its new priorities in a press release on April 24, 2025, stating "NEH is especially interested in projects on the nation's semiquincentennial and U.S. history more generally."[3] The press release also explained NEH "cancelled awards that are at variance with agency priorities, including but not limited to those on diversity, equity, and inclusion (or DEI) and environmental justice, as well as awards that may not inspire public confidence in the use of taxpayer funds" and that "NEH-supported projects must not promote a particular political, religious, or ideological point of view and must not engage in political or social advocacy." However, such attempt at an explanation has no bearing on the inadequate and unlawful termination of this Award. The press release was not incorporated into the Letter, nor could it have been, as it was published over three weeks after NEH terminated the Award. Moreover, NEH still has not articulated how this Award is inconsistent with its newly identified priorities. Accordingly, the press release cannot retroactively save the agency's deficient termination.

Second, § 200.340(a) clearly states an award may be terminated only "[b]y *the* Federal agency"—*i.e.*, the agency responsible for the award. Here, that means NEH alone. That this Letter was sent by an email account unaffiliated with NEH (to which all further inquiries are also directed) indicates the termination was not issued by NEH and any implication that NEH itself decided to terminate this Award is pretextual.

II. The General Terms and Conditions Do Not Permit Termination of the Award

The Letter plainly cites § 200.340 as the purported authority for the termination, stating the Award "no longer effectuates the agency's needs and priorities and conditions of the Grant Agreement and is subject to termination due to several reasonable causes, *as outlined in 2 CFR § 200.340*."

[3] *See* https://www.neh.gov/news/update-neh-funding-priorities-and-agencys-recent-implementation-trump-administration-executive.

The Letter does not cite the General Terms and Conditions, which are incorporated in the Award, as a basis for the termination.

However, even if the Letter could be read to rely on the General Terms and Conditions for authority to terminate this Award, such reliance is also misplaced. Section XIII provides, in relevant part, that NEH may suspend or terminate an award if "an award no longer effectuates the agency's needs and priorities" or NEH "has other reasonable cause." As described above, NEH failed to conduct the award-level analysis required by the regulation underpinning this provision, nor did it articulate any agency need or priority this Award "no longer effectuates." Nor could it, as it does not appear NEH even made this termination decision.

The Letter also fails to point to any reasonable cause. The Letter contends that "NEH has reasonable cause to terminate [the Award] in light of the fact that the NEH is repurposing its funding allocations in a new direction in furtherance of the President's agenda[,]" and more specifically states: "The President's February 19, 2025 executive order mandates that the NEH eliminate all non-statutorily required activities and functions. *See Commencing the Reduction of the Federal Bureaucracy*, E.O. 14217 (Feb. 19, 2025)." But that is wrong.[4] Although the Order states that "non-statutory components and functions . . . shall be eliminated" for the Presidio Trust, Inter-American Foundation, United States African Development Foundation, and United States Institute of Peace, NEH is noticeably absent from that list. In sum, the sole, potentially articulable basis for the termination provided in the Letter—the Executive Order purportedly mandating elimination of this Award—is flatly wrong.

III. This Award Is Not Inconsistent with Agency Priorities

Even if NEH could, in theory, terminate this Award based on misalignment with unspecified agency priorities or reasonable causes, it was mistaken—and acted arbitrarily and capriciously—in drawing that conclusion here. This project is directly aligned with the fundamental purpose of the NEH, which is directed by statute to "initiate and support research and programs to strengthen the research and teaching potential of the United States in the humanities," "foster the interchange of information in the humanities," and "foster programs and projects that provide access to, and preserve materials important to research, education, and public understanding of, the humanities." 20 U.S.C. § 956.

Consistent with that directive, this Award supports the Mark Twain Project (the "Project"), a long-standing scholarly initiative dedicated to preserving, editing, and making accessible the works and life of one of America's greatest writers, Mark Twain. Since 1967, with support from the NEH, the Project has produced accurate, annotated editions of Twain's writings, both in print and online, and assembled an unparalleled archive of his manuscripts, letters, and related materials. The Project plays a vital role in American and global literary scholarship by ensuring free and widespread access to Twain's works through *Mark Twain Project Online*, an open-access digital platform launched in 2007. The terminated Award would have supported the publication of major

[4] See Exec. Order No. 14217, https://www.federalregister.gov/documents/2025/02/25/2025-03133/commencing-the-reduction-of-the-federal-bureaucracy.

works like *The Innocents Abroad* and *Following the Equator*, a digital edition of his notebooks, and more of his correspondence, while also ensuring the continued technical and editorial development of the website.

Internationally recognized for its rigorous standards and comprehensive resources, the Project not only preserves Twain's legacy but also deepens our understanding of American literature, culture, and history, making it an invaluable asset to scholars, students, and general readers worldwide. For example, renowned biographer Ron Chernow recently published a major biography of Mark Twain, made possible in large part by the Project, which provided him with extensive documentation and support.

This Award embodies the statutory purpose of NEH, funding critical efforts to preserve, edit, and make accessible the works and life of Mark Twain, widely regarded as a quintessential American writer whose contributions hold a central place in the American literary canon and American history and culture more generally. Indeed, Mark Twain holds a singular place in American and world literature as one of the most widely read, studied, and beloved authors. His work captures the complexities, contradictions, and spirit of the American experience with unmatched humor, insight, and humanity. Moreover, the Award is consistent with and effectuates NEH's newly declared priority to promote "U.S. history more generally." NEH also recognized in its press release that, while the agency may now be "especially interested in projects with a focus on American history and the nation's founding[,] . . . NEH continues to accept (and fund) applications in all areas of the humanities as defined by NEH's statute." Thus, by its own declaration, NEH is not constrained to awarding funds to projects that focus solely on America's founding and intends to continue funding projects in all areas of the humanities, which include the study and preservation of literature and history. *See* 20 U.S.C. § 952(a).

The Award also does not focus on DEI, gender ideology, environmental justice, or any other topic this Administration (or NEH in its recent press release) has identified as a non-priority. Therefore, to the extent this Award was terminated by NEH on the assumption it focuses on DEI or another such topic, or that it does not enrich American history, that is deeply mistaken. Termination of this Award is simply perplexing.

NEH never gave UC the opportunity to explain all the above before immediately terminating the Award, despite that being the usual practice. *See* General Terms and Conditions (2024) § XIII ("Generally, NEH will terminate an award only after notifying the recipient of the deficiency and giving the recipient sufficient time to correct it; however, this does not preclude immediate suspension or termination when such action is required to protect the interests of the federal government."); General Terms and Conditions (2022) § XIII (functionally the same). Instead, NEH concluded the Award's "immediate termination is necessary to safeguard [unarticulated] interests of the federal government." Hence NEH failed to both "reasonably consider[] the relevant

issues and reasonably explain[] the decision." *Prometheus Radio Project*, 592 U.S. at 423. For that reason alone, the termination was arbitrary and capricious and should be reversed. *Id.*

IV. Request for Relief

For the reasons stated above, UC respectfully requests that the decision to terminate the Award be reversed and that funding be reinstated; or in the alternative, to allow UC to modify the project's objectives to more closely align with NEH's new priorities.

We appreciate the consideration of this appeal and look forward to a timely and favorable response.

Sincerely,

Angela R. Ford
Executive Director, Sponsored Projects Office
Research Administration and Compliance
University of California, Berkeley
arford@berkeley.edu
510-642-8117

cc: Michael McDonald, Acting Chairman, National Endowment for the Humanities (mmcdonald@neh.gov)
Robert Hirst, Principal Investigator, Head, and Curator, Mark Twain Papers
Kairi Williams, Assistant Vice Chancellor, Research Administration and Compliance

Encls.
Termination Notice
Funding Notification

---------- Forwarded message ---------
From: **Grant Notification** <Grant_Notifications@nehemail.onmicrosoft.com>
Date: Wed, Apr 2, 2025 at 8:36 PM
Subject: Notice of Grant Termination – Effective April 2, 2025
To: sabina_g@berkeley.edu <sabina_g@berkeley.edu>

Ms. Sabina Gafarova,

We regret to inform you that your NEH grant has been terminated. Please see the attached grant termination notice.

With Regards,
Michael McDonald
Acting Chairman, National Endowment for the Humanities

NATIONAL ENDOWMENT FOR THE HUMANITIES
NOTICE OF GRANT TERMINATION

April 2, 2025

Ms. Sabina Gafarova

Regents of the University of California, Berkeley

Dear NEH Grantee,

This letter provides notice that the National Endowment for the Humanities (NEH) is terminating your federal grant (Grant Application No. RQ30029725) effective April 2, 2025, in accordance with the termination clause in your Grant Agreement.

Your grant no longer effectuates the agency's needs and priorities and conditions of the Grant Agreement and is subject to termination due to several reasonable causes, as outlined in *2CFR§200.340*. NEH has reasonable cause to terminate your grant in light of the fact that the NEH is repurposing its funding allocations in a new direction in furtherance of the President's agenda. The President's February 19, 2025 executive order mandates that the NEH eliminate all non-statutorily required activities and functions. *See Commencing the Reduction of the Federal Bureaucracy*, E.O. 14217 (Feb. 19, 2025). Your grant's immediate termination is necessary to safeguard the interests of the federal government, including its fiscal priorities. The termination of your grant represents an urgent priority for the administration, and due to exceptional circumstances, adherence to the traditional notification process is not possible. Therefore, the NEH hereby terminates your grant in its entirety effective April 1, 2025.

Please remember that your obligations under the Grant Agreement continue to apply. Additionally, an audit may be conducted by the NEH after the termination of your grant.

Please contact Grant_Notifications@nehemail.onmicrosoft.com with only urgent questions.

Sincerely,

/s/ *Michael McDonald*

Michael McDonald
Acting Chairman, National Endowment for the Humanities
400 7th Street S.W., Washington, DC 20506

NATIONAL ENDOWMENT FOR THE HUMANITIES

August 28, 2024

Jessie Brown
Contract and Grant Officer
Sponsored Projects Office
University of California, Berkeley
1608 Fourth Street, Suite 220
Berkeley, CA 94710-1749

Application Number: RQ-300297

Dear Ms. Brown:

Congratulations! I am pleased to inform you that application RQ-300297 entitled "Mark Twain Project" under the direction of Robert H. Hirst has been approved to receive an offer for funding. The National Endowment for the Humanities (NEH) offers the University of California, Berkeley support for this project in an amount not to exceed $450,000.00 in federal matching funds, subject to the following condition:

NEH offers to provide federal matching funds of up to $450,000 on condition that (a) an equal amount of eligible non-federal, third-party gifts is raised and either certified or forwarded to NEH by June 30, 2027, and (b) sufficient funds allocated for matching purposes are available in the Division of Research Programs. It should be noted that this offer may be withdrawn at any time by the chair of NEH. Please see the Federal Matching Fund Guidelines (available at https://www.neh.gov/grants/manage/federal-matching-funds-guidelines) for details on the eligibility of gifts and their certification.

We anticipate that the federal matching funds for this project will be provided incrementally during the period of performance. Recipients are nevertheless encouraged to certify all eligible gifts as soon as possible so that NEH will be able to amend the award as soon as matching funds become available for this project.

If you wish to accept this offer of support, your response to the above condition(s) and the Gift Certification Form must be submitted via eGMS Reach, NEH's online electronic grant management system no later than June 30, 2027. Instructions for accessing eGMS Reach can be found below. Please note that the Endowment's review of the material requested and the preparation of the award documents require approximately four weeks.

NEH is making available to you our online electronic grant management system, eGMS Reach. You will be able to view offer and award letters, view and submit reports, receive alerts and notifications regarding the grants you manage, and send messages to NEH staff to raise questions and concerns.

When accessing eGMS Reach for the first time, go to https://reach.neh.gov/, click the Sign In Help link, and follow the on screen instructions. An e-mail message will be sent to you with a link to select a password.

This “offer” letter does not constitute an award. It formally communicates the level of funding recommended for the project and the conditions that must be met before an award will be issued by NEH. Should you have any questions concerning this offer of support, please feel free to contact Peter Scott at pscott@neh.gov, or Jason Boffetti at jboffetti@neh.gov.

NEH staff look forward to working with you.

Sincerely,

Shelly C. Lowe (Navajo)
Chair

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Attorneys for Plaintiffs and the Proposed Class
[Additional counsel listed on signature page]

UNITED STATES DISTRICT COURT

NORTHERN DISTRICT OF CALIFORNIA

NEETA THAKUR, KEN ALEX, NELL GREEN NYLEN, ROBERT HIRST, CHRISTINE PHILLIOU, and JEDDA FOREMAN, on behalf of themselves and all others similarly situated,

Plaintiffs,

v.

DONALD J. TRUMP, in his official capacity as President of the United States; DEPARTMENT OF GOVERNMENT EFFICIENCY ("DOGE"); AMY GLEASON, in her official capacity as Acting Administrator of the Department of Government Efficiency; NATIONAL SCIENCE FOUNDATION;

[*caption cont'd next page*]

Case No. 3:25-cv-04737-RL

DECLARATION OF RENA DORPH

The Honorable Rita F. Lin

BRIAN STONE, in his official capacity as Acting Director of the National Science Foundation;
NATIONAL ENDOWMENT FOR THE HUMANITIES;
MICHAEL MCDONALD, in his official capacity as Acting Chairman of the National Endowment for the Humanities;
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY;
LEE ZELDIN, in his official capacity as Administrator of the U.S. Environmental Protection Agency;
UNITED STATES DEPARTMENT OF AGRICULTURE;
BROOKE ROLLINS, in her official capacity as Secretary of the U.S. Department of Agriculture;
AMERICORPS (a.k.a. the CORPORATION FOR NATIONAL AND COMMUNITY SERVICE);
JENNIFER BASTRESS TAHMASEBI, in her official capacity as Interim Agency Head of AmeriCorps;
UNITED STATES DEPARTMENT OF DEFENSE;
PETE HEGSETH, in his official capacity as Secretary of the U.S. Department of Defense;
UNITED STATES DEPARTMENT OF EDUCATION;
LINDA MCMAHON, in her official capacity as Secretary of the U.S. Department of Education;
UNITED STATES DEPARTMENT OF ENERGY;
CHRIS WRIGHT, in his official capacity as Secretary of Energy;
UNITED STATES DEPARTMENT OF HEALTH AND HUMAN SERVICES;
ROBERT F. KENNEDY, JR., in his official capacity as Secretary of the U.S. Department of Health and Human Services;
UNITED STATES CENTERS FOR DISEASE CONTROL;
MATTHEW BUZZELLI, in his official capacity as Acting Director of the Centers for Disease Control;
UNITED STATES FOOD AND DRUG ADMINISTRATION;
MARTIN A. MAKARY, in his official capacity as Commissioner of the Food and Drug Administration;
UNITED STATES NATIONAL INSTITUTES OF HEALTH;
JAYANTA BHATTACHARYA, in his official capacity as Director of the National Institutes of

Health;
INSTITUTE OF MUSEUM AND LIBRARY SERVICES;
KEITH SONDERLING, in his official capacity as Acting Director of the Institute of Museum and Library Services;
UNITED STATES DEPARTMENT OF THE INTERIOR;
DOUG BURGUM, in his official capacity as Secretary of the Interior;
UNITED STATES DEPARTMENT OF STATE;
MARCO RUBIO, in his official capacity as Secretary of the U.S. Department of State;
DEPARTMENT OF TRANSPORTATION;
SEAN DUFFY, in his official capacity as Secretary for the U.S. Department of Transportation,

Defendants.

DECLARATION OF RENA DORPH

I, Rena Dorph, declare as follows:

1. I have personal knowledge of the facts contained in this declaration and, if called as a witness, could and would testify competently to them.

2. I am the Director of The Lawrence Hall of Science at University of California, Berkeley (UCB). I have worked there since 2003, when I joined as Director of its Research Group.

3. I have worked in the field of education, with a focus on research and evaluation, for over 25 years. Prior to joining The Lawrence Hall of Science, I served as Director for Research, Policy, and Technology in the Teacher Education and Professional Development Unit of the University of California Office of the President; as an educational consultant for California schools, districts, and county offices of education; as the Lead Researcher for the School Restructuring Study at UC Berkeley; and worked for the National Center for Restructuring Education, Schools, and Teaching at Columbia University/Teachers College in New York City.

4. I also serve on many governing and advisory boards, including the Board of Directors of the Association for Science and Technology Centers (ASTC) and WestEd. I additionally serve as the Principal Investigator for multiple STEM learning R&D projects.

5. I received a B.A. in Psychology from the University of California, Davis. I received my M.A. in the Sociology of Education from Teachers College at Columbia University. I received my Ph.D. in Educational Policy, Organization, Measurement, and Evaluation from University of California, Berkeley's Graduate School of Education.

6. My job as Director of The Lawrence Hall of Science includes overseeing more than 30 staff members with academic appointments. Many of these research and STEM learning experts rely heavily on federal grant funding to conduct their research; to deliver on-site educational activities for museum visitors; to create and deliver professional learning opportunities for educators and educational leaders; and to provide off-site STEM education to local youth, among other activities. Our staff researchers and learning designers also benefit the

public nationally by developing K-12 science curriculum for states and districts to adopt and for districts, schools, and teachers to implement. We estimate that these science curricular materials are used by over 7 million students in K-12 classrooms across the United States.

7. The abrupt and unexpected termination of numerous grants to The Lawrence Hall of Science that were previously awarded by the National Science Foundation (NSF) and the Institute for Museum and Library Services (IMLS) has already had a significant negative effect on our operations as we scramble to locate alternative funding sources, if available. In the wake of this precipitous loss of expected and relied-upon funding, many of our staff fear for their jobs. These grant terminations pose a serious ongoing threat to the viability of much of the institution's work, and to our ability to retain our specialized, highly educated and skilled research staff.

8. To communicate the severity of the impact of the sudden federal grant terminations on The Lawrence Hall of Science that has arisen since President Trump's inauguration, in April 2025 I prepared for our campus leadership a memorandum titled "Impact and Implications of Federal Grant Terminations (to-date)." A true and correct copy of that memorandum, which cumulates harms to The Lawrence Hall of Science as of late April, is attached as Exhibit A.

I declare under penalty of perjury under the laws of the State of California and the United States that the foregoing is true and correct.

Executed this 4 day of June, 2025.

Signed by:
Rena Dorph
220D6E5[illegible]

Rena Dorph

EXHIBIT A

The Lawrence Hall of Science
UNIVERSITY OF CALIFORNIA, BERKELEY

To: Kathy Yelick, Vice Chancellor for Research
Lok Siu, Associate Vice Chancellor for Research
Elizabeth Brashers, Assistant Vice Chancellor and Chief of Staff
David Castellanos, Chief Financial Officer
From: Rena Dorph, Director of The Lawrence Hall of Science
Date: April 29, 2025
Re: Impact and Implications of Federal Grant Terminations (to-date)

I am writing to provide you with a brief description of the impact (individual and collective) of the federal grant terminations we have received to date.

Context

The Lawrence Hall of Science has historically relied on and benefited from significant (20-25% of our budget) federal funding to support the research, development, innovation and scaling work that we do to inspire tomorrow by engaging young people, families, communities, and educators in STEM discovery and learning in ways that advance equity. Federal funding (mostly from NSF and IMLS, but also from NASA, NOAA, and NIH) provides a critical innovation and resource engine for all of our work and impact. Our federally funded work is critical to fueling our success at earning income from individuals and organizations across the formal (schools) and informal (afterschool, community-based, science centers) STEM learning marketplace. In essence, the impacts of these terminations have compromised our ability to carry out our institutional mission to the fullest degree possible.

Summary of Terminations To-Date

As of Friday, April 25, 2025 Lawrence Hall of Science Principal Investigators have collectively received 9 termination notices (8 grants; 1 subaward). Two of these were terminations of grants from the Institute of Museum and Library Services (IMLS) and 6 grants and 1 subaward were the result of terminations received from the National Science Foundation (NSF). I have listed these grants and termination dates by name here and provided more detail in an appendix.

1. Caminos de la Ciencia: Integrating inquiry-based activities into Latinx community spaces (IMLS; terminated April 8, 2025; PI Rossiter; IMLS # MG-253254-OMS-23, SPO #057093)

2. Harnessing Data for Audience-Centric Growth Through Professional Development (IMLS; terminated April 8, 2025; PI Bustos; IMLS # ME-256150-OMS-24, SPO #059097)
3. Working Toward Racial Equity: Building Capacity to Institutionalize Equity in Outdoor and Environmental Science Education (NSF; terminated April 18, 2025; PI Foreman; NSF award #2315277; SPO #056728)
4. Understanding the Impact of Outdoor Science and Environmental Learning Experiences Through Community-Driven Outcomes (NSF; terminated April 18, 2025; PI Collins; NSF award #2314075; SPO #056582)
5. Conference Proposal: Localization, High Quality Instructional Materials, and Educational Equity (NSF; terminated April 25, 2025; PI Roman; NSF award #2413236, SPO #059050)
6. DTI: Justice and Equity Centered Online Learning Design: Attending to ethics and collaboration in AI systems learning (NSF; terminated April 25, 2025; PI Cannady; NSF award #2241576, SPO #055498)
7. Supporting Rightful Presence in Museum Spaces: Youth as Participatory Designers of Indigenous Mixed Reality Science Exhibit (NSF; terminated April 25, 2025; PI Krakowski; NSF award #2241805, SPO #055414)
8. Urban Youth Participation in Community and Citizen Science (NSF; terminated April 25, 2025; PI Cuff; NSF award #2115614, SPO #052227)
9. Coherent Asynchronous Online Mathematics Teacher Professional Development for Equitable Instruction (NSF/Wested Subaward; terminated April 25, 2025; Subaward PI/Grant co-PI; Subaward #S-21318; SPO #059561)

Impact of Terminations

The Financial Impact

The financial implications of these terminations range from tens of thousands of dollars to millions of dollars depending on the scope of the award and the proximity of the original end date of the project period. All in all, **we currently estimate the cumulative amount of lost funds at over $6.4 million** dollars ($4.5 million to Lawrence Hall of Science; 1.9 million in IDC to UC Berkeley) including funding for ~ 10 Lawrence Hall of Science FTE annually (including 3 GSRs). Further, we are concerned that we may receive additional terminations in the near future as NSF continues its review of current grants. I have summarized these estimated losses on this google sheet. We will not have an exact amounts until we complete the close out of each of these awards. To learn more about the specific impact on FTE, please see the stop work tracking workbook (note the multiple tabs-one per grant) we created utilizing the template you provided to us to document the specific impact on FTE.

The Human Impact

While the financial implications are indeed debilitating, I also want to make sure to document the human cost of the termination of these awards. As you may note in the summaries I included in the appendix, the projects funded by these grants are important to the thousands of young

people, educators and partners that they are designed to engage, serve, and/or impact. In addition, each of the project proposals includes a description of the broader impacts that the project will have. The abrupt termination of these grants means that these people and organizations will be negatively impacted by the loss of funding and the direct service it is supposed to support. Our subawardees[1] and key partners are also suffering impacts due to terminations of our active projects and it may be difficult if not impossible if litigations/appeals are successful, to resume work, given the disruptions these actions have caused to those entities. Furthermore, the collaborative work with the Ohlone community, which has been deeply meaningful to the Ohlone community, The Lawrence, and the University, will suffer an enormous set back if we are unable to complete the NSF-funded youth-driven exhibits development project, that is currently in a prototype phase. Taken together, this set of terminated projects was set to impact young people, educators in and out of schools, school districts, and community-based organizations well positioned to engage educators and young people across the country.

Further, there is a significant and detrimental impact to the academic personnel and staff of UC Berkeley's Lawrence Hall of Science in the following ways: First, these abrupt terminations have a significant impact on The Lawrence's budget and will result in reductions in time and layoffs for both academic personnel and staff if we are not able to quickly materialize alternative resources. Second, these mid-project terminations negatively impact the ability of those academic personnel and staff members who have been working on these projects to advance their work and careers. Third, these terminations may negatively impact individual and organizational relationships with critical partners and audiences, some of which Lawrence employees have spent years cultivating. Fourth, the terminations and the circumstances that led to them are impacting the morale of the entire Lawrence Hall of Science and the mental health of the individuals in our team.

The Intellectual Impact

Last but not least, I am documenting the intellectual impact. As you may note in the summaries that I included in the appendix, the projects funded by these grants were each designed to advance research and/or practice in the field. In addition, each of the project proposals include a description of intellectual merit of the project. All of these projects included a knowledge building component through systematic research and/or evaluation efforts. Through a rigorous peer-review process, each of these awards was deemed important and necessary to contribute critical knowledge to the STEM learning field. The abrupt termination of these grants will result in lost opportunities to complete the data collection, analysis, and dissemination activities that were designed to advance research and practice across the field of STEM learning in and across formal (e.g. school) education and informal (e.g. science centers, libraries, afterschool, community-based organizations) learning settings.

[1] Current subawardees include: Naturebridge, Yes Nature to Neighborhoods, Wolf Ridge Environmental Learning Center, Informing Change and Harvard College. In addition, across these grant projects, we have been collaborating with several other organizations such as the Coalition of Communities of Color, Justice Outside, Restoring CARE, and others who are paid via contracts, or honoraria. We also are in partnership with multiple community-based organizations, libraries and schools to design and deliver our programs and services.

Furthermore, I am very concerned about the potential loss of critical expertise to The Lawrence and UC Berkeley if we are not able to quickly mitigate the loss of these funds with other sources. As you know, The Lawrence Hall of Science employs ~40 academic personnel, almost half of whom are impacted in varying degrees by the terminations that have occurred to date. These people and their expertise are critical to UC Berkeley's capacity for research, teaching, service, learning design, innovation, thought leadership and impact in the field of STEM learning and education. This capacity not only serves the work of The Lawrence Hall of Science but enriches UC Berkeley and the UC system significantly as we frequently work with faculty, scientists, educators, and staff across UCB and UC to advance knowledge and practice in STEM learning, education, communication and outreach.

The Societal Impact

Throughout The Lawrence Hall of Science's 55+ years of operation, federal funds, including those from NSF, NASA, NOAA, NIH, US Department of Education, and the Institute of Museum and Library Services have fueled innovation, disseminated science knowledge, prepared hundreds of thousands of educators to teach, launched millions of young people on scientific explorations, learning pathways and careers, and provided the basis for scientific literacy and decision making in everyday life for millions of individuals across the United States and internationally. A tragic by-product of these federal grant terminations is that past investments and the capacity that has resulted from them, is at risk. It is a surrender of resources and knowledge that is unprecedented in our history as a country, and one that will not easily be repaired.

Under separate cover, I will share our ideas for mitigating this risk and continuing to advance our mission, purpose and priorities during these challenging times.

Appendix

Summary Descriptions of Terminated Federal Grants as of April 25, 2025
The Lawrence Hall of Science • University of California, Berkeley

1. Caminos de la Ciencia: Integrating inquiry-based activities into Latinx community spaces
(IMLS; terminated April 8, 2025; PI Rossiter; IMLS # MG-253254-OMS-23, SPO #057093)

Project Period: 9/1/2023 to 8/31/2025
Total Award Amount: $49,770
IMLS Program: National Leadership Grants (NLG)

Proposal Project Description: Lawrence Hall of Science at the University of California Berkeley proposes a 1-year Rapid Prototyping project to IMLS's National Leadership Grants for Museums solicitation entitled Caminos de la Ciencia: Integrating museum learning activities into a Spanish-Language STEM program. The project team will integrate family learning experiences into existing Spanish-language public STEM that are inclusive of Latinx's unique identity. We will do this by: (1) enhancement of STEM talks through individualized scicomm and inclusive scicomm training; (2) incorporation of hands-on activities; and (3) a shareable model that provides guidance for other museums to follow who wish to meet communities where they are. The beneficiaries of Caminos include Latinx STEM experts, East Bay Latinx family participants, and the museum field. Intended results include inclusion of Latinx in STEM museums, inclusion in STEM identity development, access to quality STEM learning, and representation in STEM fields.

Note: Programming takes place at and in collaboration with the Oakland Public Library: César E. Chávez Branch.

2. Harnessing Data for Audience-Centric Growth Through Professional Development
(IMLS; terminated April 8, 2025; PI Bustos; IMLS # ME-256150-OMS-24, SPO #059097)

Project Period: 6/1/2024 – 5/31/2027
Total Award Amount: $249,999
IMLS Program: Museums Empowered (ME)

Proposal Abstract: The Lawrence Hall of Science at the University of California, Berkeley (The Lawrence) is seeking an IMLS Museums Empowered grant to enhance our capabilities in understanding, engaging, and serving chronically marginalized communities through the integration of data-driven approaches and comprehensive staff professional learning. This project will improve data collection and analysis, enhance practices that engage communities in collaborative design, and foster a data-centric mindset among Lawrence staff. This project will support staff in transparently aligning the institution with community needs and promoting inclusive educational experiences while balancing financial priorities and resources. The project will engage a diverse array of partners and advisors, facilitating continuous learning and change while enhancing staff skills, attitudes, and behaviors. The goal is to create a more inclusive and data-driven Lawrence Hall of Science, benefiting both marginalized communities and the broader East Bay region through increased visitorship and enhanced learning experiences.

3. Working Toward Racial Equity: Building Capacity to Institutionalize Equity in Outdoor and Environmental Science Education
(NSF; terminated April 18, 2025; PI Foreman; NSF award #2315277; SPO #056728)

Project Period: 1/2024 to 12/2028
Total Award Amount: $4,731,307
NSF Program/Solicitation: Racial Equity in STEM Learning (EDU Racial Equity)

Overview from Proposal Project Summary: The Lawrence Hall of Science at the University of California, Berkeley and Justice Outside propose a 5-year Racial Equity in STEM Education project to advance racial equity in outdoor and environmental science education (OESE) by developing a replicable model for organizational capacity building, Working Towards Racial Equity (WTRE). Using a theoretical approach that has emerged from our partnership activities, the Racialized Conditions of Systems Change, we will support leaders from each of five organizations to facilitate and guide organization-wide discussions related to racial equity, setting the foundation for each organization to participate in a systems change-focused racial equity design process. Through this process, we will develop and formalize a Racial Equity Transformation ToolKit to activate field-wide change. Concurrent research will investigate the conditions and outcomes necessary to move toward more racially just and equitable work environments by paying particular attention to the experiences of Professionals of Color within their organization and the OESE field. The evaluation focuses on the WTRE model and will examine how and to what extent the model supports individuals to do equity work in their organizations. Mechanisms embedded within programming, research, and evaluation efforts, such as a focus on “ground truthing,” BIPOC Affinity Spaces, and the Research Evaluation Advisory Group, ensure that the voices, knowledge, and experiences of those experiencing inequities caused by systemic racism are at the center of all project activities. Multiple members of the project’s leadership team and Advisory board add additional perspectives as individuals who have experienced inequities caused by systemic racism.

4. Understanding the Impact of Outdoor Science and Environmental Learning Experiences Through Community-Driven Outcomes
(NSF; terminated April 18, 2025; PI Collins; NSF award #2314075; SPO #056582)

Project Period: 01/01/2024 to 12/31/2027
Total Award Amount: $1,998,911
NSF Program/Solicitation: Advancing Informal Science Learning (AISL; EDU)

Overview from Proposal Project Summary: The Lawrence Hall of Science at the University of California, Berkeley proposes a four-year Integrating Research and Practice project to the National Science Foundation’s Advancing Informal Science Learning (NSF 22-626) program that will better position informal learning institutions to understand impact by producing a set of science and environmental literacy measures that center the knowledge, expertise, and experience of communities of color. Scientific and environmental literacy are valuable outcomes linked to academic learning, STEM career pathways, and broader engagement in science and environmental causes and advocacy. However, the current tools for measuring these concepts are insufficient; though useful for measuring some dimensions of impact, they are aligned with dominant views that exclude and erase the knowledge and expertise of communities of color. We plan to improve existing measurement tools as well as design new ones by engaging in a community-driven process that will center the voices of communities of color. We will then use

these tools to measure the impact of outdoor science and environmental learning (OSEL) experiences on students' scientific and environmental literacy. In Phase 1, we will form a Community Research Network (CRN) composed of youth, educators, leadership, and community members of partnering OSEL organizations. In collaboration with the CRN, we will engage in an iterative process of idea generation, data collection, and sensemaking to articulate and co-develop a set of revised and new outcome measures. In Phase 2, we will validate these measures through a quantitative study that will paint a fuller picture of the impact of OSEL experiences on youth, while also seeking to understand how youth of color make meaning of these experiences through a focal student case study approach. Finally, in Phase 3, we will collaborate with the CRN to share findings with the field, including through a conceptual framework that articulates the outcomes and structures within and adjacent to OSEL organizations that allow for youth to thrive.

5. Conference Proposal: Localization, High Quality Instructional Materials, and Educational Equity
(NSF; terminated April 25, 2025; PI Roman; NSF award #2413236, SPO #059050)

Project Period: 9/1/2024 – 8/31/2025
Total Award Amount: $199,995
NSF Program/Solicitation: Discovery Research K-12 (DR K-12; EDU)

Overview from Proposal Project Summary: The proposed 1-year Workshop/Conference Project within the Teaching Strand addresses the need for dialogue among expert and emerging stakeholders about the relationship and tension between localization and high-quality instructional materials (HQIMs) as two important elements in the pursuit of equitable learning outcomes in K-12 science. The project would involve organization of a Conference Series consisting of an in-person Conference and a series of four follow-up Virtual Meetings, that would bring together a representative body of contributors including teachers and district leaders; state education agency leaders; researchers; and instructional materials designers. Participants will clarify definitions, share existing models and evidence, and identify priorities for future research agendas and design efforts. The in-person Conference will include up to 50 participants, with funding provided to cover travel and subsistence expenses for 31 participants. Additional funding will be offered to address participation barriers for teachers and those with family care responsibilities. Outputs of the Conference Series will include a proposed research and design agenda for localization of HQIMs, as well as vignettes, exemplars, and models of current approaches, which will be shared via a public website and disseminated through practitioner and researcher audiences.

6. DTI: Justice and Equity Centered Online Learning Design: Attending to ethics and collaboration in AI systems learning
(NSF; terminated April 25, 2025; PI Cannady; NSF award #2241576, SPO #055498)

Project Period: 9/2023 to 8/2026
Total Award Amount: $1,291,633
NSF Program/Solicitation: Innovative Technology Experiences… (ITEST; EDU)

Overview from Proposal Project Summary: The University of California, Berkeley's Lawrence Hall of Science (The Lawrence) proposes a 3 year Developing and Testing Innovations project titled, "DTI: Justice and Equity Centered Online Learning Design: Attending to Ethics and Collaboration in AI Systems Learning." If funded, the project would strengthen and broaden

youth capacity for, and disposition toward, artificial intelligence (AI) domains and careers, and the increasingly critical sociotechnical competencies needed in AI workforce pathways. This goal will be pursued by (1) engaging high school aged youth chronically excluded from AI learning experiences in an online learning sequence that integrates learning of AI technical skills with principles of ethics that include security, accountability, fairness, transparency, and privacy; and (2) generating new knowledge about designing for prosocial learning engagement in online learning environments that lead to greater career awareness and interest.

7. Supporting Rightful Presence in Museum Spaces: Youth as Participatory Designers of Indigenous Mixed Reality Science Exhibit
(NSF; terminated April 25, 2025; PI Krakowski; NSF award #2241805, SPO #055414)

Project Period: 9/2023 to 8/2026
Total Award Amount: $1,292,298
NSF Program/Solicitation: Innovative Technology Experiences… (ITEST; EDU)

Overview from Proposal Project Summary: We, the University of California, Berkeley (UC Berkeley) and mak-'amham, an Ohlone cultural institution that empowers Ohlone people with a rich cultural identity, propose a three-year ITEST Developing and Testing Innovations project to address the ongoing marginalization of Indigenous communities from informal science learning spaces by developing and studying a model that strengthens Indigenous youths' capacity for, and disposition toward STEM pathways. Drawing on a set of design principles that emerged from an existing partnership between the Lawrence and mak-'amham, the project will engage 20 Ohlone youth (ages 10-16) in iterative cycles of participatory design and prototyping to create immersive Indigenous Science exhibit experiences for the Lawrence Hall of Science (the Lawrence) using mixed reality technologies. In centering Indigenous perspectives within science and technology learning experiences and highlighting connections between Indigenous cultural identities and contemporary STEM career pathways, our proposed project aims to reframe STEM learning to increase Indigenous youth's rightful presence (defined by a sense of belonging and shifting institutional power; Calabrese Barton & Tan, 2020) to foster positive affective shifts toward STEM that can improve prospects for a more diverse STEM workforce. The project's research will advance understanding of design practices that contribute to rightful presence for Indigenous youth, and investigate the impact of the participatory design model on youths' STEM learning, science identity, and interest in STEM careers. The project will generate insights to inform a professional learning model that supports informal science educators to facilitate Indigenous-centered learning experiences.

Notes:

- *The structure of this partnership shifted once the 'ottoy Initiative hired Vincent Medina, Louis Trevino and Deirdre Greene as University employees. At that time we discontinued the subaward with mak-'amham and we support the partnership with the Ohlone community through their leadership on our staff.*
- *A supplement was granted to this proposal to support a day-long showcase of NSF support of informal learning experiences in May, 2025. The day will feature drop-in and scheduled activities showcasing current NSF ITEST and AISL projects, including IMRSE (described above), Urban Youth Participation in Community and Citizen Science (Award No. 2115614),* and *AI Behind Virtual Humans: Communicating the Capabilities and Impact of Artificial Intelligence to the Public through an Interactive Virtual Human Exhibit (Award No. 2116109).*

8. Urban Youth Participation in Community and Citizen Science
(NSF; terminated April 25, 2025; PI Cuff; NSF award #2115614, SPO #052227)

Project Period: 9/15/2021 - 8/31/2025
Total Award Amount: $1,199,094
NSF Program/Solicitation: Advancing Informal Science Learning (AISL; EDU)

Overview from Proposal Project Summary: The University of California at Berkeley's Lawrence Hall of Science proposes a four-year Research in Service to Practice project to explore the educational and developmental impact of an informal science education programming model that features Community and Citizen Science (CCS) activities on youth of color residing in urban communities. The project is grounded in an undergirding hypothesis which holds that engagement in CCS - focused experiences results in valued learning outcomes that better position youth of color to more effectively engage in STEM-related educational, occupational, and civic activities. Each year in three economically challenged urban communities located throughout the country a total of 180 youth of color between the ages of 14 and 18 will participate in month-long summer or semester-long afterschool programs that feature CCS activities. These activities will include the collection, analysis, interpretation and presentation of environmental quality data that addresses local, pressing concerns, such as soil lead contamination and air particulate matter pollution. The project will explore the manner in which particular CCS activities (e.g., project design, data analysis and interpretation, data presentation) impact youth "science agency," which is defined as a combination of constructs that include Science Identity (i.e., sense of themselves as science thinkers), Science Value (i.e., awareness of the potential benefits of applying scientific practices to addressing critical community health and environmental issues) and Science Competency (i.e., belief of themselves as competent science practitioners). Subsequently, the project will explore how these constructs relate to one another, as well as the relationship between emerging science agency and the development of capacities to participate in community-based activism and/or advocacy efforts.

9. Coherent Asynchronous Online Mathematics Teacher Professional Development for Equitable Instruction
(NSF/Wested Subaward; terminated April 25, 2025; Subaward PI/Grant co-PI: Mayfield-Ingram; *Subaward* #S-21318; SPO #059561)

Project Period: 7/1/2024 - 6/30/2028
Total Award Amount: $151,967
NSF Program/Solicitation: Discovery Research K-12 (DR K-12; EDU) via WestEd

Scope of Work for UCB/LHS Subaward: The Lawrence Hall of Science will co-direct the design and development of a 25-hour professional learning course for middle school mathematics teachers by (1) supporting the creation of a trajectory for the equity strand focused on equitable teaching practices and positioning; (2) Providing feedback on the trajectory of the mathematics strand, with particular regard to the ways in which it supports/hinders the learning goals of the equity strand; (3) co-designing the initial module and create outlines of additional modules; (4) reviewing and providing feedback on the set of modules as they are built/designed by the larger project team; (5) reviewing feedback and research data to suggest design improvements; (6) reviewing and providing feedback after improvements have been made to course materials; (7) supporting the team in dissemination efforts, including co-authoring peer-reviewed papers and presentations.

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[Additional counsel listed on signature page]

UNITED STATES DISTRICT COURT

NORTHERN DISTRICT OF CALIFORNIA

NEETA THAKUR, KEN ALEX, NELL GREEN NYLEN, ROBERT HIRST, CHRISTINE PHILLIOU, and JEDDA FOREMAN, on behalf of themselves and all others similarly situated,

Plaintiffs,

v.

DONALD J. TRUMP, in his official capacity as President of the United States; DEPARTMENT OF GOVERNMENT EFFICIENCY ("DOGE"); AMY GLEASON, in her official capacity as Acting Administrator of the Department of Government Efficiency; NATIONAL SCIENCE FOUNDATION;

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Case No. 3:25-cv-04737-RL

DECLARATION OF SAMUEL PIMENTEL

The Honorable Rita F. Lin

BRIAN STONE, in his official capacity as Acting Director of the National Science Foundation;
NATIONAL ENDOWMENT FOR THE HUMANITIES;
MICHAEL MCDONALD, in his official capacity as Acting Chairman of the National Endowment for the Humanities;
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY;
LEE ZELDIN, in his official capacity as Administrator of the U.S. Environmental Protection Agency;
UNITED STATES DEPARTMENT OF AGRICULTURE;
BROOKE ROLLINS, in her official capacity as Secretary of the U.S. Department of Agriculture;
AMERICORPS (a.k.a. the CORPORATION FOR NATIONAL AND COMMUNITY SERVICE);
JENNIFER BASTRESS TAHMASEBI, in her official capacity as Interim Agency Head of AmeriCorps;
UNITED STATES DEPARTMENT OF DEFENSE;
PETE HEGSETH, in his official capacity as Secretary of the U.S. Department of Defense;
UNITED STATES DEPARTMENT OF EDUCATION;
LINDA MCMAHON, in her official capacity as Secretary of the U.S. Department of Education;
UNITED STATES DEPARTMENT OF ENERGY;
CHRIS WRIGHT, in his official capacity as Secretary of Energy;
UNITED STATES DEPARTMENT OF HEALTH AND HUMAN SERVICES;
ROBERT F. KENNEDY, JR., in his official capacity as Secretary of the U.S. Department of Health and Human Services;
UNITED STATES CENTERS FOR DISEASE CONTROL;
MATTHEW BUZZELLI, in his official capacity as Acting Director of the Centers for Disease Control;
UNITED STATES FOOD AND DRUG ADMINISTRATION;
MARTIN A. MAKARY, in his official capacity as Commissioner of the Food and Drug Administration;
UNITED STATES NATIONAL INSTITUTES OF HEALTH;
JAYANTA BHATTACHARYA, in his official capacity as Director of the National Institutes of Health;

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INSTITUTE OF MUSEUM AND LIBRARY SERVICES;
KEITH SONDERLING, in his official capacity as Acting Director of the Institute of Museum and Library Services;
UNITED STATES DEPARTMENT OF THE INTERIOR;
DOUG BURGUM, in his official capacity as Secretary of the Interior;
UNITED STATES DEPARTMENT OF STATE;
MARCO RUBIO, in his official capacity as Secretary of the U.S. Department of State;
DEPARTMENT OF TRANSPORTATION;
SEAN DUFFY, in his official capacity as Secretary for the U.S. Department of Transportation,

Defendants.

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DECLARATION OF SAMUEL PIMENTEL

I, Samuel Pimentel, declare as follows:

1. I have personal knowledge of the facts contained in this declaration and, if called as a witness, could and would testify competently to them.

2. I am a statistician who examines causal relationships using large data sets to address problems in health services research, epidemiology, and education. I currently serve as an Assistant Professor in the Department of Statistics at the University of California, Berkeley (UCB).

3. I received a Bachelor of Science degree in mathematical and computational science from Stanford University in 2012. I received my Doctor of Philosophy in Statistics from the Wharton School, University of Pennsylvania, in 2017. Since 2017, I have worked at UCB as an Assistant Professor.

4. My research focuses on (1) developing methods for causal inference in large observational datasets from the medical and social sciences; (2) creating transparent and interpretable approaches for estimating causal effects, even in the presence of unobserved confounding variables; and (3) applying these tools to real-world problems in health services research, epidemiology, education, and public policy. In 2022, I received the National Science Foundation (NSF) CAREER award, the foundation's prestigious early-faculty award, to continue my research concerning observational study design.

5. Articles illustrative of my focus on observational studies and the medical sciences include an article on Large, Sparse Optimal Matching With Refined Covariate Balance in an Observational Study of the Health Outcomes Produced by New Surgeons, published in the Journal of the American Statistical Association 110 (510), 515-527 (2015); and an article Comparing International and United States Undergraduate Medical Education and Surgical Outcomes Using a Refined Balance Methodology, published in Annals of Surgery 265 (5), 916-922 (2017).

6. My research frequently involves collaboration with other universities and community-based health organizations. It has been supported in the past by sources that include a graduate fellowship from the Department of Defense (DoD), federal grants from the NSF and

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Food and Drug Administration (FDA), and private foundation grants.

7. A true and correct copy of my curriculum vitae is attached as Exhibit A.

Research Project & Response to FDA Solicitation of Proposals

8. In May 2023, I agreed to work as Lead Statistician for a project titled "Health and Neurodevelopmental Outcomes in Infants at Risk for Neonatal Opioid Withdrawal Syndromes: Effects of Timing and Duration of Prenatal Opioid Exposure and Postnatal Management with ESC." "ESC" stands for "Eat, Sleep, Console." The premise of our grant research was that non-pharmacological approaches to managing neonatal opioid withdrawal syndrome (NOWS) in infants, such as the use of "Eat, Sleep, Console (ESC)," hold potential to improve infant outcomes compared to opioid replacement treatment. The project planned to compare differences in outcomes between opioid replacement pharmacotherapy and non-pharmacological management in infants with NOWS. It further aimed to test the hypothesis that timing, duration, and doses of prenatal opioid exposure help predict where non-pharmacological management will be most effective.

9. The research team planned to use the Kaiser Permanente Northern California research databases as the data source. These provide high-quality data on a large patient population, allowing for the study of birth cohorts that are linked to the mothers, which provides an excellent assessment of maternal risk factors. The data includes pharmacy and clinical data from all patient encounters in Kaiser's electronic health records.

10. The project was initially proposed by Dr. Lena Sun of Columbia University Irving Medical Center (CUMC) in response to the FDA's announcement of funding opportunity FDABAA-23-00123. This opportunity was made available through an FDA Broad Agency Announcement for the Advanced Research and Development of Regulatory Science in January 2023. After our team submitted an initial white paper proposal, FDA in May 2023 invited us to submit a full proposal. A true and correct copy of FDA's invitation is attached as Exhibit B.

Grant Proposal to FDA

11. Our final grant proposal, on which I was Lead Statistician and co-investigator, encompassed seven investigators across four institutions: UCB, Columbia, Johns Hopkins School

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of Medicine, and Kaiser Permanente. Our team's expertise spanned maternal exposure analysis, fetal epidemiology, implementation science, and statistical analysis.

12. As Lead Statistician and co-investigator, my primary role in the proposed work was to lead the design and analysis of statistical comparisons between NOWS infants exhibiting exposures of interest (*e.g.*, those receiving opioid replacement pharmacotherapy, or those receiving particular prenatal doses or durations of exposure to opioids) to corresponding control groups. My role also included presenting results at internal team meetings and external scientific meetings, preparing manuscripts, and supervising a UC Berkeley graduate student who was to be supported by the award and assist me in my duties. A true and correct copy of my letter to the Principal Investigator expressing my willingness and eagerness to collaborate as a co-investigator on the proposed project is attached as Exhibit C.

13. Our research team's Grant Application contemplated a multi-campus, multi-nonprofit research collaboration that would span four years and conclude on August 31, 2027. A true and correct copy of the Application is attached as Exhibit D.

FDA's Grant Award and My Sub-Award

14. On September 28, 2023, an FDA Grants Manager transmitted to our team a Notice of FDA's award and the Grant Agreement. The Agreement indicated that we were authorized to proceed for Project Period 9/30/2023 to 9/29/2027; that the FDA would make a total estimated payment of $1,721,851; and that this amount would be disbursed in installments across each of the project's four years. A true and correct copy of the Grant Agreement is attached as Exhibit E.

15. As part of the grant funding, I was subcontracted as Lead Statistician and received $52,555 in the base year from 9/30/2023 to 9/29/2024. This funding was authorized on May 24, 2024. For the second year, I was obligated to receive $55,122.

16. My most recent subcontractor Award Summary, dated February 11, 2025, stated that FDA had obligated to me a total of $107,677 for work performed by that date and work to be performed through September 29, 2025. A true and correct copy of this Award Summary is attached as Exhibit F.

17. To date, UCB has, on paper been sub-awarded this $107,677, of which we have

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spent and invoiced $52,366. The remaining amount was to be for payment of salaries during Summer 2025.

FDA's Grant Termination

18. On March 7, 2025, a contract specialist at FDA sent to our research team an email message with subject line text: "Notice of Modification—Termination for Convenience." The entirety of the message text was:

> *Please see attached the signed unilateral modification P00003 to FDA Contract No. 75F40123C00211. Please note that the full termination of this contract is taken for the Government's convenience and is as a result of recent Presidential Executive Orders.*
>
> *Please confirm receipt of the modification P00003.*

A true and correct copy of this email is attached as Exhibit G.

19. The e-mail message had two attachments. The first attachment was a Termination Notice that stated: "The contract identified in Block 10A is hereby terminated for the convenience of the government effective 3/7/2025." It further stated that our team was to stop work "immediately." A true and correct copy of the Termination Notice is attached as Exhibit H.

20. The second attachment, titled "Amendment of Solicitation/Modification of Contract," stated: "This modification fully terminates the Contract." A true and correct copy of this amendment/modification to our contract is attached as Exhibit I.

21. On March 10, 2025, I received a notification letter from Columbia University stating that that our grant award was terminated in full. The letter instructed the research team to "immediately stop all work." A true and correct copy of the notification letter from Columbia is attached as Exhibit J.

Harms from Grant Termination

22. I and my project team have suffered immediate harm as a result of the cancellation of our FDA grant and associated subcontracts. Specifically:

a) I have been unable to complete a new set of planned analyses aimed at understanding how interactions between opioid exposure and maternal ADHD diagnoses influence a child's ADHD risk.

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b) I have spent time that would otherwise have been committed to advancing my research in public health and associated statistical methodology seeking additional funding sources.

c) To replace summer salary provided by the grant, I have agreed to teach an online introductory statistics course that will require many hours of preparation and instruction that would otherwise have been committed to research.

d) I have also been unable to offer research assistantships to graduate students for the fall semester, which will limit my research productivity.

e) The Columbia and UC Berkeley researchers on this grant have been unable to pursue our originally-scheduled series of investigator meetings, important touchpoints for sharing, framing and conceptualizing scientific findings and for planning dissemination and implementation. This has delayed our ability to progress the work completed towards publication, and has put on hold plans to pursue follow-up work (including a new proposal to conduct additional data collection for our study cohort).

f) The graduate student supported by the terminated award during fall 2024 has been unable to continue his planned dissertation work involving our data. He is currently looking for new projects and new funding to support him in the fall 2025 semester.

g) Additionally, even if we were eventually to find replacement funding for this project (a difficult proposition), they would no longer be adequate to cover our expenses. Graduate student stipends and faculty summer salary rates increase yearly according to university policy, and under any reasonable timeline by which new funding could be obtained, the originally budgeted amounts will no longer be sufficient to cover the requisite faculty and student effort.

h) In addition, attending an important conference for which grant funds had been earmarked; at which our team had committed to participate; and for which we had already made travel arrangements — the 2025 Pediatric Academic Societies meeting — required me to pull funding from other sources.

i) Unless and until our team's grant funding is restored, our team will be unable to commit to participate in additional project-relevant conferences and I will continue to be unable to present our results there.

j) These financial and professional harms are ongoing.

k) In addition, my research team's inability to complete work on solutions and treatments for prenatal opioid exposure during the country's current opioid crisis will result in the loss of value to the public.

UC Berkeley School of Law
(510)642-5398

I declare under penalty of perjury under the laws of the State of California and the United States that the foregoing is true and correct.

Executed this 4th day of June, 2025

Signed by:
Samuel Pimentel
9936345A35CC452...

Samuel Pimentel

UC Berkeley School of Law
(510)642-5398

EXHIBIT A

Samuel David Pimentel

Department of Statistics
University of California, Berkeley
429 Evans Hall
Berkeley, CA 94720

spi@berkeley.edu
http://www.stat.berkeley.edu/~spi

EMPLOYMENT:

Assistant Professor, Department of Statistics, University of California, Berkeley, July 2017 - present.

EDUCATION:

Ph.D., Statistics, Wharton School, University of Pennsylvania, May 2017.
- Dissertation: Balancing multiple goals in observational study design.
- Dissertation Committee: Dr. Paul R. Rosenbaum (chair), Dr. Dylan S. Small, Dr. Abba M. Krieger, Dr. Jeffrey H. Silber.

B.S., Mathematical & Computational Science, Stanford University, June 2012 (with Departmental Honors and University Distinction).

SELECTED AWARDS AND FELLOWSHIPS:

- National Science Foundation CAREER award, 2022.
- Hellman Family Fellowship, 2021.
- IMS New Researcher Travel Award, Institute of Mathematical Statistics, 2018.
- J. Parker Bursk Memorial Prize for Excellence in Research, Department of Statistics, The Wharton School, University of Pennsylvania, 2016.
- Thomas R. Ten Have Award, Atlantic Causal Inference Conference, 2016 (for "exceptionally creative or skillful research in causal inference by a junior researcher").
- National Defense Science & Engineering Graduate (NDSEG) Fellowship, 2013-2016.

RESEARCH PUBLICATIONS:

Statistical Methodology

Shen, A., Visoki, E., Barzilay, R., and **Pimentel, S.D.** (2025). "A calibrated sensitivity analysis for weighted causal decompositions." *Statistics in Medicine* 44(5), e70010.

Huang, M., and **Pimentel, S.D.** (2025+). "Variance-based sensitivity analysis for weighting estimators results in more informative bounds." *Biometrika* (in press). Won **2023 Best Theory Poster Award** from the Society for Political Methodology.

Pimentel, S.D. and Huang, Y. (2024). "Covariate-adaptive randomization inference in matched designs." *Journal of the Royal Statistical Society - Series B (Statistical Methodology)* 86(5), 1312-1338.

Liao, L.D., Zhu, Y., Ngo, A.L., Chehab, R.F., and **Pimentel, S.D.** (2024). "Prioritizing variables for observational study design using the joint variable importance plot." *The American Statistician* 78(3), 318–326.

Soriano, D., Ben-Michael, E., Bickel, P.J., Feller, A., and **Pimentel, S.D.** (2023). "Interpretable sensitivity analysis for balancing weights." *Journal of the Royal Statistical Society - Series A (Statistics in Society)* 186(4), 707-721.

Glazer, A.K., and **Pimentel, S.D.** (2023). "Robust inference for matching under rolling enrollment." *Journal of Causal Inference* 11(1), 2022-0055.

Howard, S.R., and **Pimentel, S.D.** (2021). "The uniform general signed rank test and its design sensitivity." *Biometrika* 108, 381-396.

Pimentel, S.D., and Kelz, R.R. (2020). "Optimal tradeoffs in matched designs comparing US-trained and internationally-trained surgeons." *Journal of the American Statistical Association* 115 (532), 1675-1688.

Pimentel, S.D., Forrow, L.V., Gellar, J., and Li, J (2020). "Optimal matching approaches in health policy evaluations under rolling enrolment." *Journal of the Royal Statistical Society - Series A (Statistics in Society)* 183 (4), 1411-1435.

Keele, L., Harris, S., **Pimentel, S. D**., & Grieve, R. (2020). "Stronger instruments and refined covariate balance in an observational study of the effectiveness of prompt admission to intensive care units." *Journal of the Royal Statistical Society: Series A (Statistics in Society)* 183 (4), 1501-1521.

Keele, L., and **Pimentel, S.D.** (2019). "Matching with attention to effect modification in a data challenge." *Observational Studies* 5, 83-92.

Pimentel, S.D., Page, L., Lenard, M., and Keele, L. (2018). "Optimal multilevel matching using network flows: an application to a summer reading intervention." *Annals of Applied Statistics* 12 (3), 1479 -1505.

Pimentel, S.D., Small, D.S., and Rosenbaum. P.R. (2017). "An exact test of fit for the Gaussian linear model using optimal nonbipartite matching." *Technometrics*, 59 (3), 330-337.

Pimentel, S.D., Small, D.S., and Rosenbaum. P.R. (2016). "Constructed second control groups and attenuation of unmeasured biases." *Journal of the American Statistical Association*, 111 (515), 1157-1167, doi: 10.1080/01621459.2015.1076342.

Pimentel, S.D., Kelz, R.R., Silber, J.H., and Rosenbaum, P.R. (2015). "Large, sparse optimal matching with refined covariate balance in an observational study of the health outcomes produced by new surgeons." *Journal of the American Statistical Association*, 110 (510), 515-527, doi: 10.1080/01621459.2014.997879.

Pimentel, S.D., Yoon, F., and Keele, L (2015). "Variable-ratio matching with fine balance in a study of the Peer Health Exchange." *Statistics in Medicine*, 34 (30) 4070-4082, doi: 10.1002/sim.6593.

Statistical Applications

Breithaupt, A., Mohan, S., Thombley, R., **Pimentel, S. D.**, ad Douglas, V. C. (2025). "Education research: exploring the impact of standardized, condition-specific note templates on quality metrics and efficiency in multiple resident clinics." *Neurology Education*, 4(1), e200200.

Feinstein, M., Ing, C., Knapp, A., Li, G., and **Pimentel, S. D.** (2025). "Research methods and approaches for studies in pediatric anesthesia safety." *Journal of Neurosurgical Anesthesiology*, 37(1), 100-102.

Merlino, B., Pimentel, D., **Pimentel S.D.,** Ugurgieri, L., Waters, A. (2024+). "'You're gonna need a bigger boat': assessing the relationship between economic performance and ethnonationalism in Bosnia and Herzegovina (2002-2022)." *Contemporary Southeastern Europe* (in press).

Kuzniewicz, M.W., Campbell, C.I., Li, S., Walsh, E.M., Croen, L.A., Comer, S.D., **Pimentel, S.D.,** Hedderson, M. and Sun, L.S., (2022). "Accuracy of diagnostic codes for prenatal opioid exposure and neonatal opioid withdrawal syndrome." *Journal of Perinatology*, 43, 293-299.

Silber, J.H., Rosenbaum, P.R., **Pimentel, S.D.**, Calhoun, S., Wang, W., Sharpe, J.E., Reiter, J.G., Shah, S.A., Hochman, L.A., and Even-Shoshan, O. (2019). "Comparing resource use in medical admissions of children with complex chronic conditions." *Medical Care*, 57 (8), 615-624.

Zaheer, S., **Pimentel, S.D**., Simmons, K.D., Kuo, L.E.Y., Datta, J., Williams, N., Fraker, D.L., and Kelz, R.R. (2016). "Comparing international and United States undergraduate medical education and surgical outcomes using a refined balance methodology." *Annals of Surgery* 265 (5), 916-922.

Grossman, G., Gazal-Ayal, O., **Pimentel, S.D**., and Weinstein, J.M. (2016). "Descriptive representation and judicial outcomes in multi-ethnic societies." *American Journal of Political Science* 60 (1), 44-69, doi: 10.1111/ajps.12187.

Software for Statistics and Data Visualization

Han, S., and **Pimentel, S.D.** (2024). "MultiObjMatch: matching with optimal tradeoffs between multiple objectives in R." *Observational Studies* 10(2), 1-32.

Liao, L.D., and **Pimentel, S.D.** (2024). "jointVIP: Prioritizing variables in observational study design with joint variable importance plot in R." *Journal of Open Source Software*, 9(103), 6093.

Liao, L.D. and **Pimentel, S.D.** (2023). R package `JointVIP`: prioritize variables with joint variable importance plot in observational study design. Published on *The Comprehensive R Archive Network* (https://cran.rstudio.com).

Han, S. and **Pimentel, S.D.** (2022). R package `MultiObjMatch`: multi-objective matching algorithm. Published on *The Comprehensive R Archive Network* (https://cran.rstudio.com).

Gellar, J., Hansen, B.B., Fredrickson, M., Glazer, A.K., Forrow, L.V., and **Pimentel, S.D.** (2021). R package `GroupMatch`: optimal matching under rolling enrollment. Available on Github (https://github.com/jgellar/GroupMatch).

Pimentel, S.D. (2016). "Large, sparse optimal matching with R package rcbalance." *Observational Studies* 2, 4-23.

Pimentel, S.D., and Keele, L. (2016). R package `matchMulti`: optimal multilevel matching using a network algorithm. Published on *The Comprehensive R Archive Network* (https://cran.rstudio.com).

Pimentel, S.D. (2016). R package `rcbsubset`: optimal subset matching with refined covariate balance. Published on *The Comprehensive R Archive Network* (https://cran.rstudio.com).

Pimentel, S.D. (2014). R package `rcbalance`: large, sparse optimal matching with refined covariate balance. Published on *The Comprehensive R Archive Network* (https://cran.rstudio.com).

Pimentel, S.D. (2014). "Choosing a clustering: an a posteriori method for social networks." *Journal of Social Structure* 15 (1), 1-21.

Pimentel, S., Walbot, V., and Fernandes, J. (2011). "GRFT – genetic records family tree web applet." *Frontiers in Genetics* 2, 14, doi:10.3389/fgene.2011.00014.

Invited Chapters

Pimentel, S.D. (2023). "Fine balance and its variations in modern optimal matching." In *Handbook of Matching and Weighting Adjustments for Causal Inference*, eds. Zubizarreta, J.R., Stuart, E. A., Small, D.S., and Rosenbaum, P.R. CRC Press: Boca Raton, FL.

Keele, L., and **Pimentel, S.D.** (2023). "Matching with multilevel data." In *Handbook of Matching and Weighting Adjustments for Causal Inference*, eds. Zubizarreta, J.R., Stuart, E. A., Small, D.S., and Rosenbaum, P.R. CRC Press: Boca Raton, FL.

Working Papers

Huang, M., Soriano, D., and **Pimentel, S.D.** (2025+). "Design sensitivity and its implications for weighted observational studies." arxiv:2307:00093.

Pimentel, S.D., and Yu, R. (2025+). "Re-evaluating the impact of hormone replacement therapy on heart disease using match-adaptive randomization inference." arxiv:2403.01330.

Pimentel, S.D., Sun, L.S., Campbell, C.I., Li, S., Walsh, E.M., Croen, L.A., Comer, S.D., Hedderson, M. and Kuzniewicz, M.W. (2025+) "Neurodevelopmental and behavioral outcomes of children with prenatal opioid exposure."

SELECTED FUNDING:

Food and Drug Administration, "Health and Neurodevelopmental Outcomes in Infants at Risk for Neonatal Opioid Withdrawal Syndromes (NOWS): Effects of Timing and Duration of Prenatal Opioid Exposure (POE) & Postnatal Management with Eat-Sleep-Console (ESC)" (75F40123C00211), 2023-2025. Co-Investigator and lead statistican (PIs: Kuzniewicz and Sun).

National Science Foundation, "CAREER: Integrating Optimal Design and Inference for Modern Observational Studies" (SES-2142146), 2022-2027. Principal Investigator.

Hellman Fellows Program, "Joint treatment-outcome variable importance in observational study design," 2021-2022. Principal Investigator.

Food and Drug Administration, "Neurodevelopmental Outcomes in Infants Receiving Opioid-Replacement Pharmacotherapy for Neonatal Opioid Withdrawal Syndrome" (75F40119C10101), 2019-2024. Co-Investigator and lead statistican (PIs: Kuzniewicz and Sun).

National Science Foundation, "RTG: Advancing Machine Learning - Causality and Interpretability," (DMS-1745640), 2018-2024. Co-Principal Investigator from July 2021 (PI: Ding).

RESEARCH PRESENTATIONS:

"Design sensitivity and its implications for weighted observational studies."
International Conference on Statistics and Data Science, Nice, France, December 2024
Department of Biostatistics, University of Washington, October 2024
Center for Causal Inference, University of Pennsylvania, Philadelphia, PA, March 2024
Center for Practice and Research at the Intersection of Information, Society, and Methodology (PRIISM), New York University, New York, NY March 2024.
Department of Statistics, Rutgers University, New Brunswick, NJ October 2023.
Department of Statistics, University of Wisconsin-Madison, Madison, WI September 2023.
Royal Statistical Society Conference, Harrogate, UK, September 2023.
Joint Statistical Meetings, Toronto, Canada, August 2023 (invited poster).
Society for Political Methodology Annual Meeting, Stanford, CA, July 2023.
Joint Statistical Meetings, Washington, DC, August 2022.

"Modification of opioid effects on ADHD by opioid replacement therapy in a matched cohort."
Pediatric Academic Societies Meeting, Toronto, Canada, May 2024.

"Match-adaptive randomization inference for optimal propensity score matching."
Berkeley Statistics Annual Research Symposium, University of California, Berkeley, Berkeley, CA April 2024.

"Fine-grained balance for observational studies via cardinality matching."
Eighth PANDA Symposium on Anesthesia/Analgesia/Sedation & Brain Health in Children, Columbia University, New York, NY, March 2024.

"Match-adaptive quasi-randomization inference for optimal propensity score matching."
Workshop on Permutation and Causal Inference: Connections and Applications, Institute for Mathematical and Statistical Innovation, Chicago, IL, August 2023.

"Causal inference conditional on optimal propensity score matching."
Joint Statistical Meetings, Toronto, Canada, August 2023.

"Covariate-adaptive randomization inference in matched designs."
6th International Conference on Econometrics and Statistics, hybrid meeting, August 2023.
International Indian Statistical Association Conference, Golden, CO, June 2023.
Statistics Department, University of California, Davis, Davis, CA, May 2023.
Institute of Mathematical Statistics Annual Meeting, London, UK, June 2022.
Eastern North American Region of the International Biometrics Society Spring Meeting, Houston, TX, March 2022.

"Impact of perinatal opioid exposure on ADHD in a matched cohort analysis."
Pediatric Academic Societies Meeting, Washington, DC, April 2023.

"Prioritizing variables in observational study design using joint variable importance plots."
Royal Statistical Society Conference, Aberdeen, UK, September 2022.

Discussant for session "Matching and design-based approaches" (Peter Cohen, Kevin Guo, Ben Hansen).
American Causal Inference Conference, Berkeley, CA, May 2022.

"Examining developmental delay following perinatal opioid exposure: a matched cohort analysis."
Pediatric Academic Societies Meeting, Denver, CO, April 2022.

"Optimal tradeoffs in matched designs comparing US-trained and internationally-trained surgeons."
Department of Statistics & Applied Probability, University of California, Santa Barbara, Santa Barbara, CA, March 2022.
Statistics Department, Michigan State University, Lansing, MI, November 2021.
Statistics Department, University of California, Berkeley, Berkeley, CA, September 2021.
Online Causal Inference Seminar, June 2021.
Biostatistics Department, University of Minnesota, Minneapolis, MN, March 2021.
Statistics Department, University of Wisconsin-Madison, Madison, WI, November 2020.
Berkeley-Columbia Meeting in Engineering and Statistics, Berkeley, CA, February 2020.

"Reassessing Uniform Randomization Inference after Matching."
Joint Statistical Meetings (held virtually), August 2021.

Discussant for "Hospital Quality Risk Standardization via Approximate Balancing Weights" (Luke Keele).
Online Causal Inference Seminar, March 2021.

"The uniform general signed rank test and its design sensitivity."
Penn-Berkeley Statistics Joint Colloquium, Berkeley, CA, September 2020.
Joint Statistical Meetings (held virtually), August 2020.

"Optimal matching approaches in matched designs comparing US-trained and internationally-trained surgeons."
International Conference on Health Policy Statistics, San Diego, CA, January 2020.

"Causal inference using multilevel matching."
Summer Institute in Computational Social Science, University of California, Los Angeles, Los Angeles, CA, June 2019.

"Optimal tradeoffs in matched study designs."
2nd International Conference on Econometrics and Statistics, Hong Kong, June 2018.
Eastern North American Region of the International Biometrics Society Spring Meeting, Atlanta, GA, March 2018.
INSEAD-Wharton Doctoral Consortium, Singapore, December 2016.

"Effect modification within matched pair designs."
Workshop for Empirical Investigation of Methods for Heterogeneity, May 2018, Pittsburgh, PA.
Co-presented with Luke Keele (Georgetown University).

"Optimal multilevel matching using network flows: an application to a summer reading intervention."
International Chinese Statistical Association Applied Statistics Symposium, Chicago, IL, June 2017.

"Large, sparse optimal matching in an observational study of surgical outcomes."
Operations Research Center, Massachusetts Institute of Technology, October 2017.
Department of Applied Statistics, Social Science, and Humanities, NYU Steinhardt, February 2017.
Department of Statistical Science, Fox School of Business, Temple University, February 2017.
Department of Epidemiology and Biostatistics, Dornsife School of Public Health, Drexel University, February 2017.
Department of Statistics, University of California, Berkeley, February 2017.
Department of Information, Risk, and Operations Management, McCombs School of Business, University of Texas at Austin, January 2017.
Department of Data Sciences and Operations, USC Marshall School of Business, January 2017.
Department of Operations Research, Naval Postgraduate School, January 2017.
Department of Statistics, University of Michigan, January 2017.
Geneva School of Economics and Management, University of Geneva, December 2016.
Decision Sciences Department, San Francisco State University, December 2016.
Department of Biostatistics & Medical Informatics, University of Wisconsin-Madison, December 2016.
Department of Biostatistics, University of Washington, December 2016.
Department of Population Health Sciences, University of Utah School of Medicine, November 2016.
Department of Statistics, Brigham Young University, October 2016.

"Constructed second control groups and attenuation of unmeasured biases."
Department of Statistics, Columbia University, February 2017.
Department of Statistics, Stanford University, January 2017.
Department of Statistics, University of California, Davis, January 2017.
School of Mathematical & Statistical Sciences, Arizona State University, January 2017.
Joint Statistical Meetings, Chicago, IL, August 2016.

"Large, sparse optimal matching with refined covariate balance."
Institute for Quantitative Theory and Methods, Emory University, January 2017.

"An exact test of fit for the Gaussian linear model using optimal nonbipartite matching."
Eastern North American Region of the International Biometrics Society Spring Meeting, Austin, TX, March 2016.

"Variable-ratio matching with fine balance in a study of peer health exchange."
Joint Statistical Meetings, Seattle, WA, August 2015.

"Descriptive representation and judicial outcomes in multi-ethnic societies."
American Law and Economics Association annual meeting, New York, NY, May 2015.

TEACHING EXPERIENCE:

Statistics Courses

Instructor, Statistics 230A: Linear Models, University of California, Berkeley, Spring 2023, Spring 2025

- Graduate course of 50 students primarily from Statistics' Master's program.

- Ordinary least squares, finite-sample exact and asymptotic inference, heteroskedastic and clustered errors, model checking and model selection, generalized linear models.

Instructor, Statistics 135: Concepts of Statistics, Fall 2024.
- Undergraduate course of 130-140 students, primarily Statistics and Data Science majors.
- Mathematical statistics using the tools of probability theory, including estimation, hypothesis testing, maximum likelihood, contingency tables, Bayesian statistics, and linear regression.

Instructor, Statistics 20: Introduction to Probability and Statistics, University of California, Berkeley, Spring 2024
- Introductory undergraduate course of 90-100 students.
- Data visualization, probability, inference, linear regression, prediction, causal claims.
- Created new course content on evaluating causal claims without randomized experiments.
- Open source course notes available at https://www.stat20.org, source code accessible at https://github.com/stat20/course-materials .

Instructor, Statistics 158: The Design and Analysis of Experiments, University of California, Berkeley, Spring 2019, Spring 2021, Fall 2023
- Upper-division undergraduate course of 30-70 students.
- Oversaw student-led projects to design, conduct, and analyze multi-factor experiments.
- Redesigned curriculum to incorporate potential outcomes, noncompliance, and interference.

Instructor, Statistics 232: Experimental Design, University of California, Berkeley, Spring 2018, Spring 2022.
- Graduate- course of 5-25 students from doctoral, masters', and undergraduate programs.
- Redesigned syllabus to incorporate modern topics such as noncompliance, interference, and online digital experimentation.

Instructor, Statistics 151A: Linear Modeling: Theory and Applications, University of California, Berkeley, Spring 2020, Fall 2020, Fall 2021.
- Upper-division undergraduate course of 70-100 students.
- Simple and multiple linear regression, model selection including shrinkage methods, generalized linear models, model comparison and iniference, the bootstrap, splines.

Instructor, Statistics 260: Observational Study Design and Causal Inference, University of California, Berkeley, Spring 2018.
- Graduate seminar of 14 doctoral students.
- Designed syllabus focused on modern research in observational studies (new course).

Co-Organizer, Berkeley Methods Workshop, University of California, Berkeley, Spring 2023 - present.
- Weekly multidisciplinary seminar focused on training graduate students in methodology for social science, co-organized with faculty in the Political Science department.
- Coordinated involvement of Statistics and Biostatistics graduate students, helped select speakers.

Co-Instructor, Causal Inference Reading Group, University of California, Berkeley, Fall 2017 - Fall 2022.
- Weekly reading group with semester-long topical focus selected jointly by several co-instructors.
- Constructed reading lists for topics "Optimal Study Design in Causal Inference," "Foundations of Causal Inference," "Applying Causal Inference to the Social and Biomedical Sciences," "Semiparametric Approaches in Causal Inference," and "Causal Inference and Time" in cooperation with co-instructors.

Lectures and Short Courses

Guest lecture, "Descriptive Representation and Judicial Outcomes in Multi-Ethnic Societies," for Statistical Models: Theory and Application (Statistics 215A) University of California, Berkeley, Berkeley, CA, October 2021.

Guest lecture, "Sensitivity analysis for unobserved confounding," for Computational Social Science (Sociology 273M), University of California, Berkeley, Berkeley, CA, April 2021.

Guest lecture, "Counterfactual approaches to fairness," Summer Cluster on Algorithmic Fairness, Simons Institute for the Theory of Computing, Berkeley, CA, July 2018.

Short course, "Observational Studies with Multilevel Data," co-taught with Luke Keele, Atlantic Causal Inference Conference, Pittsburgh, PA, May 2018.

Guest lecture for Causal Inference (B9124), Columbia University, New York, NY, November 2016.

Guest lecture, Center for Surgery and Health Economics, University of Pennsylvania, Philadelphia, PA, September 2016.

Short course, "Causal inference for observational studies with multilevel data," co-taught with Luke Keele, Atlantic Causal Inference Conference, New York, NY, May 2016.

Short course, "Matching with Multilevel Data," co-taught with Luke Keele and Lindsay Page, Society for Research on Educational Effectiveness, Washington, D.C., March 2016.

Guest lecture for Observational Studies (Statistics 921), University of Pennsylvania, Philadelphia, PA, November 2015.

ADVISING:

Doctoral dissertation committees (at University of California, Berkeley):

Yaxuan Huang, Department of Statistics, May 2024 - present.
Andy Shen, Department of Statistics, March 2024 - present (co-chair).
Sizhu Lu, Department of Statistics, January 2024 - present.
Abhineet Agarwal, Department of Statistics, August 2023 - present.
Lauren Liao, Graduate Division of Biostatistics, November 2022 – June 2024 (co-chair).
Kevin Benac, Graduate Division of Biostatistics, August 2022 - present.
Fangzhou Su, Department of Statistics, August 2022 – August 2024.
Benjamin Lu, Department of Statistics, March 2022 - present.
Briton Park, Department of Statistics, February-May 2022.
Daniel Soriano, Department of Statistics, January 2022 - August 2023 (co-chair).
Melody Huang, Department of Statistics, January 2022 - April 2023.
Miyabi Ishihara, Department of Statistics, August 2021 - December 2023 (co-chair).
Amanda Glazer, Department of Statistics, April 2021 - May 2024.
Jacob Spertus, Department of Statistics, April 2021 - May 2024.
Maruf Ahmed, Department of Electrical Engineering and Computer Sciences, March 2021-August 2023.
Nicholas Altieri, Department of Statistics, August-October 2020.
Yu Wang, Department of Statistics, June 2018-August 2020.

Doctoral qualifying exam committees (at University of California, Berkeley):
Yaxuan Huang, Department of Statistics, April 2024.
Andy Shen, Department of Statistics, February-March 2024.
Sizhu Lu, Department of Statistics, November 2023.
Abhineet Agarwal, Department of Statistics, July 2023.
Lauren Liao, Graduate Division of Biostatistics, September-November 2022.
Kevin Benac, Graduate Division of Biostatistics, June-July 2022.
Fangzhou Su, Department of Statistics, June-July 2022.
Benjamin Lu, Department of Statistics, November-December 2021 (chair).
Melody Huang, Department of Statistics, October -November 2021 (chair).
Daniel Soriano, Department of Statistics, May-June 2021.
Miyabi Ishihara, Department of Statistics, February-May 2021.
Amanda Glazer, Department of Statistics, February-April 2021.
Maruf Ahmed, Department of Electrical Engineering and Computer Sciences, Dec 2020-Mar 2021.
Jacob Spertus, Department of Statistics, November 2020-April 2021.
Briton Park, Department of Statistics, November 2019-Jan 2020 (chair).
Sang Min Han, Department of Electrical Engineering and Computer Sciences, May-June 2019.
Nicholas Altieri, Department of Statistics, February 2019 (chair).
Jason Wu, Department of Statistics, May-July 2018.
Yu Wang, Department of Statistics, February-April 2018.
William Murdoch, Department of Statistics, February 2018.

Masters' thesis committees (at University of California, Berkeley):
Tyler Mansfield, Division of Biostatistics, January-June 2023.
Emily Flanagan, Department of Statistics, December 2022.
Benjamin Lu, Department of Statistics, April-June 2020.
Olivia Angiuli, Department of Statistics, April-May 2020.
Da Xu, Graduate Division of Biostatistics, April-May 2018.

Undergraduate honors thesis supervision (at University of California, Berkeley):
Shichao Han, Department of Statistics, September-December 2020.

PROFESSIONAL SERVICE:

Associate Editor, *Journal of Causal Inference*, June 2019 - present.

Statistical Consultant, Clinical & Translation Science Institute, University of California, San Francisco, January 2020 - present.

Assistant Head Graduate Advisor, Department of Statistics, University of California, Berkeley, July 2024 - present.

Search Committee, Cluster Hire in Artificial Intelligence, Inequality, and Society, Department of Statistics, University of California, Berkeley, July 2024 - present.

Masters' Program Committee, Department of Statistics, University of California, Berkeley, July 2024 - present.

PhD Admissions Co-Chair, Department of Statistics, University of California, Berkeley, July 2022 - June 2024.

Organized invited session, "Planning observational studies with unobserved confounding in mind," Joint Statistical Meetings, Toronto, Canada, August 2023.

Search Committee, Department of Computational Precision Health, University of California, Berkeley and University of California, San Francisco, July 2022 - June 2023.

PhD Admissions Committee, Department of Statistics, University of California, Berkeley, August 2020 - June 2022.

Program Committee, Foundations of Data Science Conference 2020, January-July 2020.

Organizing Committee, American Causal Inference Conference 2022, August 2019 - May 2022.

Equity Advisor, Department of Statistics, University of California, Berkeley, August 2019 – June 2021.

Academic Personnel Committee, Department of Statistics, University of California, Berkeley, August 2019 - May 2020.

Search Committee, Data Science Health Innovation Fellowship Program, University of California, Berkeley and University of California, San Francisco, July 2019 – September 2019.

Organizing Committee, American Causal Inference Conference 2022, Berkeley, CA. November 2018 – May 2022.

Organizer of the Neyman Seminar, Department of Statistics, University of California, Berkeley, September 2017- May 2019.

NSF Research Training Grant Postdoctoral Scholar search committee, University of California, Berkeley, January-February 2019, January-March 2020, and December-March 2021.

Masters Program Admissions Committee, Department of Statistics, University of California, Berkeley, January-February 2019.

Community Task Force on improving student support during PhD program, Department of Statistics, University of California, Berkeley, March 2018 - December 2018.

Statistical Consultant on proposal for evaluation of the Bundled Payments for Care Improvement (BCPI) initiative, Booz Allen Hamilton, June-September 2018.

Organized topic-contributed session, "New Matching Designs to Get the Most from Observational Data," Joint Statistical Meetings, Chicago, IL, July 2016.

Student Panelist, Wharton Doctoral Programs Maternity/Paternity workshop, University of Pennsylvania, February 2016.

Student Panelist, Wharton Doctoral Programs Recruitment Webinar, , University of Pennsylvania, October 2016.

Organizing committee member, 2015 Atlantic Causal Inference Conference at the University of Pennsylvania.

Member of Wharton Doctoral Programs Executive Committee, University of Pennsylvania, September 2013 - May 2014.

Panelist and ad hoc reviewer for National Science Foundation program in Measurement Methodology, and Statistics (Directorate for Social, Behavioral, and Economic Sciences).

Reviewer for *Journal of the American Statistical Association; Journal of the Royal Statistical Society – Series B; Biometrika; Proceedings of the National Academy of Science; JAMA Surgery; The Lancet Neurology; Biometrics; Annals of Applied Statistics; Journal of the Royal Statistical Society – Series A; Operations Research; Journal of the Royal Statistical Society – Series C;*

Statistics in Medicine; Journal of Causal Inference; Biostatistics; Observational Studies; *Journal of Machine Learning Research; Journal of Research on Educational Effectiveness*; *Journal of Computational and Graphical Statistics; Statistics and Public Policy; Journal of Statistical Planning and Inference; The R Journal*; *Computational Statistics and Data Analysis; TEST; GMS Medical Informatics, Biometry and Epidemiology;* and *Journal of Social Structure*.

EXHIBIT B

U.S. FOOD & DRUG ADMINISTRATION

May 03, 2023

Institution Name: Columbia University Irving Medical Center

Attention: Lena Sun

Subject: Request for Full Proposal, Broad Agency Announcement for the U.S. Food and Drug Administration (FDABAA-23-00123)

Dear Lena Sun:

The U.S. Food and Drug Administration (FDA) has completed the review of your Quad Chart and White paper:

Health and Neurodevelopmental Outcomes in Infants at Risk for Neonatal Opioid Withdrawal Syndromes (NOWS): Effects of Timing and Duration of Prenatal Opioid Exposure (POE) & Postnatal Management with Eat-Sleep-Console (ESC)

We are pleased to inform you that after careful consideration of your Quad Chart and White Paper, you are invited to submit a full proposal. The guidelines for the preparation of the full proposal are described in the BAA Part III.

The following technical feedback from the review of your white paper is provided to further guide you in the formulation of your full proposal. Please note that since multiple reviewers contributed to the guidelines below, some redundancies in comments provided present multiple view points for clarity:

1. *The study topic is a high priority area in regulatory science, however some of the study aims do not have a clear regulatory impact. We recommend reframing the study aims to focus on determining differences of non-pharmacologic (i.e., Eat-Sleep-Console) vs. pharmacologic treatment on NOWS outcomes.*
2. *Retrospective studies are a useful option for gathering and evaluating data from a difficult-to-recruit and difficult-to-treat population. However, they have certain limitations and can introduce biases, such as in recordkeeping. To strengthen this proposal, we recommend re-scoping the study to add a small prospective cohort of cases to follow, based on the same criteria as retrospective data, and evaluate whether your findings from the retrospective studies can predict or inform treatment outcomes.*
3. *In addition to including timing and duration as measures of exposure, consider adding dosage information as a predictive variable. Dosage may act as a moderating or mediating variable and could make the results difficult to interpret if not controlled for. In addition, explain how maternal dose of opioid analgesic*

prescriptions or medications for opioid use disorder (e.g., buprenorphine or methadone) would be treated in the exposed groups.

4. *The proposal identifies that concomitant exposure with controlled substances and psychotropic medications may be a confound. Explain how this potential confound will be addressed.*
5. *Consider additional metrics for early neurodevelopmental outcomes. The listed outcomes for neurodevelopment may not be diagnosable until after age two. Earlier measures, such as qualification for Early Intervention services (e.g., speech therapy, physical therapy), may serve as earlier, clinically meaningful outcome variables.*
6. *In the full proposal, identify and provide a plan for filling specific support staff roles. The speed and quality of hires for data analysis, project management, and research assistance will impact the project timeline and its overall success. Additionally, include a description of study limitations, provide a brief description of the statistical analysis plan, such as power analysis and statistical test(s) for experimental goals involving hypothesis testing, and describe plans for study documentation.*
7. *Because FDA's funding is contingent on Congressional appropriations, it would be helpful to include an outline of one or more deliverables per each year of funding.*

Additionally, in accordance with Part III, Section 4 (A) and (C) of the BAA, in order to provide the Government with greater flexibility regarding technical needs and funding constraints, you are encouraged to structure your proposal with severable/stand-alone deliverables to the extent it is practicable with the research being proposed. Your cost proposal shall clearly identify the costs associated with each task to be completed and whether or not they are proposed as part of a single, non-severable undertaking, or as part of a severable deliverable.

Thank you for your continued interest in the BAA. We look forward to receiving your full proposal. Your proposal must be signed by an individual who is authorized to legally commit your institution to any subsequent offer. Please submit your full proposal no later than 3:30pm ET, June 02, 2023, in accordance with the BAA.

Please send one electronic copy of the full proposal by the date and time specified above to the following email addresses:

FDABAA@fda.hhs.gov
Ingrid.Walker@fda.hhs.gov

Attention: Ingrid Walker, Contract Specialist
Reference: FY23C3DWP3

Please note that in order to be considered for award, your organization must be registered in the System for Award Management (SAM) in accordance with FAR 4.1102.

U.S. FOOD & DRUG ADMINISTRATION

If you have any questions, please contact FDABAA@fda.hhs.gov

Sincerely,

Ingrid Walker
Contract Specialist

EXHIBIT C

Berkeley
UNIVERSITY OF CALIFORNIA

Dr. Samuel D. Pimentel
Assistant Professor
Department of Statistics

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May 11, 2023

Lena S. Sun, MD, FAAP, D.ABA
Emanuel M. Papper Professor of Pediatric Anesthesiology
Professor of Anesthesiology and Pediatrics
Executive Vice Chairman, Department of Anesthesiology
Chief, Division of Pediatric Anesthesia
College of Physicians and Surgeons
Columbia University
CH 4-440 North
622 West 168th Street
New York, New York 10032

Dear Dr. Sun,

This letter signifies my willingness to collaborate as a co-investigator on your proposed project entitled, "Health and Neurodevelopmental Outcomes in Infants at Risk for Neonatal Opioid Withdrawal Syndromes (NOWS): Effects of Timing and Duration of Prenatal Opioid Exposure (POE) & Postnatal Management with Eat-Sleep-Console (ESC)."

I am Assistant Professor of Statistics at the University of California, Berkeley. My primary expertise is in constructing and analyzing multivariate matched samples within large observational datasets including medical claims databases and electronic health records. My work has been published in leading statistical journals, and I have worked closely with clinicians to apply matching techniques in studies of health outcomes. I am the author and maintainer of several software packages for matching, including rcbalance in R, which has been used to conduct statistical analysis in several recent studies in health services research. We worked together previously on the project "Neurobehavioral Outcomes in Children Following Exposures to Maternal Opioids Use: Analysis of the Kaiser Permanente Northern California Birth Cohort," which is closely related to the proposed work.

The current proposal is novel in its use of a high-quality dataset to analyze long-term outcomes related to different forms of perinatal opioid exposure (POE) and different management strategies for POE. The planned research will be greatly enhanced by the use of new multivariate matching tools, which are especially appropriate for a setting like this one in which concerns are high about comparability of groups.

I look forward with enthusiasm to working closely with you and with the strong multifaceted research team you have created for this proposal.

Sincerely,

Samuel D. Pimentel, PhD

EXHIBIT D

VOLUME I – FULL TECHNICAL PROPOSAL

1. COVER PAGE

BAA Number: FY23C3DWP3

Title of Proposal: Health and Neurodevelopmental Outcomes in Infants at Risk for Neonatal Opioid Withdrawal Syndromes (NOWS): Effects of Timing and Duration of Prenatal Opioid Exposure (POE) & Postnatal Management with Eat-Sleep-Console (ESC)

Prime Offeror: Lena S. Sun, MD

Topical Area: # III.D. 1.2.d: Develop methods and carry out studies to better understand the trajectory of use of controlled substances and associated public health consequences

List of Subcontracts: (1) Kaiser Permanente Northern California
(2) University of California at Berkeley

Technical Contact:
Lena S. Sun, MD
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(212) 305-2413
lss4@cumc.columbia.edu

Administrative Contact:
Katherine Leon
Sponsored Projects Administration
630 West 168th Street, Box 49
New York, NY 10032
(212) 305-4191
grants-office@columbia.edu

Duration of Effort: 48 months

2. OFFICIAL TRANSMITTAL LETTER

COLUMBIA UNIVERSITY MEDICAL CENTER

Sponsored Projects Administration

Office Location
154 Haven Avenue, 2nd Floor
New York, NY 10032
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New York, NY 10032

May 22, 2023

Ms. Ingrid Walker
Contracts Specialist, Scientific Support Branch
Division of Acquisition Operations (DAO)
Office of Acquisitions and Grants Services (OAGS)
Office of Finance, Budget, Acquisitions, and Planning
U.S. Food and Drug Administration (FDA)
4041 Powder Mill Road, 4th Floor
Beltsville, MD 20705
Tel: (301) 796-7233
Ingrid.Walker@fda.hhs.gov

Re: Official Transmittal Letter

Dear Ms. Walker:

On behalf of The Trustees of Columbia University in the City of New York, please find enclosed the referenced contract bid in response to FDABAA-23-00123 from Dr. Lena Sun.

I confirm that I am an Authorized Organizational Representative of Columbia University and furthermore confirm that I have the authority to propose to Government solicitations and compete with industry, and their compliance with the associated sponsoring agreement and terms and conditions.

If you should need any additional information, please contact me at grants-office@columbia.edu or 212-305-4191.

Regards

Madhavi Nambiar

Madhavi Nambiar, PhD
Associate Director of Research Operations
Sponsored Projects Administration

3. TABLE OF CONTENTS

4. EXECUTIVE SUMMARY

In alignment with the objectives of FDA to apply regulatory science to ensure optimal drug safety in pediatric populations, the proposed project will address the critical public health consequences of prenatal opioid exposure during the ongoing opioid epidemic in the US. The proposal will specifically compare differences in outcomes (both in-hospital and neurodevelopmental outcomes) between opioid replacement pharmacotherapy and non-pharmacological management in infants with neonatal opioid withdrawal syndrome (NOWS).

- Hypothesis

We will test the hypothesis that non-pharmacological approach to manage NOWS infants, including the use of “Eat, Sleep, Console (ESC)”, improves their in-hospital and neurodevelopmental (ND) outcomes compared to opioid replacement treatment. We will further test the hypothesis that timing, duration and doses of prenatal opioid exposure are modifiers of the effects of non-pharmacological management on in-hospital and ND outcome in NOWS infants such that better outcomes are most evident in infant with sustained opioid exposures for eight or more weeks or in infants who had prenatal opioid exposure that included first or second trimester.

- Data Source

The proposed study will use the Kaiser Permanente Northern California (KPNC) research databases as the data source. The KPNC research databases (herein referred to as KPNC database) consist of multiple databases, and they are a repository for KPNC clinical and administrative databases from legacy and KP HealthConnect® (KPHC). For the proposed study, data will be captured using the following KPNC databases: Infant Cohort (IC), Virtual Data Warehouse (VDW), KPNC laboratory database (LURS), and Clarity. Only data sources derived from KP HealthConnect® (KPHC) will be used. KPHC is an integrated electronic health record (EHR) system designed by the Epic Systems Corporation (Verona, WI) with the following major Epic modules: (1) Ambulatory/Outpatient (2) KP HealthConnect Online and (3) Inpatient. The KPNC databases provide comprehensive and high quality administrative and clinical data on a large and diverse patient population. KPNC program participants come from a very diverse geographic, racial, ethnic, and socioeconomic background. Infants born within KPNC (birth cohorts) can be tracked longitudinally and are linked to the mothers, providing excellent assessment of maternal risk factors. The KPNC databases include detailed pharmacy records and clinical data from all inpatient and outpatient encounters in the EHR, so details of both exposures and outcomes in our proposed study can be further validated and verified. In addition, data from the KPNC Early Start screening are also used to identify opioid exposure during pregnancy.

- Study Cohorts

We will use the KPNC database to create a birth cohort from 2010-2023. To perform the retrospective matched analysis for the proposal we will generate a NOWS cohort from the birth cohort, and additional discrete NOWS cohorts based on management approaches and timing/durations/doses of exposures. In KPNC, during the proposed study period, infants with NOWS have been managed either using opioid replacement pharmacotherapy or non-pharmacological care. Starting in 2016, KPNC standardized the management approach for infants with NOWS, with a structured ESC approach that includes keeping the maternal/infant dyad together, maximizing non-pharmacologic interventions, avoiding over-stimulation, empowering families, and only treating with opioid replacement if after optimizing the above interventions, symptoms interfere with the ability to feed, sleep, and be consoled. Prior to 2016, there was no standardized approach to managing NOWS, and infants were managed at the discretion of individual physicians, with a reliance on opioid replacement to control withdrawal symptoms. We therefore divide infants with NOWS who were managed non-pharmacologically into two distinct cohorts: ***Pre-ESC*** are those born before 2016 who were managed non-pharmacologically and ***ESC*** are those who were born 2016 or later who were or are managed non-pharmacologically with a structured ESC approach. Among those infants with NOWS that receive opioid replacement therapy, they are divided into: ***Pre-ESC Rx*** are those born before 2016 and ***Post-ESC Rx*** are those born 2016 or later. In addition, we will have a "sustained exposure" cohort, an "early gestational exposure" cohort and a" high-dose exposure" cohort. The "sustained exposure" study cohort consists of those infants with NOW with durations of exposures for at least two four-week periods. The study cohort based on timing of gestational exposure consists of infants with NOWS either with prenatal opioid exposure during the third trimester only (late gestational), or with prenatal opioid exposures that occurred beginning in the first or second trimester of pregnancy (early gestational). The "high-dose exposure" cohort is restricted to infants with prenatal exposure to maternal prescription opioids. High dose is defined as having the cumulative dose in morphine milligram equivalents (MME) of prenatal opioid exposure in the top quartile of the entire group. We will also recruit a cohort using a subset of the birth cohort from 2013-2018 to perform prospective assessment as a pilot study.

- Outcomes

<u>In-hospital outcomes</u> are mortality, re-admission to hospital or NICU, NICU Length of Stay (LOS), hospital LOS, any surgical, diagnostic, or therapeutic procedures requiring sedation, respiratory support (oxygen therapy, CPAP, mechanical ventilation), need for medications for treatment of neurological symptoms and need for vasoactive medications for hemodynamic support.

<u>Neurodevelopmental outcomes</u> are assessed ***retrospectively*** by (1) diagnoses of disorders of cognition, development, behavior, and psychiatric conditions using ICD-9 or ICD-10 codes, (2) available EHR documentation of referral for evaluation for hearing, vision or autism spectrum disorders, language delay, physical, occupational therapy,

speech therapy or Individualized Educational Plan (IEP). Neurodevelopmental outcomes are assessed ***prospectively*** using (1) the home version of ADHD-Rating scale, fifth edition (ADHD-RS-5) to assess ADHD and (2) the Colorado learning difficulties questionnaire (CLDQ) to assess learning difficulties. We will also trial the use of additional validated neuropsychological (NIH Toolbox) and behavior instruments (ABAS II and Conner CBRS).

- Specific Aims

Aim 1A: To compare in-hospital and neurodevelopmental (ND) outcomes between infants with NOWS treated with opioid replacement and those managed non-pharmacologically, including using the "Eat, Sleep, Console" approach.
Aim 1B: To perform a pilot prospective cohort study to assess feasibility of comparing ND outcomes between non-pharmacologically managed and opioids replacement treated infants with NOWS.
Aim 2A: To characterize the sources (prescription versus illicit opioids) and doses (total milligram morphine equivalents) of opioid exposure and co-exposures to other substances in infants with NOWS.
Aim 2B: To examine the in-hospital and ND outcomes in infants with NOWS with high MME (milligram morphine equivalent) prenatal opioid exposure and compare the effects of management approach between high and other MME groups.
Aim 3A:To characterize the timing and duration of opioid exposure in infants with NOWS, and to compare the in-hospital and ND outcomes between infants with sustained and non-sustained exposure and between infants with and without early gestational exposure.
Aim 3B: To assess how varying duration or timing of prenatal opioid exposure modifies the effects of management approach on in-hospital and ND outcomes in infants with NOWS.

- Tasks, Milestones and Deliverables

The proposed project consists of <u>five tasks</u> to be completed over a four-year period:

Task 1 **Project Preparation & Planning**: query of the KPNC databases and other data sources to conduct the proposed research aims.
Task 2 **Testing and Selecting Models for Analysis**: testing of different matching models that results in selecting the variables and model for the matched analysis of the project.
Task 3 **Data Analysis**: Performing analyses for each of the three study aims.
Task 4 **Dissemination of Study Results**: through presentation at scientific meetings and submission of study findings for publication.
Task 5 **Project Monitoring and Team Communication**: meetings and reports

Timeline and Deliverables

	Year 1	Year 2	Year 3	Year 4	Deliverables
Task 1					All data elements (demographic, clinical, exposure & outcome) are identified, reviewed and finalized for the project.
Task 2					Identify and finalize match variables. Select best matching model after testing of multiple matching models.
Task 3					Obtain results from analysis of Aim1, Aim 2 and Aim 3. Additional analysis as indicated by guided by the findings
Task 4					Prepare results for presentations at scientific meetings. Publications of study results in peer-reviewed journals.
Task 5					Monthly investigator phone conferences and regularly held in-person investigators meetings. Monthly progress reports to FDA.

5. INTRODUCTION

5.a. Responses to reviewers' comments

The reviewers indicated there are several issues that were not addressed in the Whitepaper submitted for the proposed study. Please see our responses and action plans below.

1. *The study topic is a high priority area in regulatory science, however some of the study aims do not have a clear regulatory impact. We recommend reframing the study aims to focus on determining differences of non-pharmacologic (i.e., Eat-Sleep-Console) vs. pharmacologic treatment on NOWS outcomes.*

We have reorganized our specific aims to focus on determining the differences in the in-hospital and neurodevelopmental outcomes between the non-pharmacologically managed and pharmacologically treated infants with NOWS. In Aim 1, we will compare outcomes between non-pharmacologically managed and pharmacologic treatment in infants with NOWS. In Aim 2, we will examine the doses of opioid exposures and co-exposures to other substances as modifiers of effects of management approaches on outcomes. In Aim 3, we will examine timing and duration as modifiers of effects of

management approaches on outcomes.

2. *Retrospective studies are a useful option for gathering and evaluating data from a difficult-to-recruit and difficult-to-treat population. However, they have certain limitations and can introduce biases, such as in recordkeeping. To strengthen this proposal, we recommend re-scoping the study to add a small prospective cohort of cases to follow, based on the same criteria as retrospective data, and evaluate whether your findings from the retrospective studies can predict or inform treatment outcomes.*

In Aim 1B, we propose to conduct a pilot study and recruit a small number of infants with NOWS born between 2013-2019 and prospectively assess ND outcomes at ages 6-12 years. The results of the pilot study will support the planning of a full prospective cohort neurodevelopmental outcome study.

The budget in our Whitepaper does not include recruitment and assessment of a prospective cohort. Therefore, we are submitting a revised budget that includes the cost of a neuropsychologist consultant, IRB preparation, setup of a Redcap database, and incentives for study participants.

3. *In addition to including timing and duration as measures of exposure, consider adding dosage information as a predictive variable. Dosage may act as a moderating or mediating variable and could make the results difficult to interpret if not controlled for. In addition, explain how maternal dose of opioid analgesic prescriptions or medications for opioid use disorder (e.g., buprenorphine or methadone) would be treated in the exposed groups. The proposal identifies that concomitant exposure with controlled substances and psychotropic medications may be a confound. Explain how this potential confound will be addressed.*

We have revised the proposal to include examination of dosage of exposure on outcomes. In infants with NOWS who had prenatal exposure from prescription opioids we will have reliable data from pharmacy records to quantify maternal doses of opioids in total milligram morphine equivalents (MME). In infants with NOWS who had prescription opioid exposure, we will designate those with exposure at the top quartile of MME doses as the high MME group. We will further examine the comparative outcomes between management approaches in the high MME group and other MME groups. In the revised proposal, we will examine substances co-exposures including prescription psychoactive medications. Co-exposures will be adjusted for in the matched analysis, or using regression models after matching when matching does not control them sufficiently.

4. *Consider additional metrics for early neurodevelopmental outcomes. The listed outcomes for neurodevelopment may not be diagnosable until after age two. Earlier measures, such as qualification for Early Intervention services (e.g., speech therapy, physical therapy), may serve as earlier, clinically meaningful outcome variables.*

We have included additional metrics for early neurodevelopmental outcomes in the full proposal. Specifically, the metrics are evaluation for hearing, vision or autism spectrum disorders, language delay, referral for physical, occupational therapy, or speech therapy, as well as referral for individualized educational plan (IEP).

5. *In the full proposal, identify and provide a plan for filling specific support staff roles. The speed and quality of hires for data analysis, project management, and research assistance will impact the project timeline and its overall success. Additionally, include a description of study limitations, provide a brief description of the statistical analysis plan, such as power analysis and statistical test(s) for experimental goals involving hypothesis testing, and describe plans for study documentation.*

We have identified specific individuals who will be filling the support staff positions for data analysis, project management and research assistance. Their names and detailed responsibilities are included in the Cost Proposal budget and budget justification. Study limitations, and statistical analysis plan are included in the Full Proposal.

6. *Because FDA's funding is contingent on Congressional appropriations, it would be helpful to include an outline of one or more deliverables per each year of funding.*

We have included in the proposal specific deliverables for each year (see .8.1 Deliverables Schedule by Year)

5.b. Background

During the national opioid crisis, the tremendous increase in opioid use by pregnant women has resulted in an estimated seven-fold increase in infants born with neonatal opioid withdrawal syndrome (NOWS) due to prenatal opioid exposure[1, 2].

Several studies have shown that adverse neurodevelopmental outcomes occur in infants with NOWS from prenatal exposure to opioids [3, 4]. Infants with NOWS often have not only prenatal opioid exposure but also co-exposure to other substances[5, 6]. These substances include alcohol, cigarettes, cocaine, marijuana, amphetamines, selective serotonin uptake inhibitors [7] and other anti-depressant medications. Many, but not all, of these substances have been shown to have deleterious neurodevelopmental effects thus confounding the interpretation of the adverse effects of prenatal opioid exposure on ND outcome[8, 9]. Aside from the drugs of exposure, another area that deserves further investigation is the timing and duration of exposure. Most outcome studies in infants with NOWS have concentrated on exposures that occurred during the last 90 days before delivery, with very little data regarding outcomes in infants with prenatal exposures to opioids and/or other substances that occurred or began during early pregnancy or mid-pregnancy. Our proposal aims to examine the effects of timing and duration of exposure to opioids on in-hospital and ND outcomes, thus filling the current gap in knowledge.

Clinical signs of NOWS result from neurobiological dysregulation in control of sleep cycle, motor/muscle tone, autonomic functioning, and sensory processing. Management of NOWS aims to reduce the signs and symptoms of NOWS including pharmacotherapy with opioid replacement based on traditional Finnegan Neonatal Abstinence Scoring System (FNASS) or non-pharmacological strategies. While management of substance-exposed infants has always included nonpharmacologic care, there has been a recent transition from using FNASS to the Eat, Sleep, Console (ESC) function-based method for assessing symptoms to guide treatment of NOWS[2, 10-14], with a much greater reliance on non-pharmacological care for infants with NOWS. The principles of non-pharmacological ESC care include (1) minimizing environmental stimuli (both light and sound), (2) swaddling to reduce stimulation and promote sustained sleep, (3) responding early to infant agitation, (4) Kangaroo care and use of pacifiers, (5) preventing diaper dermatitis, (6) applying positioning and comforting techniques (swaying, rocking), (7) using music and massage therapy, (8) providing nutritional support including frequent and small feeds and use of high caloric feeds, and lower lactose formula, (9) promoting rooming-in of mother and infant, and (10) having active maternal participation, particularly encouraging breastfeeding if not contraindicated. In 2020, the American Academy of Pediatrics issued a guidance of clinical care that stated "nonpharmacologic interventions should be used for all infants with opioid exposure and should be considered the foundation of care" for NOWS and "pharmacologic therapy should be considered for severe opioid withdrawal". However, the benefit in terms of outcomes using the ESC approach has not been consistently shown[2, 10-15]. Several studies have shown that ESC reduces the percentage of infants requiring pharmacotherapy and length of stay (LOS) compared to the FNASS. Other studies have not demonstrated such benefits. It has been suggested that treatment of dysregulation associated with NOWS with opioid replacement therapy may in fact be beneficial in minimizing long-term adverse neurodevelopment. To date, there have been no data on whether ESC could improve ND outcomes[2, 3, 10-15].

Outcome studies in infants with NOWS can provide important data for understanding potential health care resource utilization in the affected infants during infancy, childhood[16-19], and beyond. In a study using the Medicaid dataset from 2003 to 2013, children with neonatal abstinence syndrome (NAS) had more hospital admissions, emergency room visits, prescription medications, and outpatient encounters during the first three years of life compared to those without NAS[20]. With respect to comparative costs between different management approaches, several studies have provided evidence that in infants with NOWS, non-pharmacological management was associated with lower hospitalization costs as results of their having shorter hospital stays and there was a reduced need for pharmacological treatment[14, 21, 22]. However, since studies of late neurodevelopmental outcomes in infants with NOWS are still lacking[23], there are no data regarding long-term health care resource utilization between infants who are pharmacologically managed and those who are managed with ESC. Thus, studies of neurodevelopmental outcomes are urgently needed to guide public health planning and policy decision making.

6. STATEMENT OF WORK

This Statement of Work (SOW) is an indivisible single undertaking that cannot be divided into separable SOW units.

6.a. Scope

6.a.1. Goals: The scope of the proposal includes the following goals:

1) Generate a dataset using the Kaiser Permanente Northern California research databases, which combine administrative/billing data and clinical/pharmacy data from electronic health records (EHR), to create a birth cohort of all infants born between 1/1/2010-12/31/2023.
2) Create study cohorts from the birth cohort 2010-2023 to address each of the three aims:
    a. Infants with NOWS cohort (NOWS cohort): all infants evaluated or scored for abstinence symptoms)
        i. Retrospective
        ii. Prospective
    b. NOWS cohort by management approaches and birth years
        i. Non-pharmacological managed: Pre-ESC and ESC
        ii. Opioid replacement treated: Pre-ESC Rx and Post-ESC Rx
    c. NOWS cohort with only prescription opioid exposure
        i. High MME and other MME dose cohorts
    d. NOWS cohort according to duration or timing of exposure
        i. Sustained and non-sustained exposure cohorts
        ii. Late gestational and early gestational exposure cohorts
3) Examine outcomes
    a. In-hospital outcomes
    b. Neurodevelopmental outcomes identified by ICD-9 and/or ICD-10 diagnostic codes for disorders in development, cognition, behavior and neuropsychiatric conditions. Prospective assessment of ND outcomes.
4) Identify and test variables for matching that may be included in the multi-variate matched analysis:
    a. maternal data elements.
    b. infant data elements.
    c. exposure data elements.
    d. outcomes data elements.
5) Test models for matched analysis.
6) Finalize variables for the matched sets and finalize matching model.
7) Conduct multivariate matched analysis of in-hospital and neurodevelopmental outcomes comparing infants with NOWS who were non-pharmacologically managed (ESC) with those who were opioid replacement-treated.

6.a.2. Tasks: The project will consist of Five different Tasks (see details under ***d. Tasks and Subtasks*** below), each with specific deliverable(s).

1) Task 1: Project Preparation and Planning focuses on query of the KPNC databases and other data sources to conduct the proposed research aims. The deliverable of a final dataset that will be used for analysis.
2) Task 2: Pre-analysis Phase of the Project focuses on testing of different matching models that results in selecting the variables and model for the matched analysis of the project. The deliverable of the task is finalizing the model for the matched analysis.
3) Task 3: Project Analysis Phase consists of performing all of the analyses for each of the three study aims. Deliverables of this task are the analysis results of the three Aims.
4) Task 4: Results Dissemination includes preparation and presentation of study findings, drafting of manuscripts, and submission of study findings for publication. The deliverable of this task is the submission of the Final Report to the FDA.
5) Task 5: Project Monitoring and Team Communication. This task involves team communication and monitoring progress of the project and spans the entire project period. The deliverables include regular research team in-person meetings and monthly phone/video-conferencing calls with the research team. In addition, monthly Progress Report will be submitted to the FDA.

6.b. Objectives

The objectives of the proposed study are to examine the effects of postnatal management approaches (non-pharmacological, including ESC versus opioid replacement pharmacotherapy) and the timing and duration of gestational opioid exposure on in-hospital and neurodevelopmental outcomes in infants with NOWS.

6.c. Technical Approach

6.c.1. Study Design: The proposed study employs both retrospective and prospective cohort study design to test two hypotheses: (1) Structured approach in non-pharmacological management using “Eat, Sleep, Console” (ESC) improves in-hospital and ND outcomes in infants with NOWS. (2) Timing, doses and durations of prenatal opioid exposure are modifier of the effects of management approaches on in-hospital and neurodevelopmental outcomes.

6.c.2 Methods

6.c.2.1 Data Source: We will use the KPNC Virtual Data Warehouse (VDW) and several existing research databases/registries: the infant cohort (IC) dataset and the Neonatal Minimum Dataset (NMDS). The VDW contains membership, outpatient pharmacy, medical encounter, diagnostic, health service, and laboratory data extracted from the electronic health records (EHR) and additional mortality, census, and birth certificate data. The IC dataset contains all KPNC births with infant and mother demographic data, diagnostic codes for the maternal encounter & infant birth hospitalization, outcomes data on death, length of stay, NICU admission. The NMDS captures clinical information on interventions, diagnoses, outcomes of all infants admitted to NICU within KPNC through abstraction by chart reviewers using a

standardized abstraction protocol/definitions with electronic data capture from EHR.

6.c.2.2 Study Cohorts: The inclusion and exclusion criteria are summarized below

	Inclusion Criteria	Exclusion Criteria
Birth Cohort	• All infants born 2010-2023. • Follow-up data available after age 24 months.	• Delivery room deaths. • Chromosomal abnormalities • Congenital anomalies.
NOWS Infant Cohort	• Mother with the following during pregnancy: (1) Prescription for opioids (2) + urine tox screen for opioids (3) + for KPNC Early Start drug use survey • History of diagnosis of NOWS/NAS. • Evaluated, scored for abstinence after birth • P779.5, P96.1, P04.49 in 1st 7 days of life and received opioid replacement treatment or non-pharm management, e,g, ESC	No scoring (Finnegan) or evaluation documented for abstinence.
Retrospective NOWS Cohort	• NOWS cohort born 2010-2023	
Prospective NOWS Cohort	• NOWS cohort born 2013-2018 • parents consented for prospective assessment of the child at ages 6-12 years	• infants with NOWS not born between 2013-2018. • infants with NOWS unable to be recruited for study
MME Dose NOWS Cohort	• Source of opioid exposure is prescription opioids • Opioid exposure at top ¼ (high MME)	• Sources of opioid exposure other than prescription opioids • Insufficient data for MME
Sustained Exposure NOWS Cohort	• Opioid exposure for ≥ 2 four-week periods during pregnancy	• Opioid exposure < 2 four-week periods during pregnancy
Gestational Exposure NOWS Cohort	• Opioid exposure based on trimester of exposure • Late gestational exposure cohort: opioid exposure during the third trimester only. • Early gestational exposure cohort: initial opioid exposure during 1st and/or 2nd trimester	• Data for timing of exposure not available

Below is a summary of the Retrospective and Prospective NOWS study cohorts:

Retrospective, Sustained Exposure, Late Gestational Exposure and MME Dose NOWS Cohorts		
	Inclusion Criteria	**Exclusion Criteria**

Treated NOWS (Pre-ESC Rx)	• NOWS cohort born 2010-2015 • opioid replacement treatment	
Treated NOWS (Post-ESC Rx)	• NOWS cohort born 2016-2023 • opioid replacement treatment	
Non-Pharm Management (Pre-ESC)	• NOWS cohort born 2010-2015 • No opioids replacement treatment	Received pharmacotherapy to treat opioids withdrawal signs and symptoms.
Non-Pharm Management By ESC (ESC)	• NOWS cohort born 2016-2023 • No opioids pharmacotherapy • ESC approach management	Received pharmacotherapy to treat opioids withdrawal signs and symptoms.

Prospective NOWS Cohort		
	Inclusion Criteria	**Exclusion Criteria**
Treated NOWS (Pre-ESC Rx)	• NOWS cohort born 2013-2015 • opioid replacement treatment	
Treated NOWS (Post-ESC Rx)	• NOWS cohort born 2016-2018 • opioid replacement treatment	
Non-Pharm Management (Pre-ESC)	• NOWS cohort born 2013-2015 • Received only non-pharmacological management	Received pharmacotherapy to treat opioids withdrawal signs and symptoms.
Non-Pharm Management By ESC (ESC)	• NOWS cohort born 2016-2018 • Managed only using a structured ESC approach	Received pharmacotherapy to treat opioids withdrawal signs and symptoms.

6.c.2.3. Outcome Measures

Outcomes will include short-term in-hospital outcomes, and late neurodevelopmental outcomes that are both retrospectively and prospectively assessed.

In-hospital outcomes are mortality, re-admission to hospital or NICU, NICU Length of Stay (LOS), hospital LOS, any surgical, diagnostic, or therapeutic procedures requiring sedation, respiratory support (oxygen therapy, CPAP, mechanical ventilation), need for medications for treatment of neurological symptoms, need for medication for hemodynamic support. The primary outcome for in-hospital outcomes is a composite of having any one of the following: mortality, requirement for additional therapy or readmission to hospital or NICU.

Neurodevelopmental outcomes are assessed ***retrospectively*** by (1) diagnoses of disorders of cognition, development, behavior and psychiatric conditions using ICD-9 or ICD-10 codes, (2) available EHR documentation of referral for evaluation for hearing, vision or autism spectrum disorders, language delay, physical, occupational therapy, or speech therapy. Neurodevelopmental outcomes are also assessed ***prospectively*** using (1) the home version of ADHD-Rating scale, fifth edition (ADHD-RS-5) to assess ADHD and (2) the Colorado learning difficulties questionnaire (CLDQ) to assess learning difficulties.

The primary ND outcome is the presence of any of the following codes denoting an abnormal ND outcome in the retrospective analysis:

(1) Autism Spectrum Disorders: 299.0, 299.8, 299.9 (ICD-9), F84.0, F84.5, F84.8, F84.9 (ICD-10).
(2) Behavioral disorders: Attention Deficit Hyperactivity Disorders (ADHD): 314 (ICD-9), F90 (ICD-10), other Behavioral Disorders: 300, 312, 313 ((ICD-9), F91, F93, F94, F98 (ICD-10).
(3) Cognitive disorders: 317, 318, 319 (ICD-9), F70, F71, F72, F73, F78, F70, R41.83 (ICD-10)
(4) Developmental disorders: 315 (ICD-9), F80, F81, F82, F88, F89 (ICD-10)
(5) Depression, anxiety and other psychiatric disorders: 311 (ICD-9), F32, F33 (ICD-10)

The secondary ND outcomes (1) any documented referral for evaluation of delay in language development, speech or autism (2) documented referral for additional supportive therapy including occupational, Individualized Educational Plan (IEP) and (4) scores obtained from prospective assessment using ADHD-RS-5 or CLDQ.

6.c.2.4. General Matching Algorithms for Data Analysis

To construct matched comparisons between each exposure of interest and relevant controls, we will first determine the optimal matching ratio (i.e. the number of controls k to select for each exposed subject) by comparing sample sizes and propensity scores estimated using logistic regression. We will construct the matched groups using a two-step process[24]. First, a group of matched controls will be selected in the appropriate ratio (nk controls to n pharmacologically treated) to satisfy balance constraints on the pre-treatment variables, which will be chosen to ensure that the selected groups have distributions as similar as possible. If it is not possible to balance subjects adequately, the exposed subjects most dissimilar from the controls (e.g. in Aim 1A, pharmacologically treated subjects with severe symptoms) may be pruned for the sample, or weighting methods may be used to give more fine-grained control of balance[25]. Next, each pharmacologically treated subject will be paired with exactly k of the selected controls, producing n matched sets. This pairing will be conducted to maximize similarity on multivariate Mahalanobis distances, as well as similarity on propensity scores and individual variables important to the specific comparison. Matching will be conducted using the software packages designmatch and rcbalance in R[25-27]. Subgroup analyses will be conducted by enforcing exact agreement on the relevant subgroup variable in the second step to create pure subgroups for each level of the subgroup variable.

Outcome analysis for each matched comparison will be conducted by computing simple risk differences and by fitting conditional logit and stratified Cox proportional hazard models. Risk differences provide the most direct and interpretable results but do not correct for residual differences after matching or variable follow-up times. The logit and Cox models both allow adjustment for variables that cannot be balanced perfectly. They will be especially useful for possible co-exposure differences between pharmacologically treated subjects and controls that may be too large to be corrected

by matching. The Cox models will also be able to incorporate variable follow-up times due to large differences in length of surveillance across our multiyear cohort. When conducting subgroup analyses, interaction effects will be added to the logit and Cox models to allow for different estimates in distinct subgroups. Hypothesis tests will be conducted using within-match permutation tests and model-based estimates and confidence intervals will also be presented. Sensitivity analyses for unobserved confounding will be conducted, using the method of Rosenbaum[28] for risk differences and the method Lin, Psaty, and Kronmal [29]for logit and Cox models. We will also measure intensity of follow-up after exposure using data on completion of well-child visits, and if follow-up rates differ significantly after matching, we will conduct additional sensitivity analysis by adjusting for well-child visit status and its interaction with exposure in our model-based approaches.

6.c.3 Specific Aims

6.c.3.1 Aim 1A: To compare in-hospital and neurodevelopmental (ND) outcomes between infants with NOWS treated with opioid replacement and those managed non-pharmacologically, including using the "Eat, Sleep, Console" approach.

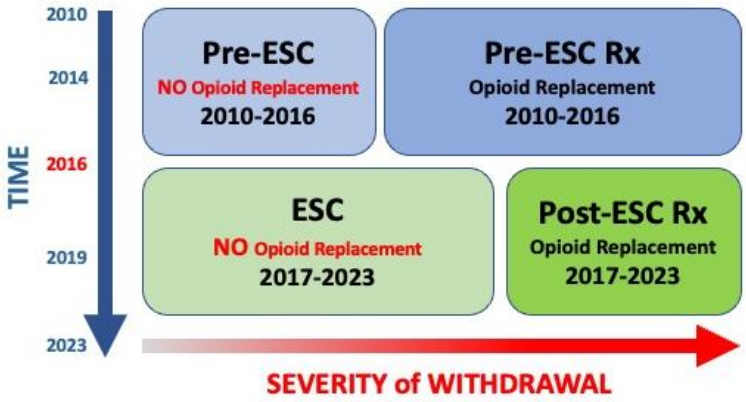
We will test the hypothesis that ***infants with neonatal opioid withdrawal syndrome (NOWS) experience improved in-hospital and neurodevelopmental (ND) outcomes when managed using a structured "Eat, Sleep Console" non-pharmacological approach compared to opioids replacement treatment***. We will use real-world data provided by the Kaiser research database to compare differences in outcomes between using this non-pharmacological approach and pharmacological opioids replacement in infants with NOWS. We will examine both short-term in-hospital outcomes and later neurodevelopmental outcomes.

Rationales: Finnegan scoring has been used traditionally to evaluate withdrawal symptoms among infants with NOWS in determining their need for opioid replacement pharmacotherapy. More recently, the use of ESC assessment tool has focused on function-based scoring for abstinence, prioritizing the use of non-pharmacological management. Several studies have shown that using scoring by the ESC assessment tool to determine the care administered to infants with NOWS improves LOS (length of stay); however, data on long term neurodevelopmental outcomes are lacking. Throughout the entire proposed study period, the standard of care in managing infants with NOWS in the Kaiser Permanente Northern California (KPNC) health system has always been to prioritize non-pharmacological approaches. In 2016, non-pharmacological management was formalized as a structured "Eat, Sleep, Console" approach at KPNC. Our proposal aims to compare non-pharmacological approaches in general, and the structured ESC approach in particular, with opioid replacement treatment in NOWS infants. Our study cohorts are organized based on management approaches and birth years.

- ***All Non-Pharm*** are all non-pharmacologically managed in the entire birth cohort.
- ***All Rx*** are all who received opioids pharmacotherapy in the entire birth cohort.

- ***Pre-ESC*** are those managed non-pharmacologically before the structured ESC approach was instituted in 2016.
- ***ESC*** are those managed using the structured ESC approach beginning 2016.
- ***Pre-ESC Rx*** are those managed with opioid replacement therapy before 2016
- ***Post-ESC Rx*** are those managed with opioids replacement therapy 2016 or later

Severity of withdrawal symptoms varies systematically across different study cohorts, and does so differently across birth years as depicted below:



Detailed Study Protocols: We will compare in-hospital and ND outcomes between the two different management approaches in infants with NOWS. First, infants with NOWS from the entire birth cohort (2010-23) will be used to compare outcomes between those non-pharmacologically managed with those treated with opioids replacement: ***All Non-Pharm vs All Rx***. We will also compare outcomes between the two management approaches used after implementation of the ESC approach in 2016: ***ESC vs Post-ESC Rx*** *(*ESC-managed vs opioids replacement treated infants with NOWS born after 2016).

Finally, we will compare outcomes between infants with NOWS managed using an ESC approach with those treated with opioids before 2016: ***ESC vs Pre-ESC Rx***. The 2016 implementation of a structured ESC approach may have lead providers to initiate opioid replacement therapy at higher levels of withdrawal symptom severity than they did before ESC. The Pre-ESC Rx group during the period of “usual care” as the comparative arm in the analysis will therefore address confounding by indication that might have occurred with the ESC implementation and better simulate a randomized comparison between ESC and opioid replacement therapy.

Preliminary Data: Total number of available children for each study cohort is shown:

	Pre-2016	**2016-2019***	**Total (2010-2019)**
NOWS infants	900	621	1521
Non-Pharm	(Pre-ESC) 751	(ESC) 486	1237
Opioids Rx	(Pre-ESC Rx) 149	(Post-ESC Rx) 135	284

*2020-2023 study cohorts will be added during the project study period.

Power analysis (All Rx vs. All Non-Pharmacological***:*** Power at a given sample size for detecting a given hazard ratio (HR) comparing all pharmacologically treated infants to non-pharmacologically managed infants is shown below.

# matched samples (% of total Rx treated cohort)	Hazard Ratio (HR)		
	1.7	1.8	1.9
300 (75%)	0.68	**0.78**	**0.85**
330 (83%)	0.72	**0.82**	**0.88**
360 (90%)	**0.76**	**0.85**	**0.91**
400 (100%)	**0.80**	**0.88**	**0.94**

The sample size given is the number of matched pairs chosen from each group (assuming 1:1 matching ratio). Sample sizes in the table range from 75%-100% of estimated total pharmacologically treated infants from 2010-2023, allowing for the possibility that some of these infants will be too dissimilar to the non-pharmacologically treated group to be matched. To carry out the power calculations, we used time-varying estimates of the incidence of any adverse neurodevelopmental event and of the rate of censoring in the portions of the non-pharmacologically managed cohort and the ESC cohort currently available from 2010-2019 KPNC data. We scaled up the current size of the pharmacologically treated sample (n=284) by 1.4 to account for the additional data we aim to collect in the four additional years (2020-2023). Power was computed using the function “powerCT.default” from the R package powerSurvEpi [30], which implements a procedure described in Rosner (section 14.12)[31]. This procedure is designed for grouped Cox models rather than the paired Cox models we intend to fit, which will account for additional data adjustments via matching.

6.c.3.2 Aim 1B: To perform a pilot prospective cohort study to assess feasibility of comparing ND outcomes between non-pharmacologically managed and opioids replacement treated infants with NOWS.

Rationale: With many of the limitations of retrospective analysis, the strength of evidence regarding ND outcomes will be greatly enhanced if the longitudinal prospective cohort study can be conducted on the Kaiser birth cohort. A prospective cohort study will directly assess ND outcomes with focuses in specific domains, which cannot be done using the current data source.

We propose to perform a pilot study that will determine the feasibility of performing prospective assessment of ND outcomes in our study cohorts. We will recruit infants with NOWS from the 2013-18 birth cohort to determine our ability to contact, recruit, enroll and prospectively assess study participants at ages 6-12 years. The age range of 6-12 years captures school age, when issues of learning, language, attention and behavior will be most important. This age range also allows for direct assessment of study participants, in addition to parental or self-reporting using validated assessment tools. We selected the cohort to span the birth years 2013-18 to cover an equal period before and after the implementation of ESC in 2016. By ending birth year in 2018 for the

cohort, we will also avoid any confounding from concerns related to the COVID-19 pandemic. The pilot study will provide useful data for power analysis for sample size for a larger prospective cohort study. In addition, comparing results from the prospective assessment and those from the retrospective analysis have the potential to inform what retrospective data source are most reliable, thus improving the design of future studies.
Preliminary Data: Total number of available study children for each cohort is shown:

	Pre-2016 (2013-2015)	**2016-2018**	**Total (2013-2018)**
NOWS infants	508	480	988
Non-Pharm	(Pre-ESC) 415	(ESC) 342	787
Opioids Rx	(Pre-ESC Rx) 93	(Post-ESC Rx) 108	201

Detailed Study Protocols: In the prospective NOWS cohort pilot study, we will recruit 10 children from each of the following four cohorts: Pre-ESC, ESC, Pre-ESC Rx and Post-ESC Rx. We will use the data collected to design a prospective cohort study to compare ND outcomes between infants with NOWS managed by an ESC approach with those who receive opioid replacement therapy. We will work with study participants' primary pediatricians to obtain contact information for study participants. A member of the research team will contact the family by email, phone and mail for recruitment into the study. We will obtain informed consent from those eligible for the study and agree to participate. Enrollled children will complete a review of medical and surgical history, including hospitalizations and medications, and verify recorded demographic data. Parent(s) or caretakers will be asked to complete (1) an ADHD assessment using the home version of the ADHD-Rating scale, fifth edition (ADHD-RS-5) and (2) a learning difficulty assessment using the Colorado learning difficulties questionnaire (CLDQ). We will additionally administer a questionnaire regarding home environment. We will explore with a subset of the enrolled study participants to participate in in-person assessments using ABAS II, *Conners* CBRS Comprehensive Behavior *Rating* Scale (parent and self-report) and the NIH Toolbox. Study participants will be invited to have the in-person sessions when contacted for the questionnaires. Study participants will be reimbursed $100 per encounter for their time to complete an interview regarding medical history, CLDQ, ADHD-RS-5 or home environment questionnaire or an in-person assessment session for ABAS II, Conners CBRS or NIH Toolbox.

We will document (1) the total number of children contacted, (2) eligible, (3) successfully consented, (4) enrolled, (5) with complete historical EHR data, (6) who successfully completed the two assessments and home environment questionnaire, and (7) agreed to participate in an in-person session and (8) completed an in-person session. Results from the retrospective analysis will be retrieved and compared with those obtained from prospective assessments. A draft data collection form will be developed, which will include demographic data, all retrospective collected data, and data derived from the home environment questionnaire and prospective assessment results. The data collection form will be finalized and be used for the planned full prospective study. The results of the prospective assessment will be used to perform sample size estimation for the full prospective cohort study. We will also make plans to submit an IRB research proposal for the full prospective cohort study.

6.c.3.3 Aim 2A: To characterize the sources (prescription versus illicit opioids) and doses (total milligram morphine equivalents) of opioid exposure and co-exposures to other substances in infants with NOWS.

We will query the entire database to collect data regarding sources of prenatal opioid exposure (prescription opioids or maintenance therapy for addiction, other sources). We will query pharmacy records to determine the types of co-exposure substances or medications. We will specifically determine co-exposures to prescription medications for depression, anxiety and other DSM-5 conditions. To examine doses of prenatal opioid exposure, we will restrict examination to those study participants with prenatal exposure to prescription opioids, quantified in milligrams morphine equivalents (MME). We will specifically test the hypothesis that ***prenatal prescription opioid exposure at high MME is more frequently associated with co-exposure to other prescription psychoactive medications.***

Rationales: Studies in infants with NOWS have mostly examined prenatal exposures to the opioids methadone, buprenorphine, or other illicit substances, with fewer studies examining exposure to prescription opioids[32]. The objective of Aim 2A is to characterize, in infants with NOWS, variation in sources (prescriptions, maintenance treatment for substances), doses (in milligrams morphine equivalents or MME), and psychoactive substances of co-exposure, including prescription anti-depressant and psychotherapeutic drugs. Our preliminary data indicate that the majority of prenatal opioid exposures in infants with NOWS from KPNC dataset derives from prescription opioids. The pharmacy record also provides reliable data on doses of prescription opioids and types and doses of prescription antidepressants and psychoactive medications. We will therefore focus the examination of doses of opioid exposure in the group with prenatal exposure to prescription opioids, and co-exposures to prescription medications.

Detailed Study Protocols: In each of the NOWS study cohorts from Aim 1A, we will determine distribution of various sources of exposures: (1) prescription opioids, (2) maintenance treatment for addiction with methadone or buprenorphine, and (3) heroin and other illicit opioids. We will categorize co-exposure substances as follows: (1) amphetamines, (2) barbiturates, (3) other non-opioid substances, (4) prescription SSRI antidepressants, and (5) prescription non-SSRI psychoactive medications. We will characterize the relative frequency, categories, and total number of substances for each source of exposure.

To characterize doses of prescription opioid exposure, we will determine total cumulative doses in MME, and generate descriptive statistics for dosage (range, mean, median, and distribution) in each of the NOWS study cohorts. Doses of MME opioids will be divided into quartiles, and **the top quartile is the high MME dose**. We will create a high MME exposure cohort as those with prenatal prescription opioid exposure in the top quartile of dose by MME.

In the NOWS group with prenatal prescription opioid exposure, we will query the EHR to identify any documented maternal psychiatric diagnoses, defined as ICD-10-CM codes corresponding to a condition found in the DSM-V. We will also query the pharmacy record to obtain data on any prescription medications used to treat those conditions. We will examine the incidence of co-exposure, types of substances of co-exposure, and number of different co-exposure substances in the high MME group and the other MME (non-high MME) groups. We will further specifically determine in the high MME group incidence of co-exposure to SSRIs and other prescription psychoactive medications. Associations between MME and co-exposure will be tested using permutation methods for 2xk tables. The high MME and non-high MME NOWS cohorts created in Aim 2A will be used to perform matched analysis to examine the effects of doses on outcomes in Aim 2B.

Preliminary Data Among the entire NOWS cohort from 2010-2019, 926 (61%) had prenatal exposure to prescription opioids, 525 (34%) were exposed to methadone/buprenorphine and 80 (5%) had prenatal exposure to heroin. Co-exposure of the following substances: amphetamines, barbiturates, cocaine, THC, benzodiazepines, antidepressants, ETOH in NOWS cohort is presented below:

Sources of Prenatal Opioids	No co-exposure	+ Co-exposure
Heroin (n=80)	11%	89%
Methadone/Buprenorphine (n=515)	46%	54%
Prescription opioids (n=926)	47%	53%

6.c.3.4 Aim 2B: To examine the in-hospital and ND outcomes in infants with NOWS with high MME (milligram morphine equivalent) prenatal opioid exposure and compare the effects of management approach between high and other MME groups.

We will use the high MME cohort created in Aim 2A to the hypothesis that ***infants with NOWS who have high doses of prenatal prescription opioid exposure are at risk for worse in-hospital and ND outcomes***.

Rationales: Little is known regarding the relationship between dose, timing and duration of prenatal opioid exposure and neonatal outcomes, particularly long-term neurodevelopmental outcomes. Mothers with more serious substance use disorder or other co-morbid conditions may also have higher doses of exposure, so a dose-response curve between exposure and outcome needs to control for confounding introduced by co-morbidity and sources of prenatal opioid exposure. Our proposal will analyze dose-response effects using NOWS infants with prenatal prescription opioid exposure. Restricting this study to NOWS infants with a single type of opioid exposure minimizes some of the potential confounding of exposure to MAT or illicit drugs. In addition, the availability of detailed pharmacy records provides reliable quantitative data on doses of opioid exposure. Similarly, the KPNC dataset provides data regarding detailed timing of opioid use during pregnancy from EHR without relying on recall or self-report by mothers.

Detailed Study Protocols: We will first perform matched analyses to compare in-hospital and ND outcomes between the high MME group and non-high MME groups to test the hypothesis that high doses of prenatal opioid exposure increase risk for worse in-hospital and ND outcomes. We will match the co-exposure variables (types, and number) between groups in the match analysis. If the co-exposure variables are significantly imbalanced between groups such that adequate matching is not achievable, our alternative approach will be to perform the analysis with co-exposure variables in a regression model.

If the results indicate that the high MME group has worse outcomes compared to the other MME group, we will perform additional subgroup analysis to examine effects of management approach on outcomes in the high MME group. Specifically, we will perform subgroup analyses for the proposed comparison from Aim 1A (All Non-Pharm vs. All Rx) in high MME and all non-high MME groups. Should sample sizes permit, we will perform additional subgroup analyses for the other proposed comparison from Aim 1A (ESC vs. Pre-ESC Rx and ESC vs Post-ESC Rx)

6.c.3.5 Aim 3A: To characterize the timing and durations of opioid exposure in infants with NOWS, and to compare the in-hospital and ND outcomes between infants with sustained and non-sustained exposure and between infants with and without early gestational exposure.

We will test the hypothesis that ***infants with NOWS with long durations (sustained exposure) or with early gestational prenatal exposure are at risk for worse in-hospital and ND outcomes than infants who do not experience sustained exposure or early gestational prenatal exposure***. In the NOWS cohort, we will create sustained and non-sustained exposure cohorts based on the duration of exposure. We will create from the NOWS cohort two cohorts determined by the timing of exposure, one with and one without early gestational opioid exposure.

Rationales: A recent study using the MoBa cohort found that a longer duration of prenatal analgesic opioid exposure (> 5 weeks compared to ≤ 4 weeks) increases risk for diagnosis of ADHD[33]. Their use of a 4-week period for exposure has been used elsewhere and is our rationale for generating the sustained exposure cohort using multiples of 4-week periods. Using claims data from Optum, Wen et al. [34]found no association between opioid exposure and neurodevelopmental disorders, but increased risk was observed with longer duration or higher doses of opioid exposures. In the MoBa study, timing of exposure was not associated with increased risk for ADHD. Our proposed study will examine timing and duration of opioid exposure on broader neurodevelopmental outcomes as well as in-hospital outcomes, and whether these factors modify the effect of management approaches on outcomes.

Detailed Study Protocols: Duration of exposure will be quantified based on number of four-week periods of exposure. We will create a sustained exposure cohort consisting of NOWS infants with prenatal opioid exposures for 2 or more four-week

periods and a non-sustained exposure cohort with 2 or fewer four-week periods of exposure. We will perform matched analyses to compare in-hospital and ND outcomes between sustained and non-sustained exposure cohorts to determine if duration of exposure influences outcome.
Timing of exposure will be categorized by the first trimester in which the infant was exposed to opioids: first (0-12 weeks gestation), second (13-28 weeks gestation) and third (29 weeks till delivery). To examine the effects of timing of exposure on outcomes, we will create a late gestational exposure cohort consisting of infants with NOWS whose prenatal opioid exposure occurred ONLY during the third trimester and an early gestational exposure cohort consisting of infants with NOWS whose prenatal opioid exposure occurred initially during the first and/or second trimester. To determine whether timing of exposure affects outcomes, we will conduct matched analyses to compare in-hospital and ND outcomes between the late gestational exposure cohort with the early gestational exposure cohort.

6.c.3.6 Aim 3B: To assess how varying duration or timing of prenatal opioid exposure modifies the effects of management approach on in-hospital and ND outcomes in infants with NOWS.

We will test the hypothesis that ***timing and duration of prenatal opioid exposure could modify the effects of management approach on in-hospital and ND outcomes in NOWS infants.***

Rationales: Longer durations of exposure have been reported to be associated with increased risk of neurodevelopmental disorders, but no data exist regarding short duration of exposure on ND outcomes, and data related to timing on ND outcomes have been inconsistent. Any data available on whether timing or duration of prenatal exposure modify the effect of management approach on outcomes will be extremely helpful in guiding allocation of resources to specific vulnerable groups of NOWS infants, either with prolonged exposure or specific timing of exposure with NOWS, either with prolonged exposure or specific timing of exposure.

Detailed Study Protocols: We will compare in-hospital and ND outcomes between the two management approaches in the sustained and the non-sustained exposure cohorts by performing subgroup analyses for the sustained and non-sustained groups within the matched comparison of All Non-Pharm with All Rx constructed for Aim 1A. If we detect differences in outcomes between All Non-Pharm and All Rx only in the sustained exposure cohort, then the results would indicate that duration of prenatal opioid exposure may modify the effects of management approach on outcomes. Additional analyses to be performed will be guided by these results.

We will use the late gestational exposure and early gestational exposure cohorts to determine if timing of prenatal opioid exposure modifies the effects of management approach on outcomes. We will perform subgroup analyses for the matched comparison in Aim 1A, All Non-Pharm with All Rx, within the late gestational exposure and the early gestational exposure groups. If we find differences in outcomes between

All Non-Pharm and All Rx in only the early gestational exposure or the late gestational exposure group, then the results would indicate that timing of prenatal opioid exposure may modify the effects of management approach on outcomes. Additional analyses to be performed will be guided by these results.

6.c.4 Anticipated Study Results and Limitations

At KPNC, the structured ESC approach to management of NOWS was formalized at the end of 2015, and fully implemented by 2016. Our proposal aims to compare non-pharmacological management of NOWS, specifically the structured ESC approach, with opioids replacement treatment, for both short-term in-hospital outcomes and long-term ND outcomes. We recognize that evaluation of withdrawal symptom severity using the ESC assessment tool only began in 2020; our study is not comparing management approaches relying on tools used to assess severity of withdrawal symptoms but rather, comparing the use of non-pharmacological approaches with pharmacotherapy. We have previously reported that there are no differences between using the ESC tool and modified Finnegan scoring on initiation of pharmacotherapy. Thus, the KPNC NOWS cohort is an ideal cohort to compare outcomes between non-pharmacological approach and pharmacotherapy.

In the examination of timing and duration of prenatal opioid exposure as modifiers of the effect of management approach on outcomes, we propose to perform subgroup analyses within the sustained/non-sustained exposure cohorts, as well as the late/early gestational exposure cohorts comparing All Non-Pharm with All Rx. We will explore the possibility to also perform subgroup analyses comparing ESC with Pre-ESC Rx, and ESC with Post-ESC Rx, but these subgroup analyses are not included due to concerns related to limitations in sample sizes for the sustained/non-sustained exposure and late/early gestational exposure cohorts.

6.c.5 Clinical Guideline for Management of Neonatal Abstinence Syndrome at KPNC

Antenatal Management. The mothers of many of the babies evaluated and treated for NAS in KP nurseries are followed prenatally by the Early Start Program. Efforts should be made at each medical center to arrange prenatal counseling with the Neonatology or Pediatric HBS physicians who staff the nursery in the facility where delivery is planned. We recommend consultation for any mother on methadone or buprenorphine and any mother on daily opioids in the third trimester. A successful approach to arranging consultations utilizes a shared Healthconnect mailbox for the neonatologists or pediatricians to which consult requests can be sent by obstetricians or Early Start counselors. The counseling appointments may be in person but will typically be by phone and will enable the pediatric staff to introduce more detailed information about hospital workflows related to monitoring babies for evidence of NAS. Basic information about NAS scoring and anticipated length of stay should be included in the conversation. This is also an opportunity to inform the mother that the reason for monitoring and treatment of the baby will have to be shared with her partner and a plan to inform the partner in advance of the baby's birth is desirable. A smart phrase (.NASconsult) is available for providers doing phone consultations with families of

infants at risk for NAS. A KP Parent NAS Information Handout (revised 2018) is available and should be given to families in the third trimester.

Coding Recommendations. For an infant being observed in mother baby unit due to maternal exposure please use ICD-10 code P0449 "Newborn affected by maternal use of drugs of addiction". For infants requiring pharmacologic treatment, use code P961 Neonatal withdrawal symptoms from maternal use of drugs of addiction or code P96.2 Neonatal drug withdrawal syndrome maternal therapeutic drug.

Non-Pharmacological Management. There is mounting evidence that optimization of the hospital environment expedites weaning and discontinuation of opioid medications with the goal of discharge home (Bagley, 2014). The noise and disruption of open ward style NICU's is over-stimulating to infants suffering from NAS and appears to lead to increased duration of opioid weaning. Whenever possible, strategies should be implemented to move babies into private rooms where much of the care can be provided by the mother and other family members. For mothers who are compliant with a drug treatment program the standard recommendation should be to breast feed the baby. Breast milk provides optimal nutritional support and promotes mother-infant bonding. There is evidence suggesting breastfed neonates exposed to opioid maintenance treatment (OMT) medication prenatally have lower incidence of NAS and require shorter pharmacotherapy for NAS than infants who are not breastfed.

The following should all be addressed as part of a comprehensive NAS treatment program that should begin at birth, and not only when the baby shows signs of withdrawal. In a patient being observed/treated for NAS, use of the following measures should be reinforced: (1) Minimize environmental stimuli (both light and sound), (2) Swaddling lessens stimulation and promotes sleep that is more sustained, (3) Attempt to respond early to infant signals before agitation becomes amplified, (4) Kangaroo care and pacifiers may help to calm infants, (5) Prevent diaper dermatitis with application of petrolatum-based ointments &/or skin barriers containing zinc oxide with every diaper change. Follow the AWHONN Neonatal Skin Care Guidelines for additional prevention and treatment recommendations, (6) Teach and institute appropriate positioning and comforting techniques (swaying, rocking), (7) Music therapy and massage therapy may soothe some infants, (8) Frequent small volumes of feeds to allow adequate growth. For babies with excessive weight loss, which can be seen in the first 1-2 weeks of NAS care, fortification of breast milk to 22kcal/oz may be appropriate (caloric need maybe as high as 150-250 kcal/k/day), (9) Consider a partially hydrolyzed lower lactose formula for infants with diarrhea that is difficult to manage, (10) Promote rooming-in of mother and infant while assessing for NAS treatment. For those infants who require treatment, once drug tapering is initiated, move patient to a private room on the pediatrics floor if available in the facility, (11) Active maternal participation is the best non pharmacologic care. It is promoted by encouraging breastfeeding for mothers who adhere to a drug treatment program.

Finnegan Scoring. Most physicians and nurses who manage NAS utilize the Finnegan scoring system to identify babies who require therapy, and once on therapy to wean the treatment drug. Inter-observer variation in score assignment makes the use of the Finnegan scale problematic. This is particularly true as babies reach several weeks of age. There is some evidence that the normal score rises over the first month of life. Even with these limitations, we continue to recommend Finnegan scoring at this time.

(1) Start Finnegan scoring every 3-4 hours when a newborn is 12 hours of age. There is no clearly defined maternal opioid intake below which a fetus is not at risk for NAS. If there is a question about need for observation in the setting of low dose maternal opioid use, a neonatology or addiction medicine consult may be considered.
(2) Scoring should be done in the mother's room on the maternity ward, preferably while the baby is being held after a feeding. Babies at risk for NAS should be observed and scored in the hospital until 3-5 days of age before discharge home.
(3) For babies with scores >10: confirm nonpharmacologic measures are in place; add pharmacologic measures if nonpharmacologic measures are not sufficient to keep score ≤ 10
(4) For babies with any score >14, notify provider of the need to assess the baby.
(5) Finnegan scores tend to increase as infants mature over the first several weeks of life. In the third week of life, consider increasing the threshold from 10 to 12.
(6) See recommendations below for use of Finnegan scores for medication tapering.
(7) See attached appendix for definitions of specific components of the Finnegan Score.

Optimal Drug Therapy. For infants with severe opioid withdrawal, the mainstay of therapy is prescribing a replacement opioid to capture withdrawal symptoms, a short period of stabilization and a controlled taper of the replacement medication. Use of Tincture of opium is not recommended due to high alcohol content. Barbiturates should be avoided in the management of NAS because of long term neurodevelopmental concerns and availability of alternative, safer medications. After review of the available literature, we recommend the use of methadone. The long drug half-life in neonates permits every 12 hour dosing. Methadone also provides control of autonomic symptoms. Methadone at high dose may prolong the QTc interval. If the family history is positive for prolonged QTc an ECG should be obtained on the patient. Clonidine should be used in an adjuvant role when NAS is not controlled by methadone alone. The recommended approach to treatment is as follows: (1) Obtain a urine toxicology screen on all babies being evaluated for possible NAS. The presence of drugs other than opioids may complicate and prolong therapy, (2) Consider initiation of the methadone dosing schedule (see below) at step 1 for infants with two Finnegan scores greater than 10 or one greater than 1

Initiation and Escalation

Step 1: 0.1 mg/kg/dose orally every 6 hours for 4 doses

If the infant fails step 1 (score of greater than 10), consider steps 1A through 1C. Also, for babies who fail step 1, consider initiation of Clonidine (see below for dosing). After completing steps 1A through 1C, resume protocol at step 2. **Step 1A:** 0.1 mg/kg dose orally every 4 hours for 6 doses. **Step 1B:** 0.1 mg/kg orally every 8 hours for 3 doses. **Step 1C:** 0.1 mg/kg orally every 12 hours for 2 doses

Once stabilized, wean according to the following schedule

Wean to the next step if the average Finnegan score is less than 10 for prior 24 hours

If Finnegan score > 10, consider rescue dose of morphine 0.05 mg/kg dose orally

If infant requires more than 1 rescue morphine dose, return to dose in previous step of dosing schedule

Step 2: 0.07 mg/kg orally every 12 hours for 2 doses
Step 3: 0.05 mg/kg orally every 12 hours for 2 doses
Step 4: 0.04 mg/kg orally every 12 hours for 2 doses

Step 5: 0.03 mg/kg orally every 12 hours for 2 doses
Step 6: 0.02 mg/kg orally every 12 hours for 2 doses*
Step 7: 0.01 mg/kg orally every 12 hours for 2 doses*
Step 8: 0.01 mg/kg orally every 24 hours for 1 dose*
*When ordering the lowest doses in KPHC for small babies, it may be necessary to enter an explicit mg amount rather than a weight based dose.
Adjunct Consider adding clonidine if patient fails Step 1 methadone therapy and requires escalation to step 1A. (.i.e. if scores >10 after completion of step 1 above.) This may include babies with poly substance exposure or those whose methadone dose requires escalation to 0.1mg/kg/dose EVERY 4 HOURS with persistent elevation of Finnegan scores. (>10).

- Start clonidine at 1.5mcg/kg/dose orally every 6 hours
- Wean the patient off methadone as described above. The following day, wean clonidine to 50% of dose day 1, 25% of dose day 2, then off.
- Consider more frequent BP's during initiation and weaning of clonidine. Delay discharge for 1-2 days after clonidine is discontinued.

Discharge Observe for 36-48 hours from the last dose of step 8 if methadone is the only treatment agent. Consider adequate weight gain as a discharge criterion since weight gain may be a proxy for withdrawal severity. For infants with difficult to manage NAS who reach the high end of the dosing range for both methadone and clonidine, consider placing an Econsult for Addiction Medicine. In NCAL phone consultation is also available by calling 510 368 4504. Consultations are available during weekdays, weekends, and after hours. For any infants requiring pharmacologic treatment for NAS, there is evidence of increased risk of learning disability suggesting need for school age intervention. The benefit of High Risk Infant Follow up is unclear.

6.c.6 NASS (Modified Finnegan) Scoring Criteria (score in parenthesis)

- Excessive Crying: Unable to decrease crying within 15 seconds of self-consoling, or up to 5 minutes with caregiver interventions. (2)
- Continuous Crying: Unable to decrease crying within 15 seconds of self-consoling, or for longer than 5 minutes with caregiver interventions. (3)
- Sleep: Base on the longest period of sleep between scoring.
- Tremors: Mild= hands / feet only (1)
  Moderate = arm / leg (2)
  Undisturbed =wait 45 seconds after disturbing infant to see if tremors continue. If yes, then the tremors are undisturbed. (3 or 4 for mild or moderate)
- Increased Muscle Tone: Body rigidity or no head lag. Test while infant is quiet and awake - not sleeping or crying. (2)
- Excoriation: Do not assess for excoriation on buttocks related to loose stools. Assess for excoriation on nose, chin, cheeks, elbows, toes, etc. (1)
- Excessive Sucking: More than 3 attempts between scoring to self-console by sucking on pacifier, hand, fist, or other object. (1)
- Poor Feeding: Gulping, out of breath, uncoordinated feeding. (2)
- Loose Stool: Curdy, seedy, liquid without a water ring. (2)

• Watery Stool:	Liquid with a water ring. (3)
• Yawning/Sneezing:	3-4 yawns, 3-4 sneezes since last scoring. They do not need to be consecutive. Enlist help of parents and other caregivers to record events on log. (1 for yawning, 1 for sneezing).

6.c.7 References

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6.d Tasks and Sub-Tasks

Tasks				
Task 1: Project Planning and Preparation				
	Subtasks		Deliverables	Assessment Deemed Acceptable if
	1.1	Create NOWS cohort from birth cohort	Based on inclusion and exclusion criteria, NOWS cohort created from birth cohort 2010-2023.	NOWS cohort created.
	1.2	Query dataset for maternal exposures	Sources of maternal opioid exposure established	All data or sources of opioid exposure for the study cohorts are completed, and accuracy confirmed with select samples chosen from EHR for review and validation.
	1.3	Query pharmacy records for maternal exposures	Maternal opioid exposure re: timing during pregnancy, durations, types of opioids and doses established. Milligrams morphine equivalent doses of prescription opioids during pregnancy calculated.	Prescription opioids doses data are abstracted, and conversion to MME completed.
	1.4	Query dataset for postnatal management	Postnatal management by non-pharmacologic or opioids replacement treatment confirmed	Study cohorts created based on postnatal management with non-pharmacological approach or by pharmacotherapy.
	1.5	Obtain IEP and other developmental data	All referrals for evaluations of hearing, autism, speech identified. All referrals for occupational, physical and speech therapy identified. IEP referral data obtained.	All data related to referral for evaluations or supportive therapy are complete.
	1.6	Create study cohorts	Four different study cohorts from the NOWS cohort are created based on management approaches and birth years: Pre-ESC, ESC, Pre-ESC Rx and	Creation of study cohort based on management approaches and birth years is complete.

			Post-ESC Rx.	
Task 2: Testing and Selecting Models for Analysis				
	Subtasks		Deliverables	Assessment Deemed Acceptable if
	2.1	Generate and test match models	Generate and test different models for the matched analysis. Findings from the testing are summarized, with strengths and weaknesses of the different models identified.	Matching variables and models testing generate final list of variables and model for matching.
	2.2	Select match model to use for analysis	Select final model used for match analysis	Final model used for match analysis is selected
Task 3: Data Analysis of All Study Aims				
	Subtasks		Deliverables	Assessment Deemed Acceptable if
	3.1.1	Analysis Aim 1A All Non-Pharm vs All Rx	Analysis in the NOWS cohort, derived from the entire birth cohort from 2010-2023. Completed analysis with results that either show no differences or a difference in outcomes between non-pharmacological management compared to opioids replacement pharmacotherapy.	Analysis completed, and results regarding comparative outcomes between management approaches are found.
	3.1.2	Analysis Aim 1A ESC vs Pre-ESC Rx	Analysis that compares the in-hosp outcomes and ND outcomes between ESC-managed and opioids replacement treated infants with NOWS before 2016.	Analysis completed with findings reported.
	3.1.3	Analysis Aim 1A ESC vs Post-ESC Rx	Analysis that compares the in-hosp outcomes and ND outcomes between ESC-managed and opioids replacement treated.	Analysis completed with findings reported.
	3.2.1	Analysis Aim 1B Pilot prospective study I: Recruit/enroll	Contact children from each of the four cohorts: Pre-ESC, ESC, Pre-ESC Rx and Post-ESC to discuss study, and recruit study participants, and consent parents	Complete enrollment of 10 children from each of the four groups

	3.2.2	Analysis Aim 1B Pilot prospective study II.	Testing administered to the study participants. Draft data collection form.	Successfully complete testing in >80% of enrolled study participants.
	3.3.1	Analysis Aim 2A Sources, doses in NOWS cohorts	Determine the sources of opioid exposure in the entire NOWS cohort, and the four study cohorts.	Sources of exposure determined for all study cohorts. Analysis of doses in MME completed for prescription opioids exposed group. High MME cohort established and available for use in analysis.
	3.3.2	Analysis Aim 2A Co-exposures in NOWS cohorts	Characterize co-exposures in the NOWS cohort, the four study cohorts. Co-exposures include other substances (amphetamines, barbiturates, and illicit substances) and prescription psychoactive medications and SSRI	Co-exposures determined for all study cohorts. Co-exposures to prescription psychoactive medications determined,
	3.3.3	Analysis Aim 2A: Create MME cohort	In the group with prenatal prescription opioids, review of pharmacy records to determine doses (in MME): total cumulative, range, mean, median. The top quartile MME is denoted as the high MME cohort. Characterize co-exposures in the high MME cohort. Analysis of co-exposure to prescription psychoactive medications in the high MME group.	High MME dose cohort created. Analysis of co-exposure to prescription psychoactive medications in high MME group completed
	3.4.1	Analysis Aim 2B: Outcomes in high MME cohort	Compare In-hospital and ND outcomes between high MME group with the remaining MME (non-high) group.	Analysis completed with findings confirmed and available to be reported.
	3.4.2	Analysis Aim 2B: MME doses as a modifier of management approach	Subgroup analysis within the high MME and non-high MME groups comparing between different management approaches (All non-pharm vs All Rx).	Subgroup analysis completed with findings confirmed and available to be reported.
	3.5.1	Analysis Aim 3A	Determine the durations of exposures (in	Durations of exposures determined for

		Durations of exposures	weeks) in the NOWS cohort. Determine the distribution of exposure durations based on number of four-week periods in the NOWS cohort and the study cohorts	the NOWS cohort, including distribution for all study cohorts.
	3.5.1	Analysis Aim 3A Create sustained exposure cohort	Denote sustained exposure cohort: ≥ 2 four-week periods. All others are non-sustained exposure cohort.	Sustained exposure cohort created.
	3.5.2	Analysis Aim 3A Timing of exposures	Examine the timing of exposures based on the trimester(s) of exposure. Define distribution of gestational exposure in all cohorts.	Timing of exposure established and results available to be used for analysis.
	3.5.2	Analysis Aim 3A Create exposure cohorts based on timing	Designate infants with NOWS having exposure during the third trimester as the late gestational exposure cohort. Those with exposure that began in 1st and/or 2nd trimesters as the early gestational exposure cohort.	Exposure cohorts created based on timing of exposure.
	3.5.3	Analysis Aim 3A Outcomes in sustained cohort	Compare In-hospital and ND outcomes between sustained and non-sustained cohorts.	Analysis completed with findings confirmed and available to be reported.
	3.5.4	Analysis Aim 3A Outcomes in late cohort	Compare In-hospital and ND outcomes between exposure cohorts with different timings of exposure.	Analysis completed with findings confirmed and available to be reported.
	3.6.1	Analysis 3B Durations as a modifier of management (sustained cohort)	Subgroup analysis within the sustained and non-sustained cohorts and compare between different management approaches (All non-pharm vs All Rx)	Subgroup analysis completed with findings confirmed and available to be reported.
	3.6.2	Analysis 3B Timing as a modifier of management	Subgroup analysis within the exposure cohorts based on timing and compare between different management approaches: (All non-pharm vs All Rx)	Subgroup analysis completed with findings confirmed and available to be reported.

Task 4: : Dissemination of Study Results				
	Subtasks		Deliverables	Assessment Deemed Acceptable if
	4.1	Presentation of results at meetings	Abstracts to report result of research are submitted for presentations of at national meetings of professional societies or academic medicine.	Abstracts are accepted for presentation at national meetings
	4.2	Preparation of manuscripts for publication	Manuscripts are drafted and submitted for publication in peer reviewed journals	Findings are organized as manuscripts and ready for submission for publication in peer-reviewed journals.
Task 5: Project Monitoring and Team Communication				
	Subtasks		Deliverables	Assessment Deemed Acceptable if
	5.1	Monthly research team phone conferences	Virtual monthly meetings are held with participation of the entire research team to discuss research findings.	Agendas and minutes of each phone conference are maintained for documentation.
	5.2	Monthly progress reports	Study progress, challenges, and budget expenditures are summarized and submitted to FDA.	Monthly progress report of study and budget items are filed, and acknowledged
	5.3.1	First In-Person Investigators meetings	Review study progress, ensure all milestones are met, discuss problems, develop solutions, plan presentations	Meeting minutes and action items
	5.3.2	Second In-Person Investigators meetings	Review study progress, ascertain tall milestones are met, discuss problems, develop solutions, plan analysis, present & publish study results	Meeting minutes and action items
	5.3.3	Third In-Person Investigators	Review study progress, ascertain tall milestones are met, discuss problems,	Meeting minutes and action items

		meetings	develop solutions, plan analysis, present & publish study results	
	5.3.4	Fourth In-Person Investigators meetings	Review study progress, ascertain tall milestones are met, discuss problems, develop solutions, plan analysis, present & publish study results	Meeting minutes and action items
	5.3.5	Fifth In-Person Investigators meetings	Review study progress, ascertain tall milestones are met, discuss problems, develop solutions, plan analysis, present & publish study results	Meeting minutes and action items
	5.3.6	Final In-Person Investigators meetings	Review study progress, ascertain tall milestones are met, discuss problems, develop solutions, plan analysis, present & publish study results	Meeting minutes and action items

7. Gantt Chart, Work Breakdown Structure and Milestones

7.a. Gantt Chart & WBS

The responsible co-investigators, as well as the PI, are indicated in the Gantt chart with each specific WBS #. Gantt chart with Work Breakdown Structures are shown with initials of the Co-Investigators in the Gantt chart WBS are as follows

LS=Lena Sun (PI), MK= Michael Kuzniewicz (Kaiser site PI and co-investigator) CC=Cynthia Campbell and MH=Monique Hedderson (both co-investigators at Kaiser); SP=Samuel Pimentel (Lead statistician and co-investigator at Berkeley); SC=Sandra Comer (Co-investigator at Columbia); CS=Cynthia Salorio (consultant)

WBS #	TASKS	Responsible investigator(s)	Year 1				Year 2				Year 3				Year 4			
			2023	2024			2025				2026				2027			
			Sept-Dec	Jan-Mar	Apr-Jun	Jul-Sept	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sept	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sept	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Aug
1	**Prepare and planning of study**																	
1.1	Create birth cohort	LS, MK, CC, MH																
1.2	Query dataset for maternal exposures	LS, MK, CC, MH																
1.3	Query pharmacy records for maternal exposures	LS, MK, CC, MH																
1.4	Query dataset for postnatal management	LS, MK, CC, MH																
1.5	Obtain IEP and other developmental data	MK, CC, MH,CS																
1.6	Create study cohorts	LS, MK, CC, MH																
2	**Test and finalize plans for match analysis**																	
2.1	Generate and test match models	LS, MK, SP																
2.2	Select match model to use for analysis	LS, MK, SP																
3	**Data analyses of all study aims**																	
3.1.1	Analysis Aim 1A:All Non-Pharm vs All Rx	LS, MK, SP																
3.1.2	Analysis Aim 1A: ESC vs Pre-ESC Rx	LS, MK, SP																
3.1.3	Analysis Aim 1A: ESC vs Post-ESC Rx	LS, MK, SP																
3.2.1	Analysis Aim 1B: Pilot prospective study: Recruit/enroll	LS, MK, SP,CS																
3.2.2	Analysis Aim 1B: Pilot prospective study: Testing	LS, MK, SP,CS																
3.3.1	Analysis Aim 2A: Sources, dosess in NOWS cohort	LS, MK, SC, SP																
3.3.2	Analysis Aim 2A: Co-exposures in NOWS cohort	LS, MK, SC, SP																
3.3.3	Analysis Aim 2A: Create MME cohort	LS, MK, SC, SP																
3.4.1	Analysis Aim 2B: Outcomes in high MME cohort	LS, MK, SP																
3.4.2	Analysis Aim 2B: MME doses as modifier of management	LS, MK, SP																
3.5.1	Analysis Aim 3A: Durations & Create sustained exposure cohort	LS, MK, SP																
3.5.2	Analysis Aim 3A: Timing & Create timing of exposure cohorts	LS, MK, SP																
3.5.3	Analysis Aim 3A: Outcomes in sustained exposure cohort	LS, MK, SP																
3.5.4	Analysis Aim 3A: Outcomes in timing of exposure cohorts	LS, MK, SP																
3.6.1	Analysis Aim 3B: Durations as modifier of management	LS, MK, SP																
3.6.2	Analysis Aim 3B: Timing as modifier of management	LS, MK, SP																
4	**Dissemination of study results**																	
4.1	Presentation of results at meetings	LS, MK, SP, CC, MH,SC,CS																
4.2	Preparation of manuscripts to submit for publication	LS, MK, SP, CC, MH,SC,CS																
5	**Project monitoring & study team communications**																	
5.1	Monthly research team phone conferences	LS, MK, SP, CC, MH,SC,CS																
5.2	Monthly progress reports	LS																
5.3	In-Person Investigators meetings	LS, MK, SP, CC, MH,SC,CS																

7.b. Assigned WBS # for Subcontracting Site Research Personnel

WBS	KPNC					Berkeley
	Michael Kuzniewicz	Cynthia Campbell	Monique Hedderson	Dana Edelman	Sheiran Li	Samuel Pimentel
	Site PI	Co-investigator	Co-investigator	Program manager	Data Analyst	Site PI; Lead statstician
1.1	X	X	X	X	X	X
1.2	X	X	X	X	X	X
1.3	X	X	X	X	X	X
1.4	X	X	X	X	X	X
1.5	X	X	X	X	X	X
1.6	X	X	X	X	X	X
2.1	X					X
2.2	X					X

WBS	Michael Kuzniewicz	Cynthia Campbell	Monique Hedderson	Dana Edelman	Sheiran Li	Samuel Pimentel
3.1.1	X				X	X
3.1.2	X				X	X
3.1.3	X				X	X
3.2.1	X				X	X
3.2.2	X				X	X
3.3.1	X				X	X
3.3.2	X				X	X
3.3.3	X				X	X
3.4.1	X				X	X
3.4.2	X				X	X
3.5.1	X				X	X
3.5.2	X				X	X
3.5.3	X				X	X
3.5.4	X				X	X
3.6.1	X				X	X
3.6.2	X				X	X
4.1	X	X	X	X	X	X
4.2	X	X	X	X	X	X
5.1	X	X	X	X	X	X
5.2	X					X
5.3	X	X	X	X	X	X

7.c. Timeline and Milestones

Date of Completion	Milestones
6/30/2024	Complete query EHR and pharmacy record for exposures
3/31/2025	Obtain other developmental metrics Complete creation of study cohorts
9/30/2025	Finalize plans for matched analysis
12/31/2026	Complete analysis of Aim 2A Create exposure cohorts based on durations and timing
3/31/2027	Complete analysis of Aim 1A Complete analysis of Aim 2B Outcomes in exposure cohorts based on durations & timing Complete analysis of Durations as a modifier Complete analysis of Timing as a modifier
6/30/3027	Complete prospective pilot
8/31/2027	Complete project

8. DELIVERABLE SCHEDULE

8.a. Deliverable Schedule by Year

Year 1	• Finalize NOWS cohort from birth cohort (1.1) • Complete queries re maternal exposures & postnatal management (1.2, 1.3, 1.4) • Monthly team phone conference (5.1) • Monthly progress report submission to FDA (5.2) • ***Two*** In-person Investigators meetings (5.3)
Year 2	• Obtain IEP & other data re ND from non-Kaiser sources (1.5) • Finalize study cohorts based on management approaches (1.6) • Finalize match model for analysis (2.1, 2.2) • Assemble prospective cohort (3.2.1) • Presentation of results (4.1) • Monthly team phone conference (5.1) • Monthly progress report submission to FDA (5.2) • ***One*** in-person investigators meeting (5.3)
Year 3	• Characterize sources of prenatal opioid exposures (3.3.1) • Determine MME doses of prescription prenatal opioid exposure (3.3.1) • Characterize gestational timing, durations of exposures (3.4.1, 3.4.2) • Characterize co-exposures of other substances (3.3.2) • Complete data collection for prospective ND outcomes assessment (3.2.2) • Presentation of results (4.1) • Prepare manuscript (4.2) • Monthly team phone conference (5.1) • Monthly progress report submission to FDA (5.2) • ***One*** In-person investigators meeting (5.3)
Year 4	• Finalize high MME dose cohort (3.4.1) • Finalize exposure cohorts by durations & timing (3.5.1, 3.5.2) • Complete analysis of in-hospital outcomes in all study cohorts (3.1.1, 3.1.2, 3.1.3, 3.4.1, 3.5.3, 3.5.4) • Complete analysis of ND outcomes in all study cohorts (3.1.1, 3.1.2, 3.1.3, 3.4.13.5.3, 3.5.4) • Complete subgroup analysis of timing and duration of exposures as modifiers of outcomes (3.6.1, 3.6.2) • Presentation of study results (4.1) • Prepare and submit manuscripts (4.2) • Monthly team phone conference 5.1) • Monthly progress report submission to FDA (5.2) • ***Two*** In-person investigators meetings (5.3)

8.b. Detailed Deliverable Schedule with Timeline and Due Dates

Task 1: Project Planning and Preparation

Subtasks		*Timeline*	*Due Date*	*Deliverables*
1.1	**Create NOWS cohort from birth cohort**	9/2023-3/2024	3/31/2024	NOWS cohort created from birth cohort 2010-2023.
1.2	**Query dataset for maternal exposures**	9/2023-6/2024	6/30/2024	Sources of maternal opioid exposure established
1.3	**Query pharmacy records for maternal exposures**	9/2023-6/2024	6/30/2024	Maternal opioid exposure re: timing during pregnancy, durations, types of opioids and doses established. Milligrams morphine equivalent doses of prescription opioids during pregnancy calculated.
1.4	**Query dataset for postnatal management**	9/2023-6/2024	6/30/2024	Postnatal management by non-pharmacologic or opioids replacement treatment confirmed.
1.5	**Obtain IEP and other developmental data**	9/2023-3/2025	3/31/2025	All referrals for evaluations of hearing, autism, speech identified. All referrals for occupational, physical and speech therapy identified. Data re IEP referral retrieved
1.6	**Create study cohorts**	4/2024-3/2025	3/31/2025	Four different study cohorts from the NOWS cohort are created: Pre-ESC, ESC, Pre-ESC Rx and Post-ESC Rx

Task 2: Testing and Selecting Models for Analysis

Subtasks		*Timeline*	*Due Date*	*Deliverables*
2.1	**Generate and test match models**	7/2024-6/2025	6/30/2025	Generate and test different models for the matched analysis. Findings from the testing are summarized, with strengths and weaknesses of the different models identified.
2.2	**Select match model to use for analysis**	1/2025-9/2025	9/30/2025	Select final model used for match analysis

Task 3: Data Analysis of All Study Aims

Subtasks		*Timeline*	*Due Date*	*Deliverables*
3.1	**Analysis Aim 1A**			
3.1.1	Analysis Aim 1A All Non-Pharm vs All Rx	4/2025-3/2027	3/31/2027	Analysis in the NOWS cohort, derived from the entire birth cohort from 2010-2023. Completed analysis with results that either show no differences or a difference in outcomes between non-pharmacological management compared to opioids replacement pharmacotherapy.
3.1.2	Analysis Aim 1A ESC vs Pre-ESC Rx	4/2025-3/2027	3/31/2027	Analysis that compares the in-hosp outcomes and ND outcomes between ESC-managed and opioids replacement treated infants with NOWS before 2016.
3.1.3	Analysis Aim 1A ESC vs Post-ESC Rx	4/2025-3/2027	3/31/2027	Analysis that compares the in-hosp outcomes and ND outcomes between ESC-managed and opioids replacement treated.
3.2	**Analysis Aim 1B**			
3.2.1	Analysis Aim 1B Pilot prospective study: Recruit/enroll	10/2024-6/2027	6/30/2027	Contact children from each of the four cohorts: Pre-ESC, ESC, Pre-ESC Rx and Post-ESC to discuss study, and recruit study participants, and consent parents
3.2.2	Analysis Aim 1B Pilot prospective study II	10/2024-6/2027	6/30/2027	Administer testing and home environment questionnaire. Draft data collection form
3.3	**Analysis Aim 2A**			
3.3.1	Analysis Aim 2A Sources, doses in NOWS cohorts	4/2025-12/2026	12/31/2026	Determine the sources of opioid exposure in the entire NOWS cohort, and the four study cohorts
3.3.2	Analysis Aim 2A Co-exposures in NOWS cohorts	7/2025-12/2026	12/31/2026	Characterize co-exposures in the NOWS cohort, the four study cohorts. Query EHR to identify DSM-5 diagnoses of mothers of NOWS cohort and

				the high MME cohort. Characterize prescription SSRI and psychoactive medications in the NOWS cohort and high MME cohort.
3.3.3	Analysis Aim 2A: Create MME cohort	7/2025-12/2026	12/31/2026	In the group with prenatal prescription opioids, review of pharmacy records to determine doses (in MME): total cumulative, range, mean, median. The top quartile MME is denoted as the high MME cohort. Characterize co-exposures in the high MME cohort. Analysis of co exposure of prescription psychoactive medications in the high MME group.
3.4	**Analysis Aim 2B**			
3.4.1	Analysis Aim 2B: Outcomes in high MME cohort	7/2025-12/2026	12/31/2026	Compare In-hospital and ND outcomes between high MME group with the remaining MME group.
3.4.2	Analysis Aim 2B: MME doses as a modifier of management	7/2025-3/2027	3/31/2027	Subgroup analysis within the high MME and remaining MME groups comparing between different management approaches (All non-pharm vs All Rx)
3.5	**Analysis Aim 3A**			
3.5.1	Analysis Aim 3A Durations & Create sustained exposure cohort	7/2024-12/2026	12/31/2026	Determine the durations of exposures (in weeks) in the NOWS cohort. Determine the distribution of exposure durations based on number of four-week periods in the NOWS cohort and the study cohorts Denote sustained exposure cohort: ≥ 2 four week periods. All others are non-sustained exposure cohort.

3.5.2	Analysis Aim 3A Timing & Create exposure cohort based on timing of gestational exposure	7/2024-12/2026	12/31/2026	Examine the timing of exposures based on the trimester(s) of exposure. Define distribution of gestational exposure in all cohorts. Designate infants with NOWS having exposure during the third trimester as the late gestational exposure cohort. Those had exposure that began during 1st and/or 2nd trimesters as the early gestational exposure cohort
3.5.3	Analysis Aim 3A Outcomes in sustained exposure cohort	7/2024-3/2027	3/31/2027	Compare In-hospital and ND outcomes between sustained and non-sustained cohorts
3.5.4	Analysis Aim 3A Outcomes in exposure cohorts based on timing	7/2024-3/2027	3/31/2027	Compare In-hospital and ND outcomes between late gestational and early gestational exposure cohorts,
3.6	**Analysis Aim 3B**			
3.6.1	Analysis 3B Durations as a modifier of management (sustained cohort)	7/2024-3/2027	3/31/2027	Subgroup analysis within the sustained and non-sustained cohorts and compare between different management approaches (All non-pharm vs All Rx)
3.6.2	Analysis 3B Timing as a modifier of management	7/2024-3/2027	3/31/2027	Subgroup analysis within the late gestational exposure and early gestational exposure cohorts and compare between different management approaches: (All non-pharm vs All Rx)

Task 4: Dissemination of Study Results

Subtasks		*Timeline*	*Due Date*	*Deliverables*
4.1	**Presentation of results at meetings**	4/2025-8/2027	8/31/2027	Abstracts to report result of research are submitted for presentations of at national meetings of professional societies or academic medicine.
4.2	**Preparation of**	7/2025-	8/31/2027	Manuscripts are drafted and

	manuscripts for publication	8/2027		submitted for publication in peer reviewed journals

Task 5: Study Team Communication and Project Monitoring

Subtasks		*Timeline*	*Due Date*	*Deliverables*
5.1	**Monthly research team phone conferences**	9/2023-8/2027	Monthly	Virtual monthly meetings are held with participation of the entire research team are held each month to discuss research findings.
5.2	**Monthly progress reports**	Monthly 9/2023-8/2027	By 15th of each month	Study progress, challenges, and budget expenditures are summarized and submitted to FDA.
5.3	**In-Person Investigators meetings**			
5.3.1	First In-Person Investigators meetings	9/2023-12/2023	12/31/2023	Review study progress, ascertain tall milestones are met, discuss problems, develop solutions, plan analysis, present & publish study results
5.3.2	Second In-Person Investigators meetings	7/2024-9/2024	9/2024	Review study progress, ascertain tall milestones are met, discuss problems, develop solutions, plan analysis, present & publish study results
5.3.3	Third In-Person Investigators meetings	4/2025-6/2025	6/2025	Review study progress, ascertain tall milestones are met, discuss problems, develop solutions, plan analysis, present & publish study results
5.3.4	Fourth In-Person Investigators meetings	1/2026-3/2026	3/2026	Review study progress, ascertain tall milestones are met, discuss problems, develop solutions, plan analysis, present & publish study results

5.3.5	Fifth In-Person Investigators meetings	10/2026-12/2026	12/2026	Review study progress, ascertain tall milestones are met, discuss problems, develop solutions, plan analysis, present & publish study results
5.3.6	Sixth and Final In-Person Investigators meetings	7/2027-8/2027	8/2027	Review study progress, ascertain tall milestones are met, discuss problems, develop solutions, plan analysis, present & publish study results

9. SECURITY PLANNING

Data abstracted and datasets compiled for the for the study will reside on Kaiser Permanente Division of Research Severs in folders only accessible to the study team and on a secure, password-protected KP server behind a firewall at the Division of Research. Only PHI relevant to the study will be extracted. Study identification numbers will be assigned so that medical record numbers can be stripped from the dataset whenever feasible. PHI will only be utilized for purposes of data cleaning and auditing. De-identification will take place once all linkages are performed and data is validated and cleaned. Identifiers will be removed from datasets during the de-identification process. Data will be de-identified as soon as it is feasible. All analyses will occur within the KPNC firewall following standard procedures in place at the Division of Research. Summary data of results will be shared with team members outside of Kaiser Permanente, but all raw data will reside on the KP servers. Sam Pimentel PhD (UC Berkeley) will be granted authorization to access the study when physically at the DOR to direct the analytic plan. No data will be removed from KP DOR servers.

For the prospective pilot study, research team members at Kaiser will identify potential study participants, then contact each potential study participant to discuss the study, assess eligibility, recruit, consent and enroll. For each study participant, assessment will be performed either on site at one of the Kaiser facilities or virtually or by phone. All study related data from EHR and the results will be deidentfied, and entered into a data collection form for further analyses.

The performance site at Columbia University is PH5-544, which has card-key restricted access. De-identified data and summary results from analysis of the study and all other study-related information will be additionally encrypted before saved on desktop computers or mobile devices. All desktops, laptop computers and mobile devices will be password protected.

10. INTELLECTUAL PROPERTY

No issued patents or published patent applications will be used in the performance of the contract. The Offeror's research team at Columbia University and Kaiser Permanente Northern California will have intellectual ownership of the work product derived from the proposed contract. The final ownership will be negotiated between the two entities.

11. BIOGRAPHICAL SKETCHES

Lena S. Sun, MD. Role: PI

Over the past decade, Dr. Sun's research has focused on neurodevelopmental outcome studies in children who had early childhood exposure to anesthesia. As the leader and PI of the Pediatric Anesthesia NeuroDevelopment Assessment (PANDA) project, she worked closely with an interdisciplinary team to examine anesthesia and neurodevelopment in children. Her clinical background as a pediatrician, an anesthesiologist, her research background related to prenatal exposure to cocaine and neurodevelopmental outcome as well as her track record to lead an interdisciplinary research team will importantly contribute to the knowledge and skills needed to successfully complete the proposed study.

Sandra Comer, PhD. Role: Co-investigator

Dr. Sandra Comer is a Professor of Neurobiology (in Psychiatry) at Columbia University Medical Center (CUMC), a Research Scientist at the Research Foundation for Mental Hygiene, Inc. (RFMH) and at the New York State Psychiatric Institute (NYSPI). She has been performing substance abuse research with opioids. Dr. Comer has worked on projects designed to examine the relative abuse liabilities of opioid medications, including an existing study that was funded recently by the FDA. Dr. Comer has a broad background in substance abuse medications development research using a variety of drug self-administration paradigms in both laboratory animals and humans, with specific expertise in opioid use disorders (OUD). Over the past 25 years, she has been a PI or Co-PI on several human laboratory proof-of-concept trials of new medications. Of relevance to the proposed project are studies that she has completed using models of opioid withdrawal in human research volunteers.

Michael Kuzniewicz, MD. MPH. Role: Site PI at Kaiser

Dr. Michael Kuzniewicz is the director of the Perinatal Research Unit at Kaiser Permanente Northern California, where each year >40,000 births/year are followed for short- and long-term outcomes in neonates (such as cerebral palsy and autism spectrum disorders), going back as far as 1995. He has utilized the data from the Kaiser Permanente database and has significant experience on how to acquire data from Kaiser Permanente's integrated electronic databases. He has been responsible for overseeing the maintenance and updating of data collection efforts as the director of the Perinatal Research Unit. Thus, he is uniquely positioned to facilitate the

acquisition of the necessary data elements for this project. As a practicing neonatologist, Dr. Kuzniewicz brings the clinical perspective in thinking about the clinical risk factors in the neonatal period that may confound the outcomes that will be studied in this proposal

Cynthia Campbell, PhD. Role: Co-investigator

Dr. Cynthia Campbell is a senior research scientist at the Division of Research, Kaiser Permanente Northern California. She has been conducting research related to substance use and comorbidity for 20 years, using pragmatic trials, patient surveys, and electronic health record data. Her work has focused largely on prescription opioid use and misuse and co-occurring psychiatric and medical conditions. She has studied longitudinal trends of substance use and the impact of health policy on access to substance use treatment, including for women with substance use disorder and the impact of cannabis use on obstetric and child developmental outcomes. She is the Contact PI (MPI Bradley) of the Health Systems Node of the NIDA Clinical Trials Network (CTN); the node focuses on integrating care for addiction into medical settings and conducting research as embedded researchers in learning health care systems. She has collaborated successfully with the research team in previous studies examining opioid use in pregnant women, and this important research builds on that work. She will contribute to successful execution of the proposed study aims.

Monique Hedderson, PhD, Role: Co-investigator

Dr. Monique Hedderson is senior research scientist and an epidemiologist at the Division of Research, Kaiser Permanente Northern California. Her research portfolio investigates the influence of preconception, prenatal and early childhood exposures on maternal and child health. She is a well-established addiction researcher. Her work includes developing methods to quantify maternal opioids use. As a member of the research team, she will contribute her wide- ranging content expertise in this area. In addition, she will bring her extensive experience in the use of the KPNC database specifically related to examining maternal opioids and other substances use in the proposed study.

Samuel Pimentel, PhD. Role: Site PI at UC Berkeley

Dr. Samuel Pimentel, an assistant professor at UC Berkley. His research focuses on developing and applying statistical methods for estimating causal effects in observational datasets, including administrative records and large electronic health databases. He is the Principal Investigator for NSF CAREER award #2142146, which supports his work on modernizing matching and weighting methods for large administrative datasets. His work has been published in leading statistical journals such as the *Journal of the American Statistical Association*, *Biometrika*, and *The Annals of Applied Statistics*. His software packages for matching in R, rcbalance and matchMulti, are widely used in practice. He has extensive experience collaborating with diverse teams of clinical and policy researchers on problems in health services

research. He will lead in the design, analysis, and reporting of matched comparisons and effect estimates, and supervise and direct the graduate student supported by the grant in their implementation of these comparisons and be a co-author articles for publication in peer-reviewed journals.

Cynthia Salorio, PhD. Role: Consultant

Dr. Cynthia Salorio, Associate Professor of Physical Medicine and Rehabilitation at Johns Hopkins School of Medicine and Co-Director, Department of Neuropsychology at Kennedy Krieger Institute. She substantial clinical and research experience, in neurodevelopmental outcomes after early brain insult in children. She has been the neuropsychology expert who oversaw the outcomes measurement and study design for several multicenter studies, including examining developmental outcomes in children with early anesthesia exposure (PANDA) and children who have undergone extracorporeal membrane oxygenation (ECMO/BEAM). Dr. Salorio will serve as a consultant and recommend the assessment instruments for the prospective study and assist in the interpretation of the results from the assessments.

12. LIST OF THE LAST 3 RELATED CONTRACTS DURING THE PAST 3 YEARS

Name of Contracting Organization: Food and Drug Administration
Contract Number: 75F40120D00039
Contract Type: Fixed Price Contract
Total Contract Value: $4,375,540
Description of Requirement: OHDSI-based FDA BEST Community Engagement and Development Coordination Center
Contracting Officer's Name and Telephone Number: Nick Sartain; (870) 543-7370
Program Manager's Name and Telephone Number: N/A
NAICS Code: 611310

Name of Contracting Organization: Duke University Medical Center (via Food and Drug Administration)
Contract Number: DUMC A034238 (FDA contract # 75F40120C00179)
Contract Type: Cost Reimbursement Contract
Total Contract Value: $50,000
Description of Requirement: QUANTIFYING PATIENTS' BENEFIT-RISK TRADEOFFS ASSOCIATED WITH PERCUTANEOUS REVASCULARIZATION OPTIONS FOR PERIPHERAL ARTERIAL DISEASE: A COLLABORATIVE EFFORT WITH THE RAPID PATHWAYS PATIENT SCIENCE WORKING GROUP
Contracting Officer's Name and Telephone Number: Thushi Amini; Thushi.Amini@fda.hhs.gov
Program Manager's Name and Telephone Number: N/A
NAICS Code: 611310

Name of Contracting Organization: University of St. Gellen (via Food and Drug Administration)
Contract Number: USG 11-21 (FDA contract # 75F40121C00161)
Contract Type: Cost Reimbursement Contract
Total Contract Value: $148,659
Description of Requirement: RiskSurve-Towards a holistic riskbased Site Surveillance An approach for remote, data-based site risk identification and inspection preparation in a (post-) Covid Environment
Contracting Officer’s Name and Telephone Number: Kimberly DeLong; Kimberly.Delong@fda.hhs.gov
Program Manager’s Name and Telephone Number: N/A
NAICS Code: 611310

EXHIBIT E

AWARD/CONTRACT

1. THIS CONTRACT IS A RATED ORDER UNDER DPAS (15 CFR 700)

RATING

PAGE OF PAGES: 1 | 32

2. CONTRACT *(Proc. Inst. Ident.)* NO.: 75F40123C00211

3. EFFECTIVE DATE: See Block 20C

4. REQUISITION/PURCHASE REQUEST/PROJECT NO.: 1269284

5. ISSUED BY — CODE: DAO

DHHS/FDA/OAGS/DAO
ATTN: Matthew Tran
4041 Powder Mill Road
Beltsville MD 20705

6. ADMINISTERED BY *(If other than Item 5)* — CODE:

SCD-C

7. NAME AND ADDRESS OF CONTRACTOR *(No., street, country, State and ZIP Code)*

TRUSTEES OF COLUMBIA UNIVERSITY IN THE CITY OF NEW YORK
Attn: OLGA CARR
722 W 168TH STREET
4TH FLOOR
NEW YORK NY 100323702

CODE 135598093 FACILITY CODE

8. DELIVERY
☐ FOB ORIGIN ☒ OTHER *(See below)*

9. DISCOUNT FOR PROMPT PAYMENT
HHS NET 30P

10. SUBMIT INVOICES (4 copies unless otherwise specified) TO THE ADDRESS SHOWN IN — ITEM

11. SHIP TO/MARK FOR — CODE: WO66

WHITE OAK CAMPUS, BUILDING 66
The US Food and Drug Administration
10903 New Hampshire Avenue
Building 66
Silver Spring MD 20993

12. PAYMENT WILL BE MADE BY — CODE: FDA PAYMENT SVCS

FDA PAYMENT SVCS
Attn: FDA Vendor payment Team
COLE RM8050
8455 Colesville Road
Silver Spring MD 20993

13. AUTHORITY FOR USING OTHER THAN FULL AND OPEN COMPETITION:
☐ 10 U.S.C. 2304 (c) ( ) ☐ 41 U.S.C. 3304 (a) ( )

14. ACCOUNTING AND APPROPRIATION DATA
2023.699R1FQ.25235.C23X2210OCDX545000000

15A. ITEM NO	15B. SUPPLIES/SERVICES	15C. QUANTITY	15D. UNIT	15E. UNIT PRICE	15F. AMOUNT
	Continued				

15G. TOTAL AMOUNT OF CONTRACT: $437,576.00

16. TABLE OF CONTENTS

(X)	SEC.	DESCRIPTION	PAGE(S)	(X)	SEC.	DESCRIPTION	PAGE(S)
		PART I - THE SCHEDULE				PART II - CONTRACT CLAUSES	
X	A	SOLICITATION/CONTRACT FORM	1-2	X	I	CONTRACT CLAUSES	25-29
X	B	SUPPLIES OR SERVICES AND PRICES/COSTS	3			PART III - LIST OF DOCUMENTS, EXHIBITS AND OTHER ATTACH.	
X	C	DESCRIPTION/SPECS./WORK STATEMENT	3	X	J	LIST OF ATTACHMENTS	30
X	D	PACKAGING AND MARKING	3			PART IV - REPRESENTATIONS AND INSTRUCTIONS	
X	E	INSPECTION AND ACCEPTANCE	4		K	REPRESENTATIONS, CERTIFICATIONS AND OTHER STATEMENTS OF OFFERORS	
X	F	DELIVERIES OR PERFORMANCE	4-8				
X	G	CONTRACT ADMINISTRATION DATA	9-16		L	INSTRS., CONDS., AND NOTICES TO OFFERORS	
X	H	SPECIAL CONTRACT REQUIREMENTS	16-24		M	EVALUATION FACTORS FOR AWARD	

CONTRACTING OFFICER WILL COMPLETE ITEM 17 (SEALED-BID OR NEGOTIATED PROCUREMENT) OR 18 (SEALED-BID PROCUREMENT) AS APPLICABLE

17. ☒ CONTRACTOR' S NEGOTIATED AGREEMENT (*Contractor is required to sign this document and return* 1 *copies to issuing office.*) Contractor agrees to furnish and deliver all items or perform all the services set forth or otherwise identified above and on any continuation sheets for the consideration stated herein. The rights and obligations of the parties to this contract shall be subject to and governed by the following documents: (a) this award/contract, (b) the solicitation, if any, and (c) such provisions, representations, certifications, and specifications, as are attached or incorporated by reference herein. *(Attachments are listed herein.)*

18. ☐ SEALED-BID AWARD (*Contractor is not required to sign this document.*) Your bid on Solicitation Number _____, including the additions or changes made by you which additions or changes are set forth in full above, is hereby accepted as to the items listed above and on any continuation sheets. This award consummates the contract which consists of the following documents: (a) the Government's solicitation and your bid, and (b) this award/contract. No further contractual document is necessary. (Block 18 should be checked only when awarding a sealed-bid contract.)

19A. NAME AND TITLE OF SIGNER *(Type or print)*
Madhavi Nambiar

20A. NAME OF CONTRACTING OFFICER
IAN S. WEISS

19B. NAME OF CONTRACTOR
TRUSTEES OF COLUMBIA UNIVERSITY IN THE CITY OF NEW
BY _____
(Signature of person authorized to sign)

19C. DATE SIGNED: 9/28/2023

20B. UNITED STATES OF AMERICA
BY _____
(Signature

20C. DATE SIGNED
Digitally signed by Ian S. Weiss -S
Date: 2023.09.28 10:59:56 -04'00'

AUTHORIZED FOR LOCAL REPRODUCTION
Previous edition is NOT usable

STANDARD FORM 26 (Rev. 3/2013)
Prescribed by GSA - FAR (48 CFR) 53.214(a)

NAME OF OFFEROR OR CONTRACTOR

TRUSTEES OF COLUMBIA UNIVERSITY IN THE CITY OF NEW YORK

ITEM NO. (A)	SUPPLIES/SERVICES (B)	QUANTITY (C)	UNIT (D)	UNIT PRICE (E)	AMOUNT (F)
	Tax ID Number: 13-5598093 UEI: QHF5ZZ114M72 BAA FY23C3DWP3 - Health and Neurodevelopmental Outcomes in Infants at Risk for (NOWS) Effects of timing and Duration of (POE) and Postnatal Management with (ESC) Delivery: 09/29/2024 Appr. Yr.: 2023 CAN: 699R1FQ Object Class: 25235 CenterTag: C23X2210OCDX545000000 Period of Performance: 09/30/2023 to 09/29/2027				
1	BAA - Health and Neurodevelopmental Outcomes in Infants at Risk for (NOWS) Effects of timing and Duration of (POE) and Postnatal Management with (ESC) - Base Year Obligated Amount: $437,576.00				437,576.00
2	BAA - Health and Neurodevelopmental Outcomes in Infants at Risk for (NOWS) Effects of timing and Duration of (POE) and Postnatal Management with (ESC) - Option Year One Amount: $423,419.00(Option Line Item)				0.00
3	BAA - Health and Neurodevelopmental Outcomes in Infants at Risk for (NOWS) Effects of timing and Duration of (POE) and Postnatal Management with (ESC) - Option Year Two Amount: $426,448.00(Option Line Item)				0.00
4	BAA - Health and Neurodevelopmental Outcomes in Infants at Risk for (NOWS) Effects of timing and Duration of (POE) and Postnatal Management with (ESC) - Option Year Three Amount: $434,408.00(Option Line Item)				0.00
	The total amount of award: $1,721,851.00. The obligation for this award is shown in box 15G.				

PART I

SECTION B - SUPPLIES OR SERVICES AND PRICES/COSTS

The Contractor shall furnish all facilities, materials, and personnel and shall perform all services necessary to conduct a study entitled, *"Health and Neurodevelopmental Outcomes in Infants at Risk for Neonatal Opioid Withdrawal Syndromes (NOWS): Effects of Timing and Duration of Prenatal Opioid Exposure (POE) & Postnatal Management with Eat-Sleep-Console (ESC)."*

Contract Period	Line Item	Price
30 September 2023 to 29 September 2024	BAA - Health and Neurodevelopmental Outcomes in Infants at Risk for (NOWS) Effects of timing and Duration of (POE) and Postnatal Management with (ESC) - Base Year	$437,576.00
30 September 2024 to 29 September 2025	BAA - Health and Neurodevelopmental Outcomes in Infants at Risk for (NOWS) Effects of timing and Duration of (POE) and Postnatal Management with (ESC) - Option Year One	$423,419.00
30 September 2025 to 29 September 2026	BAA - Health and Neurodevelopmental Outcomes in Infants at Risk for (NOWS) Effects of timing and Duration of (POE) and Postnatal Management with (ESC) - Option Year Two	$426,448.00
30 September 2026 to 29 September 2027	BAA - Health and Neurodevelopmental Outcomes in Infants at Risk for (NOWS) Effects of timing and Duration of (POE) and Postnatal Management with (ESC) - Option Year Three	$434,408.00
Total Estimated Amount		**$1,721,851.00**

Contract Type: Cost Reimbursement (CR)

SECTION C - DESCRIPTION/SPECIFICATIONS/STATEMENT OF WORK

See Attachment A for the Statement of Work

SECTION D - PACKAGING AND MARKING

All deliverables required under this contract shall be packaged, marked and shipped in accordance with the Government specifications below. At a minimum, all deliverables shall be marked with the contract number and contractor name.

1. The Contractor shall guarantee that all required materials shall be delivered in immediate usable and acceptable condition.
2. The Contractor shall scan all deliverables for viruses before submitting to the FDA.
3. Deliverables under this contract shall be prepared and packaged for shipment using best commercial practices to ensure safe and timely delivery.

SECTION E - INSPECTION AND ACCEPTANCE

All work hereunder shall be subject to review by the Government. Acceptance of the final deliverables shall be made in writing by the Contracting Officer.

52.252-2 CLAUSES INCORPORATED BY REFERENCE (FEB 1998)

This contract incorporates one or more clauses by reference, with the same force and effect as if they were given in full text. Upon request, the Contracting Officer (CO) will make their full text available. Also, the full text of a clause may be accessed electronically at this address: https://www.acquisition.gov/far/.

52.246-9 Inspection of Research and Development (Short Form) (APR 1984)

Note: "Acceptable" will be defined as the Contractor's good faith effort in performing the research plan, including the budget, and will not be subject to the Government's agreement with the views, findings, and opinions of the Contractor."

SECTION F - DELIVERIES OR PERFORMANCE

F.1 PERIOD OF PERFORMANCE

Total Period of Performance: 30 September 2023 to 29 September 2027
Base Year: 30 September 2023 to 29 September 2024
Option Year One: 30 September 2024 to 29 September 2025
Option Year Two: 30 September 2025 to 29 September 2026
Option Year Tree: 30 September 2026 to 29 September 2027

F.2 PLACE OF DELIVERY

52.247-34 F.O.B. DESTINATION (NOV 1991)
All deliverables with the exception of monthly progress reports shall be delivered F.O.B. Destination, under transmittal letter, to the COR at the following address:

Food and Drug Administration
10903 New Hampshire Ave
Silver Spring, MD 20993
Attention: Mary Johnson
E-mail: mary.johnson@fda.hhs.gov

F.3 DELIVERABLES

See Attachment 1, Statement of Work for deliverable schedule. In addition to the deliverables outlined herein and in the SOW, the Contractor shall submit a monthly progress report in accordance with paragraph G.5 below. All deliverables shall be sent to the COR. The final report shall be sent to the Contracting Officer and FDABAA@fda.hhs.gov. The following deliverables shall be submitted in accordance with the attached Statement of Work.

The contractor shall carry out the tasks and subtasks as outlined below, with the deliverables as indicated. For each subtasks, the deliverables are deemed acceptable with the specified assessments.

Tasks				
Task 1: Project Planning and Preparation				
	Subtasks		Deliverables	Assessment Deemed Acceptable if
	1.1	Create NOWS cohort from birth cohort	Based on inclusion and exclusion criteria, NOWS cohort created from birth cohort 2010-2023.	NOWS cohort created.
	1.2	Query dataset for maternal exposures	Sources of maternal opioid exposure established	All data or sources of opioid exposure for the study cohorts are completed, and accuracy confirmed with select samples chosen from EHR for review and validation.
	1.3	Query pharmacy records for maternal exposures	Maternal opioid exposure re: timing during pregnancy, durations, types of opioids and doses established. Milligrams morphine equivalent doses of prescription opioids during pregnancy calculated.	Prescription opioids doses data are abstracted, and conversion to MME completed.
	1.4	Query dataset for postnatal management	Postnatal management by non-pharmacologic or opioids replacement treatment confirmed	Study cohorts created based on postnatal management with non-pharmacological approach or by pharmacotherapy.
	1.5	Obtain IEP and other developmental data	All referrals for evaluations of hearing, autism, speech identified. All referrals for occupational, physical and speech therapy identified. IEP referral data obtained.	All data related to referral for evaluations or supportive therapy are complete.
	1.6	Create study cohorts	Four different study cohorts from the NOWS cohort are created based on management approaches and birth years: Pre-ESC, ESC, Pre-ESC Rx and Post-ESC Rx.	Creation of study cohort based on management approaches and birth years is complete.
Task 2: Testing and Selecting Models for Analysis				

	Subtasks		Deliverables	Assessment Deemed Acceptable if
	2.1	Generate and test match models	Generate and test different models for the matched analysis. Findings from the testing are summarized, with strengths and weaknesses of the different models identified.	Matching variables and models testing generate final list of variables and model for matching.
	2.2	Select match model to use for analysis	Select final model used for match analysis	Final model used for match analysis is selected
Task 3: Data Analysis of All Study Aims				
	Subtasks		Deliverables	Assessment Deemed Acceptable if
	3.1.1	Analysis Aim 1A All Non-Pharm vs All Rx	Analysis in the NOWS cohort, derived from the entire birth cohort from 2010-2023. Completed analysis with results that either show no differences or a difference in outcomes between non-pharmacological management compared to opioids replacement pharmacotherapy.	Analysis completed, and results regarding comparative outcomes between management approaches are found.
	3.1.2	Analysis Aim 1A ESC vs Pre-ESC Rx	Analysis that compares the in-hosp outcomes and ND outcomes between ESC-managed and opioids replacement treated infants with NOWS before 2016.	Analysis completed with findings reported.
	3.1.3	Analysis Aim 1A ESC vs Post-ESC Rx	Analysis that compares the in-hosp outcomes and ND outcomes between ESC-managed and opioids replacement treated.	Analysis completed with findings reported.
	3.2.1	Analysis Aim 1B Pilot prospective study I: Recruit/enroll	Contact children from each of the four cohorts: Pre-ESC, ESC, Pre-ESC Rx and Post-ESC to discuss study, and recruit study participants, and consent parents	Complete enrollment of 10 children from each of the four groups
	3.2.2	Analysis Aim 1B Pilot prospective study II.	Testing administered to the study participants. Draft data collection form.	Successfully complete testing in >80% of enrolled study participants.

	3.3.1	Analysis Aim 2A Sources, doses in NOWS cohorts	Determine the sources of opioid exposure in the entire NOWS cohort, and the four study cohorts.	Sources of exposure determined for all study cohorts. Analysis of doses in MME completed for prescription opioids exposed group. High MME cohort established and available for use in analysis.
	3.3.2	Analysis Aim 2 Co-exposures in NOWS cohorts	Characterize co-exposures in the NOWS cohort, the four study cohorts. Co-exposures include other substances (amphetamines, barbiturates, and illicit substances) and prescription psychoactive medications and SSRI	Co-exposures determined for all study cohorts. Co-exposures to prescription psychoactive medications determined,
	3.3.3	Analysis Aim 2: Create MME cohort	In the group with prenatal prescription opioids, review of pharmacy records to determine doses (in MME): total cumulative, range, mean, median. The top quartile MME is denoted as the high MME cohort. Characterize co-exposures in the high MME cohort. Analysis of co-exposure to prescription psychoactive medications in the high MME group.	High MME dose cohort created. Analysis of co-exposure to prescription psychoactive medications in high MME group completed
	3.4.1	Analysis Aim 3A Durations of exposures	Determine the durations of exposures (in weeks) in the NOWS cohort. Determine the distribution of exposure durations based on number of four-week periods in the NOWS cohort and the study cohorts	Durations of exposures determined for the NOWS cohort, including distribution for all study cohorts.
	3.4.1	Analysis Aim 3A Create sustained exposure cohort	Denote sustained exposure cohort: ≥ 2 four-week periods. All others are non-sustained exposure cohort.	Sustained exposure cohort created.
	3.4.2	Analysis Aim 3A Timing of exposures	Examine the timing of exposures based on the trimester(s) of exposure. Define distribution of gestational exposure in all cohorts.	Timing of exposure established and results available to be used for analysis.

	3.4.2	Analysis Aim 3A Create exposure cohorts based on timing	Designate infants with NOWS having exposure during the third trimester as the late gestational exposure cohort. Those with exposure that began in 1st and/or 2nd trimesters as the early gestational exposure cohort.	Exposure cohorts created based on timing of exposure.
	3.4.3	Analysis Aim 3A Outcomes in sustained cohort	Compare In-hospital and ND outcomes between sustained and non-sustained cohorts.	Analysis completed with findings confirmed and available to be reported.
	3.4.4	Analysis Aim 3A Outcomes in late cohort	Compare In-hospital and ND outcomes between exposure cohorts with different timings of exposure.	Analysis completed with findings confirmed and available to be reported.
	3.5.1	Analysis 3B Durations as a modifier of management (sustained cohort)	Subgroup analysis within the sustained and non-sustained cohorts and compare between different management approaches (All non-pharm vs All Rx)	Subgroup analysis completed with findings confirmed and available to be reported.
	3.5.2	Analysis 3B Timing as a modifier of management	Subgroup analysis within the exposure cohorts based on timing and compare between different management approaches: (All non-pharm vs All Rx)	Subgroup analysis completed with findings confirmed and available to be reported.
Task 4: : Dissemination of Study Results				
	Subtasks		Deliverables	Assessment Deemed Acceptable if
	4.1	Presentation of results at meetings	Abstracts to report result of research are submitted for presentations of at national meetings of professional societies or academic medicine.	Abstracts are accepted for presentation at national meetings
	4.2	Preparation of manuscripts for publication	Manuscripts are drafted and submitted for publication in peer reviewed journals	Findings are organized as manuscripts and ready for submission for publication in peer-reviewed journals.
Task 5: Project Monitoring and Team Communication				

	Subtasks		Deliverables	Assessment Deemed Acceptable if
	5.1	Monthly research team phone conferences	Virtual monthly meetings are held with participation of the entire research team to discuss research findings.	Agendas and minutes of each phone conference are maintained for documentation.
	5.2	Monthly progress reports	Study progress, challenges, and budget expenditures are summarized and submitted to FDA.	Monthly progress report of study and budget items are filed, and acknowledged
	5.3.1	First In-Person Investigators meetings	Review study progress, ensure all milestones are met, discuss problems, develop solutions, plan presentations	Meeting minutes and action items
	5.3.2	Second In-Person Investigators meetings	Review study progress, ascertain tall milestones are met, discuss problems, develop solutions, plan analysis, present & publish study results	Meeting minutes and action items
	5.3.3	Third In-Person Investigators meetings	Review study progress, ascertain tall milestones are met, discuss problems, develop solutions, plan analysis, present & publish study results	Meeting minutes and action items
	5.3.4	Fourth In-Person Investigators meetings	Review study progress, ascertain tall milestones are met, discuss problems, develop solutions, plan analysis, present & publish study results	Meeting minutes and action items
	5.3.5	Final In-Person Investigators meetings	Review study progress, ascertain tall milestones are met, discuss problems, develop solutions, plan analysis, present & publish study results	Meeting minutes and action items

WBS #	TASKS	Responsible investigator(s)	Year 1				Year 2				Year 3				Year 4			
			2023	2024			2025				2026				2027			
			Sept-Dec	Jan-Mar	Apr-Jun	Jul-Sept	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sept	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Sept	Oct-Dec	Jan-Mar	Apr-Jun	Jul-Aug
1	**Prepare and planning of study**																	
1.1	Create birth cohort	LS, MK, CC, MH																
1.2	Query dataset for maternal exposures	LS, MK, CC, MH																
1.3	Query pharmacy records for maternal exposures	LS, MK, CC, MH																
1.4	Query dataset for postnatal management	LS, MK, CC, MH																
1.5	Obtain IEP and other developmental data	MK, CC, MH,CS																
1.6	Create study cohorts	LS, MK, CC, MH																
2	**Test and finalize plans for match analysis**																	
2.1	Generate and test match models	LS, MK, SP																
2.2	Select match model to use for analysis	LS, MK, SP																
3	**Data analyses of all study aims**																	
3.1.1	Analysis Aim 1A:All Non-Pharm vs All Rx	LS, MK, SP																
3.1.2	Analysis Aim 1A: ESC vs Pre-ESC Rx	LS, MK, SP																
3.1.3	Analysis Aim 1A: ESC vs Post-ESC Rx	LS, MK, SP																
3.2.1	Analysis Aim 1B: Pilot prospective study: Recruit/enroll	LS, MK, SP,CS																
3.2.2	Analysis Aim 1B: Pilot prospective study: Testing	LS, MK, SP,CS																
3.3.1	Analysis Aim 2: Sources, dosess in NOWS cohort	LS, MK, SC, SP																
3.3.2	Analysis Aim 2: Co-exposures in NOWS cohort	LS, MK, SC, SP																
3.5.1	Analysis Aim 3A: Durations & Create sustained exposure cohort	LS, MK, SP																
3.5.2	Analysis Aim 3A: Timing & Create timing of exposure cohorts	LS, MK, SP																
3.5.3	Analysis Aim 3A: Outcomes in sustained exposure cohort	LS, MK, SP																
3.5.4	Analysis Aim 3A: Outcomes in timing of exposure cohorts	LS, MK, SP																
3.6.1	Analysis Aim 3B: Durations as modifier of management	LS, MK, SP																
3.6.2	Analysis Aim 3B: Timing as modifier of management	LS, MK, SP																
4	**Dissemination of study results**																	
4.1	Presentation of results at meetings	LS, MK, SP, CC, MH,SC,CS																
4.2	Preparation of manuscripts to submit for publication	LS, MK, SP, CC, MH,SC,CS																
5	**Project monitoring & study team communications**																	
5.1	Monthly research team phone conferences	LS, MK, SP, CC, MH,SC,CS																
5.2	Monthly progress reports	LS																
5.3	In-Person Investigators meetings	LS, MK, SP, CC, MH,SC,CS																

F.4 KICK-OFF MEETING

A kick-off meeting with Contractor and FDA representatives shall be held within one (1) month of the effective date of the contract. The kick-off meeting may be held in person, via teleconference, or via videoconference at the discretion of the COR.

F.5 52.242-15 STOP-WORK ORDER (AUG 1989) – ALTERNATE I (APR 1984)

SECTION G – CONTRACT ADMINISTRATION DATA

G.1 PAYMENT – COST REIMBURSEMENT

HHSAR 352.232-71, Electronic Submission of Payment Requests

(a) Definitions. As used in this clause-

Payment request means a bill, voucher, invoice, or request for contract financing payment with associated supporting documentation. The payment request must comply with the requirements identified in FAR 32.905(b), "Content of Invoices" and the applicable Payment clause included in this contract.

(b) Except as provided in paragraph (c) of this clause, the Contractor shall submit payment requests electronically using the Department of Treasury Invoice Processing Platform (IPP) or successor system. Information regarding IPP, including IPP Customer Support contact information, is available at www.ipp.gov or any successor site.

(c) The Contractor may submit payment requests using other than IPP only when the Contracting Officer authorizes alternate procedures in writing in accordance with HHS procedures.

(d) If alternate payment procedures are authorized, the Contractor shall include a copy of the Contracting Officer's written authorization with each payment request.

(END OF CLAUSE)

FDA Electronic Invoicing and Payment Requirements - Invoice Processing Platform (IPP) (Jan 2022)

a. All Invoice submissions for goods and or services must be made electronically through the U.S. Department of Treasury's Invoice Processing Platform System

(IPP). http://www.ipp.gov/vendors/index.htm

b. Invoice Submission for Payment means any request for contract financing payment or invoice payment by the Contractor. To constitute a proper invoice, the payment request must comply with the requirements identified in FAR 32.905(b), "Content of Invoices" and the applicable Payment clause included in this contract, or the clause 52.212-4

contract Terms and Conditions - Commercial Items included in commercial items contracts. The IPP website address is: https://www.ipp.gov

c.

1. The Agency will enroll the Contractors new to IPP. The Contractor must follow the IPP registration email instructions for enrollment to register the Collector Account for submitting invoice requests for payment. The Contractor Government Business Point of Contact (as listed in SAM) will receive Registration email from the Federal Reserve Bank of St. Louis (FRBSTL) within 3 - 5 business days of the contract award for new contracts or date of modification for existing contracts.
2. Registration emails are sent via email from ipp.noreply@mail.eroc.twai.gov. Contractor assistance with enrollment can be obtained by contacting the IPP Production Helpdesk via email to IPPCustomerSupport@fiscal.treasury.gov or phone (866) 973-3131.
3. The Contractor POC will receive two emails from **IPP Customer Support**, the first email contains the initial administrative IPP User ID. The second email, sent within 24 hours of receipt of the first email, contains a temporary password. You must log in with the temporary password within 30 days.
4. If your company is already registered to use IPP, you will not be required to re- register.
5. If the Contractor is unable to comply with the requirement to use IPP for submitting invoices for payment as authorized by HHSAR 332.7002, a written request must be submitted to the Contracting Officer to explain the circumstances that require the authorization of alternate payment procedures.

d. Invoices that include time and materials or labor hours Line Items must include supporting documentation to (1) substantiate the number of labor hours invoiced for each labor category, and (2) substantiate material costs incurred (when applicable).

e. Invoices that include cost-reimbursement Line Items must be submitted in a format showing expenditures for that month, as well as contract cumulative amounts. At a minimum the following cost information shall be included, in addition to supporting documentation to substantiate costs incurred.

- Direct Labor - include all persons, listing the person's name, title, number of hours worked, hourly rate, the total cost per person and a total amount for this category;
- Indirect Costs (i.e., Fringe Benefits, Overhead, General and Administrative, Other Indirects)- show rate, base and total amount;
- Consultants (if applicable) - include the name, number of days or hours worked, daily or hourly rate, and a total amount per consultant;
- Travel - include for each airplane or train trip taken the name of the traveler, date of travel, destination, the transportation costs including ground transportation shown separately and the per diem costs. Other travel costs shall also be listed;
- Subcontractors (if applicable) - include, for each subcontractor, the same data as required for the prime Contractor;
- Other Direct Costs - include a listing of all other direct charges to the contract, i.e., office supplies, telephone, duplication, postage; and
- Fee - amount as allowable in accordance with the Schedule and FAR 52.216-8 if applicable.

f. Contractor is required to attach an invoice log addendum to each invoice which shall include, at a minimum, the following information for contract administration and reconciliation purposes:

(a) list of all invoices submitted to date under the subject award, including the following:

(1) invoice number, amount, & date submitted

(2) corresponding payment amount & date received

(b) total amount of all payments received to date under the subject contract or order

(c) and, for definitized contracts or orders only, total estimated amounts yet to be invoiced for the current, active period of performance.

g. Payment of invoices will be made based upon acceptance by the Government of the entire task or the tangible product deliverable(s) invoiced. Payments shall be based on the Government certifying that satisfactory services were provided, and the Contractor has certified that labor charges are accurate.

h. If the services are rejected for failure to conform to the technical requirements of the task order, or any other contractually legitimate reason, the Contractor shall not be paid, or shall be paid an amount negotiated by the CO.

i. Payment to the Contractor will not be made for temporary work stoppage due to circumstances beyond the control of U.S. Food and Drug Administration such as acts of God, inclement weather, power outages, and results thereof, or temporary closings of facilities at which Contractor personnel are performing. This may, however, be justification for excusable delays.

j. The Contractor agrees that the submission of an invoice to the Government for payment is a certification that the services for which the Government is being billed, have been delivered in accordance with the hours shown on the invoices, and the services are of the quality required for timely and successful completion of the effort.

k. Questions regarding invoice payments that cannot be resolved by the IPP Helpdesk should be directed to the FDA Employee Resource and Information Center (ERIC) Helpdesk at 301-827-ERIC (3742) or toll-free 866-807-ERIC (3742); or, by email at ERIC@fda.hhs.gov. Refer to the Call-in menu options and follow the phone prompts to dial the option that corresponds to the service that's needed. All ERIC Service Now Tickets will either be responded to or resolved within 48 hours (2 business days) of being received. When emailing, please be sure to include the contract number, invoice number and date of invoice, as well as your name, phone number, and a detailed description of the issue.

G.2 TRAVEL AND PER DIEM

Travel and Per Diem authorized under this contract shall be reimbursed in accordance with the FAR 31.205-46 (Travel Costs). Per Diem rates shall not exceed the Government approved rates in effect (http://www.gsa.gov/portal/category/21287).

Travel requirements under this contract shall be met using the most economical form of transportation available. If economy class transportation is not available, the request for payment voucher must be submitted with justification for use of higher class travel indicating dates, times, and flight numbers. All travel shall be scheduled sufficiently in advance to take advantage of offered discount rates, unless otherwise directed by the Contracting Officer.

The COR must review and approve all travel requests prior to actual travel. Supporting receipts shall be provided when invoicing for travel.

G.3 CONTRACTING OFFICER (CO)

The Contracting Officer is the only person with authority to act as agent of the Government under this contract. Only the Contracting Officer has authority to: (1) direct or negotiate any changes in the project; (2) modify or extend the period of performance; (3) change the delivery schedule; (4) authorize reimbursement to the Contractor for any costs incurred during the performance of this contract; or (5) otherwise change any terms and conditions of this contract.

The contact information for the **Contracting Officer/Specialist**:

Contracting Officer
Ian Weiss
4041 Powder Mill Road
Beltsville, MD 20701
ian.weiss@fda.hhs.gov

Contract Specialist
Matthew Tran
4041 Powder Mill Road
Beltsville, MD 20701
matthew.tran@fda.hhs.gov

The contact information for the Contractor:
Primary Contact:
Katherine Leon
Columbia University
Sponsored Projects Administration
630 West 168th Street, Box 49
New York, NY 10032
grants-office@columbia.edu
(212) 305-4191

G.4 CONTRACTING OFFICER'S REPRESENTATIVE (COR)

The following COR will represent the Government for the purpose of this contract:

Contracting Officer Representative
Mary Johnson
10903 New Hampshire Avenue

Silver Spring, MD 20993
Phone: 240-402-2647
Email: mary.johnson@fda.hhs.gov

The COR is responsible for: (1) monitoring the Contractor's technical progress, including the surveillance and assessment of performance and recommending to the Contracting Officer changes in requirements; (2) interpreting the Statement of Work and any other technical performance requirements; (3) performing technical evaluation as required; (4) performing technical inspections and acceptances required by this contract; and (5) assisting in the resolution of technical problems encountered during performance.

G.5 MONTHLY PROGRESS REPORTS

On the fifteenth (15) day of each month for the previous calendar month, the contractor shall submit to the COR and the Contracting Officer a Technical Progress Report. Instructions for formulating Technical Progress Reports are detailed below. The Technical Progress Reports shall include project timelines and milestones summaries of product manufacturing, testing, and clinical evaluation. A Technical Progress Report will not be required for the period in which the Final Report is due. The Contractor shall submit two copies of the Technical Progress Report electronically via e-mail to the CO and COR. Any attachments to the e-mail report shall be submitted in Microsoft Word, Microsoft Excel, and/or Adobe Acrobat PDF files. Such reports shall include the following information:

a. Title page containing: Technical Progress Report, the contract number and title, the period of performance or milestone being reported, the Contractor’s name, address, and other contact information, the author(s), and the date of submission;

b. Introduction/Background: An introduction covering the purpose and scope of the contract effort;

c. Progress: The report shall detail, document and summarize the results of work performed, test results, milestones achieved during the period covered and cumulative milestones achieved. Must also include a summary of work planned for the next two (2) reporting periods on a rolling basis;

d. Issues: Issues resolved, new issues and outstanding issues are enumerated with options and recommendation for resolution. An explanation of any difference between planned progress and actual progress, why the differences have occurred, and, if progress activity is delinquent, and what corrective steps are planned. Revised timelines are to be included.

e. Invoices: Summary of any invoices submitted during the reporting period.

f. Action Items: Summary table of activities or tasks to be accomplished by certain date and by whom.

g. Distribution list: A list of persons receiving the Technical Report

h. Attachments: Results on the project are provided as attachments

The monthly progress reports shall be delivered via email to the Contract Specialist (CS) and the Contracting Officer's Representative (COR) at the following email addresses:

CS: matthew.tran@fda.hhs.gov COR: mary.johnson@fda.hhs.gov

G.6 FINAL REPORT

By the expiration date of the contract, the Contractor shall submit a 508 compliant Final Report that shall detail, document, and summarize the results of the entire contract work. The report shall explain comprehensively the results achieved. A draft Final Report will be submitted to the CO and COR for review and comments, then the Final Report original, copies, and an electronic file shall be submitted to the CO and COR for distribution to the Program office. Included in the final report shall be an executive summary (in plain language) within the report to summarize the results of the contract and include outcomes with possible impacts on FDA mission. The final report must have a table of contents and page numbers. Preferred Font: Calibri or Times New Roman and Size 11. The final report shall also be submitted to: FDABAA@fda.hhs.gov.

G.7 HHSAR 352.237-75 KEY PERSONNEL (DEC 2015)

The key personnel specified in this contract are considered to be essential to work performance. At least 30 days prior to the contractor voluntarily diverting any of the specified individuals to other programs or contracts the Contractor shall notify the Contracting Officer and shall submit a justification for the diversion or replacement and a request to replace the individual. The request must identify the proposed replacement and provide an explanation of how the replacement's skills, experience, and credentials meet or exceed the requirements of the contract (including, when applicable, Human Subjects Testing requirements). If the employee of the contractor is terminated for cause or separates from the contractor voluntarily with less than thirty days notice, the Contractor shall provide the maximum notice practicable under the circumstances. The Contractor shall not divert, replace, or announce any such change to key personnel without the written consent of the Contracting Officer. The contract will be modified to add or delete key personnel as necessary to reflect the agreement of the parties.

The Key Personnel under this contract are:

Lena S. Sun – Principal Investigator
Sandra Comer, PhD – Co-Principal Investigator
Jacquelin Narula – Project Research Coordinator

G.8 REPORTING MATTERS INVOLVING FRAUD, WASTE AND ABUSE

Anyone who becomes aware of the existence or apparent existence of fraud, waste and abuse in FDA funded programs is encouraged to report such matters to the HHS Inspector General's Office in writing or on the Inspector General's Hotline. The toll-free number is 1-800-HHS-TIPS (1-800-447-8477). All telephone calls will be handled confidentially. The email address is

HHStips@oig.hhs.gov and the mailing address is:

Office of Inspector General
Department of Health and Human Services
Attn: HOTLINE
330 Independence Avenue, S.W.
Washington, D.C. 20201

SECTION H - SPECIAL CONTRACT REQUIREMENTS

H.1 DISSEMINATION OF CONTRACT INFORMATION

FDA considers the sharing of research resources developed through FDA-sponsored research an important means to enhance the value and further the advancement of research. When research resources have been developed with FDA funds and the associated research findings published, those findings must be made readily available to the scientific community.

Upon acceptance for publication, scientific researchers must submit the author's final manuscript of the peer-reviewed scientific publication resulting from research supported in whole or in part with FDA funds to the NIH National Library of Medicine's (NLM) PubMed Central (PMC). FDA defines the author's final manuscript as the final version accepted for journal publication, which includes all modifications from the publishing peer review process. The PMC archive is the designated repository for these manuscripts for use by the public, health care providers, educators, scientists, and FDA. Please see the *FDA Public Access Policy*.

Any manuscript or scientific meeting abstract containing data generated under this contract must be submitted for FDA COR review no less than thirty (30) calendar days for manuscripts and fifteen (15) calendar days for abstracts before submission for public presentation or publication. Contract support shall be acknowledged in all such publications. "Publication" is defined as an issue of printed material offered for distribution or any communication or oral presentation of information.

The Contractor agrees to accurately and factually represent the work conducted under this contract in all press releases. Misrepresenting contract results or releasing information that is injurious to the integrity of FDA may be construed as improper conduct. Press releases shall be considered to include the public release of information to any medium, excluding peer-reviewed scientific publications. The contractor shall ensure that the COR has received an advance copy of any press release related to this contract not less than four (4) working days prior to the issuance of the press release.

The Contractor is responsible for ensuring compliance with all export control laws and regulations that maybe applicable to the export of and foreign access to their proposed technologies. Contractors may consult with the Department of State with any questions regarding the International Traffic in Arms Regulation (ITAR) (22 CRF Parts 120-130) and /or the Department of Commerce regarding the Export Administration Regulations (15 CRF Parts 730-774).

H.2 CONFLICT OF INTEREST

As a regulatory agency charged with protection of public health, the Food and Drug Administration (FDA) must maintain public confidence in the integrity of its decisions. The FDA has policies and procedures that safeguard against actual and apparent conflict of interest on the part of its employees. In contracting for review and evaluation of scientific data and information submitted to the agency, it is critical that the FDA be assured that there is no actual or apparent conflict of interest on the part of the individual contractor. Offers performing work under this contract must assure the protection of information and data they receive under this contract from unauthorized use or disclosure, and must avoid actions that would cause a reasonable person to question the impartiality of the contractor.

(a)Purpose. The purpose of this clause is to ensure that the contractor and its subcontractors:

(1) Are not biased because of their financial, contractual, organizational, or other interests which relate to the work under this contract, and

(2) Do not obtain any unfair competitive advantage over other parties by virtue of their performance of this contract.

(b)Scope. The restrictions described herein shall apply to performance or participation by the contractor, its parents, affiliates, divisions and subsidiaries, and successors in interest (hereinafter collectively referred to as "contractor") in the activities covered by this clause as a prime contractor, subcontractor, co-sponsor, joint venturer, consultant, or in any similar capacity. For the purpose of this clause, affiliation occurs when a business concern is controlled by or has the power to control another or when a third party has the power to control both.

(c)Warrant and Disclosure. The warrant and disclosure requirements of this paragraph apply with full force to both the contractor and all subcontractors. The contractor warrants that, to the best of the contractor's knowledge and belief, there are no relevant facts or circumstances which would give rise to an organizational conflict of interest, as defined in FAR Subpart 9.5, and that the contractor has disclosed all relevant information regarding any actual or potential conflict. The contractor agrees it shall make an immediate and full disclosure, in writing, to the Contracting Officer of any potential or actual organizational conflict of interest or the existence of any facts that may cause a reasonably prudent person to question the contractor's impartiality because of the appearance or existence of bias or an unfair competitive advantage. Such disclosure shall include a description of the actions the contractor has taken or proposes to take in order to avoid, neutralize, or mitigate any resulting conflict of interest.

(d)Remedies. The Contracting Officer may terminate this contract for convenience, in whole or in part, if the Contracting Officer deems such termination necessary to avoid, neutralize or mitigate an actual or apparent organizational conflict of interest. If the contractor fails to disclose facts pertaining to the existence of a potential or actual organizational conflict of interest or misrepresents relevant information to the Contracting Officer, the Government may terminate the contract for default, suspend or debar the contractor from Government contracting, or pursue such other remedies as may be permitted by law or this contract.

(e)Subcontracts. The contractor shall include a clause substantially similar to this clause, including paragraphs (f) and (g), in any subcontract or consultant agreement at any tier expected to exceed the simplified acquisition threshold. The terms "contract," "contractor," and "Contracting Officer" shall be appropriately modified to preserve the Government's rights.

(f)Prime Contractor Responsibilities. The contractor shall obtain from its subcontractors or consultants the disclosure required in FAR Part 9.507-1, and shall determine in writing whether the interests disclosed present an actual, or significant potential for, an organizational conflict of interest. The contractor shall identify and avoid, neutralize, or mitigate any subcontractor organizational conflict prior to award of the contract to the satisfaction of the Contracting Officer. If the subcontractor's organizational conflict cannot be avoided, neutralized, or mitigated, the contractor must obtain the written approval of the Contracting Officer prior to entering into the subcontract. If the contractor becomes aware of a subcontractor's potential or actual organizational conflict of interest after contract award, the contractor agrees that the Contractor may be required to eliminate the subcontractor from its team, at the contractor's own risk.

(g)Waiver. The parties recognize that this clause has potential effects which will survive the performance of this contract and that it is impossible to foresee each circumstance to which it might be applied in the future. Accordingly, the contractor may at any time seek a waiver from the Head of the Contracting Activity by submitting such waiver request to the Contracting Officer, including a full written description of the requested waiver and the reasons in support thereof.

H.3 REQUIREMENTS FOR CLINICAL TRIALS

As part of 21st Century Cures, HHS is required to consult with relevant Federal agencies, including FDA, and other stakeholders within 90 days of enactment to receive recommendations with respect to enhancements to the ClinicalTrials.gov databank. These recommendations are to address the usability, functionality, and search capability of the databank. NIH has confirmed that it is the lead agency for this provision and has indicated that the recommendations should be focused on the outward facing aspects of ClinicalTrials.gov, as opposed to items related to entering information or new data elements to be collected.

FDA's Office of Good Clinical Practice (OGCP) is requesting input to help NIH address this 21st Century Cures requirement. Because many different groups at FDA (e.g., review divisions, compliance offices) use ClinicalTrials.gov for a variety of purposes, we ask that you share this request broadly within your organization. Please focus on suggestions related to enhancements of the usability and search functions of ClinicalTrials.gov which may improve or augment work at FDA. Suggestions may include, but are not limited to, items such as the ease of use of the main ClinicalTrials.gov webpage, improved search capabilities, or data output formats. Recommendations related to enhancements which may be useful for FDA stakeholders, such as patients searching for clinical trials, are also being requested.

All research under this BAA must address the involvement of human subjects and protections from research risk related to their participation in the proposed research plan and comply with 32 CFR 219, 10 U.S.C. 980, and, as applicable, 21 CFR Parts 11, 50, 54, 56, 312) (45 CFR Part 46) and the ICH as well as other applicable federal and state regulations. HHS Policy also requires that women and members of minority groups and their subpopulations: children and the elderly (pediatric and geriatric) must be included in the study population of research involving human subjects, unless a clear and compelling rationale and justification is provided with respect to the health of the subjects or the purpose of the research. The HHS policy on studies that involved human subjects can be accessible through the HHS website: http://www.hhs.gov/ohrp/humansubjects/guidance/45cfr46.html.

Research Projects involving humans and/or human specimens can only be initiated with written approval by the FDA Contracting Officer. The Food and Drug Administration Amendments Act of 2007 (FDAAA) contains provisions that expand the current database known as ClinicalTrials.gov to include additional requirements for individuals and entities who are involved in conducting clinical trials that involve products regulated by FDA or that are funded by the Department of Health and Human Services (HHS), including FDA. These additional requirements include mandatory registration of certain types of clinical trials, as well as reporting of results for certain trials (“applicable trials”) for inclusion in the ClinicalTrials.gov database. More detailed information on the definition of "applicable clinical trial" and the registry and results reporting requirements can be found at https://clinicaltrials.gov/ct2/manage-recs/fdaaa. FDAAA also added new requirements concerning clinical trials supported by grants and contracts from HHS, including FDA. Under these provisions, any contract or progress report forms required under a contract from any part of HHS, including FDA, must include a certification that the “responsible party" has submitted all required information to the ClinicalTrials.gov registry database. The responsible party is the term used in Title VIII of FDAAA (PL 110-85) to refer the entity or individual responsible for meeting FDAAA’s requirement. Under BAA contracts, the Contractor assumes the responsibility, and will register a clinical investigation and submit Clinical Trial Information to the Clinical Trial Registry Data Bank if determined to be an applicable clinical trial. In case where the existing policy at the contractor’s institution requires a registration at the Clinical Trial Registry, the contractor shall provide a letter that clearly states the policy and the extent of responsibility within 30 days of the Award/Contract. This letter should be signed by the contractor and cosigned by the institutional official, and sent to the COR and the Contracting Officer (CO). More detailed information on the definition of "applicable clinical trial" and the “responsible party” can be found at http://prsinfo.clinicaltrials.gov/ElaborationsOnDefinitions.pdf. There are also provisions regarding when agencies within HHS, including FDA, are required to verify compliance with the database requirements before releasing funding to contractors.

H.4 CONTRACTOR PERFORMANCE EVALUATION(S)

In accordance with Federal Acquisition Regulation (FAR) 42.15, FDA will complete annual and final contractor performance evaluations. Annual evaluations will be prepared to coincide with the anniversary date of the contract. Additional interim performance evaluations may be prepared at Contracting Officer discretion, as necessary. Final performance evaluations will be completed upon contract expiration.

FDA will utilize the Contractor Performance Assessment Reporting System (CPARS) in order to execute annual and final contractor performance evaluations. CPARS is a secure Internet website located at http://www.cpars.gov/. FDA will register the contractor in CPARS upon receipt of the name and email address of two (2) individuals who will be responsible for serving as the Contractor's primary and alternate CPARS contacts. Once FDA registers the contractor in CPARS, the Contractor will receive an automated CPARS email message which contains User IDs and instructions for creating a password.

Once a performance evaluation is issued, the Contractor's primary and alternate CPARS contact will receive an email instructing them to logon to CPARS in order to review the performance evaluation. The Contractor has 15 days from the date of performance evaluation issuance in which to review the evaluation. If the Contractor is in agreement with the performance evaluation outcome, the evaluation becomes final. Should the Contractor be in disagreement with the performance evaluation outcome, rebuttal comments must be submitted via the CPARS within 15 days from date the evaluation was issued by FDA. Any disagreement between the Contracting Officer and the Contractor will be referred to a contracting official one level above the Contracting Officer, whose decision will be final.

Copies of each performance evaluation and contractor responses, if any, will be retained as part of the official contract file and will be used to support future award decisions. Evaluations will also be stored for a 3 year period in the Past Performance Information Retrieval System (PPIRS) at www.ppirs.gov.

Contractors may obtain CPARS training material and register for on-line training at http://www.cpars.gov/allapps/cpcbtdlf.htm. There is no fee for registration or use of the CPARS.

H.5 508 STANDARD REQUIREMENTS:

HHSAR 352.239-74 Electronic and Information Technology Accessibility (DEC 2015)

(a) Pursuant to Section 508 of the Rehabilitation Act of 1973 (29 U.S.C. 794d), as amended by the Workforce Investment Act of 1998, all electronic and information technology (EIT) supplies and services developed, acquired, or maintained under this contract or order must comply with the "Architectural and Transportation Barriers Compliance Board Electronic and Information Technology (EIT) Accessibility Standards" set forth by the Architectural and Transportation Barriers Compliance Board (also referred to as the "Access Board") in 36 CFR part 1194. Information about Section 508 is available at http://www.hhs.gov/web/508. The complete text of Section 508 Final Provisions can be accessed at http://www.access-board.gov/guidelines-and-standards/communications-and-it/about-the-section-508-standards.

(b) The Section 508 accessibility standards applicable to this contract or order are identified in the Statement of Work or Specification or Performance Work Statement. The contractor must provide any necessary updates to the submitted HHS Product Assessment Template(s) at the end of each contract or order exceeding the simplified acquisition threshold (see FAR 2.101) when the contract or order duration is one year or less. If it is determined by the Government that EIT supplies and services provided by the Contractor do not conform to the described accessibility

standards in the contract, remediation of the supplies or services to the level of conformance specified in the contract will be the responsibility of the Contractor at its own expense.

(c) The Section 508 accessibility standards applicable to this contract are:

Software applications and operating systems

Web-based intranet and internet information and applications

1194.31 Functional performance criteria

1194.41 Information, documentation, and support

(d) In the event of a modification(s) to this contract or order, which adds new EIT supplies or services or revises the type of, or specifications for, supplies or services, the Contracting Officer may require that the contractor submit a completed HHS Section 508 Product Assessment Template and any other additional information necessary to assist the Government in determining that the EIT supplies or services conform to Section 508 accessibility standards. Instructions for documenting accessibility via the HHS Section 508 Product Assessment Template may be found under Section 508 policy on the HHS website: (http://www.hhs.gov/web/508). If it is determined by the Government that EIT supplies and services provided by the Contractor do not conform to the described accessibility standards in the contract, remediation of the supplies or services to the level of conformance specified in the contract will be the responsibility of the Contractor at its own expense.

(e) If this is an Indefinite Delivery contract, a Blanket Purchase Agreement or a Basic Ordering Agreement, the task/delivery order requests that include EIT supplies or services will define the specifications and accessibility standards for the order. In those cases, the Contractor may be required to provide a completed HHS Section 508 Product Assessment Template and any other additional information necessary to assist the Government in determining that the EIT supplies or services conform to Section 508 accessibility standards. Instructions for documenting accessibility via the HHS Section 508 Product Assessment Template may be found at http://www.hhs.gov/web/508. If it is determined by the Government that EIT supplies and services provided by the Contractor do not conform to the described accessibility standards in the provided documentation, remediation of the supplies or services to the level of conformance specified in the contract will be the responsibility of the Contractor at its own expense.

(End of clause)

H.6 352.270-4b Protection of Human Subjects (December 18, 2015)

(a) The Contractor agrees that the rights and welfare of human subjects involved in research under this contract shall be protected in accordance with 45 CFR part 46 and with the Contractor's current Federal-wide Assurance (FWA) on file with the Office for Human Research Protections (OHRP), Department of Health and Human Services. The Contractor further agrees to provide certification at least annually that the Institutional Review Board has reviewed and approved the procedures, which involve human subjects in accordance with 45 CFR part 46 and the Assurance of Compliance.

(b) The Contractor shall bear full responsibility for the performance of all work and services involving the use of human subjects under this contract and shall ensure that work is conducted in a proper manner and as safely as is feasible. The parties hereto agree that the Contractor retains the right to control and direct the performance of all work under this contract. Nothing in this contract shall create an agency or employee relationship between the Government and the Contractor, or any subcontractor, agent or employee of the Contractor, or any other person, organization, institution, or group of any kind whatsoever. The Contractor agrees that it has entered into this contract and will discharge its obligations, duties, and undertakings and the work pursuant thereto, whether requiring professional judgment or otherwise, as an independent Contractor without creating liability on the part of the Government for the acts of the Contractor or its employees.

(c) Contractors involving other agencies or institutions in activities considered to be engaged in research involving human subjects must ensure that such other agencies or institutions obtain their own FWA if they are routinely engaged in research involving human subjects or ensure that such agencies or institutions are covered by the Contractors' FWA via designation as agents of the institution or via individual investigator agreements (see OHRP website at: http://www.hhs.gov/ohrp/policy/guidanceonalternativetofwa.pdf - PDF).

(d) If at any time during the performance of this contract the Contractor is not in compliance with any of the requirements and or standards stated in paragraphs (a) and (b) above, the Contracting Officer may immediately suspend, in whole or in part, work and further payments under this contract until the Contractor corrects the noncompliance. The Contracting Officer may communicate the notice of suspension by telephone with confirmation in writing. If the Contractor fails to complete corrective action within the period of time designated in the Contracting Officer's written notice of suspension, the Contracting Officer may, after consultation with OHRP, terminate this contract in whole or in part.

H.6 Restriction on Use of Human Subjects (December 18, 2015)

Pursuant to 45 CFR part 46, Protection of Human Research Subjects, the Contractor shall not expend funds under this award for research involving human subjects or engage in any human subjects research activity prior to the Contracting Officer's receipt of a certification that the research has been reviewed and approved by the Institutional Review Board (IRB) registered with OHRP. This restriction applies to all collaborating sites, whether domestic or foreign, and subcontractors. The Contractor must ensure compliance by collaborators and subcontractors.

H.7 Protection of Human Subjects—Research Involving Human Subjects Committee (RIHSC) Approval of Research Protocols Required (December 18, 2015)

(a) The Contractor agrees to protect the rights and welfare of human subjects involved in research under this contract by complying with 45 CFR Part 46 and the clause at HHSAR 352.270-4b.

(b) Initial proof of compliance with 45 CFR Part 46 shall consist of:

(1) A copy of a current Federal-wide Assurance on file with OHRP. The copy of a current Federal–wide Assurance shall be included with the Contractor's proposal;

(2) A letter from the Contractor's local IRB (the Institutional Review Board (IRB) specified in the Offeror's Assurance of Compliance) stating that it has reviewed and approved the proposed research protocol. The letter from the local IRB shall be submitted to the Contracting Office; and
(3) A copy of a letter from the RIHSC stating that it or its designee has reviewed and approved the proposed research protocol. This shall be submitted to the Contracting Officer within three business days of its issuance.

The Contractor shall not advertise for, recruit, or enroll human subjects, or otherwise commence any research involving human subjects under this contract, until RIHSC has reviewed and approved its research. The Contractor may commence other limited aspects of contract performance prior to receiving RIHSC or its designee approval of its proposed research protocol. Research involving human subjects may commence immediately upon the Contractor's receipt of RIHSC or its designee approval; however, the Contractor shall submit a copy of RIHSC's or its designee's letter of approval to the Contracting Officer within three business days of its receipt.
Failure to obtain RIHSC or its designee approval of proposed research protocols may result in the termination of this contract.

(c) The Contractor further agrees that:

(1) The Contractor will provide a letter from RIHSC, at least annually, stating that RIHSC or its designee has reviewed and approved the research protocols for research performed under this contract. This shall be submitted to the Contracting Officer for inclusion in the contract file.

(2) The Contractor will submit all proposed modifications and amendments to research protocols for research performed under this contract to RIHSC for review and approval. Modifications and amendments include, but are not limited, to changes to consent forms and advertising materials, and the addition or deletion of investigators. Changes may be instituted immediately after the Contractor has received both the local IRB and RIHSC or its designee approval (except when necessary to eliminate apparent immediate hazards to the subject); however the Contractor shall submit a copy of the letter evidencing RIHSC's or its designee's approval of the proposed changes to the Contracting Officer within three business days of its receipt.

H.8 Human Subjects Protection Review

For research exempt from the requirements of 45 CFR Part 46:
(a) The Contractor will submit to FDA a letter from their IRB or human subject protection entity that the proposed research is exempt (see 45 CFR 46.104).

(b) In accordance with SMG 9001.4, FDA will follow its procedures for exempt research determination. Data collection from human subjects cannot commence under this contract until the FDA COR provides the Contractor with the outcome of the FDA determination.

For nonexempt human subjects research:
(a) The Contractor agrees to protect the rights and welfare of human subjects involved in research under this contract by complying with 45 CFR Part 46 and the clause at HHSAR 352.270-4b.
(b) Initial proof of compliance with 45 CFR Part 46 shall consist of:
(1) A copy of a current Federal-wide Assurance on file with OHRP (https://www.hhs.gov/ohrp/federalwide-assurances-fwas.html). The copy of a current Federal–wide Assurance shall be included with the Contractor's proposal;
(2) A letter from the Contractor's local IRB (the Institutional Review Board (IRB) specified in the Offeror's Assurance of Compliance) stating that it has reviewed and approved the proposed research protocol. The letter from the local IRB shall be submitted to the Contracting Officer Representative (COR).
(3) In accordance with SMG 9001.4, the FDA will determine if FDA is considered engaged in the research for purposes of 45 CFR part 46. Data collection from human subjects cannot commence under this contract until the FDA COR provides the Contractor with the outcome of the FDA determination. When that determination is made, the FDA will confirm the extent to which the terms of "352.270-11 Protection of Human Subjects—Research Involving Human Subjects Committee (RIHSC) Approval of Research Protocols Required" apply.

PART II

SECTION I - CONTRACT CLAUSES

FAR 52.252-2 CLAUSES INCORPORATED BY REFERENCE (FEB 1998)

This contract incorporates one or more clauses by reference, with the same force and effect as if they were given in full text. Upon request, the CO will make their full text available. Also, the full text of a clause may be accessed electronically at this address: https://www.acquisition.gov/far/.

FAR 52.202-1 Definitions (JUN 2020)

FAR 52.203-3 Gratuities (APR 1984)

FAR 52.203-5 Covenant Against Contingent Fees (MAY 2014)

FAR 52.203-6 Restrictions on Subcontractor Sales to the Government (JUN 2020)

FAR 52.203-7 Anti-Kickback Procedures (JUN 2020)

FAR 52.203-8 Cancellation, Rescission, and Recovery of Funds for Illegal or Improper Activity (MAY 2014)

FAR 52.203-10 Price or Fee Adjustment for Illegal or Improper Activity (MAY 2014)

FAR 52.203-12 Limitation on Payment to Influence Certain Federal Transactions (JUN 2020)

FAR 52.203-14 Display of Hotline Poster(s) (NOV 2021)

FAR 52.203-17 Contractor Employee Whistleblower Rights and Requirement to Inform Employees of Whistleblower Rights (JUN 2020)

FAR 52.203-19 Prohibition on Requiring Certain Internal Confidentiality Agreements or Statements (JAN 2017)

FAR 52.204-4 Printed or Copied Double-Sided on Recycled Paper (MAY 2011)

FAR 52.204-10 Reporting Executive Compensation and First-Tier Subcontract Awards (JUN 2020)

FAR 52.204-13 System for Award Management Maintenance (OCT 2018)

FAR 52.204-14 Service Contract Reporting Requirements (OCT 2016)

FAR 52.204-18 Commercial and Government Entity Code Maintenance (AUG 2020)

FAR 52.204-19 Incorporation by Reference of Representation and Certifications (DEC 2014)

FAR 52.204-23 Prohibition on Contracting for Hardware, Software, and Services Developed or Provided by Kaspersky Lab and Other Covered Entities (NOV 2021)

FAR 52.204-25 Prohibition on Contracting for Certain Telecommunications and Video Surveillance Services or Equipment (NOV 2021)

FAR 52.204-27 Prohibition on a ByteDance Covered Application (JUN 2023)

FAR 52.209-6 Protecting the Government's Interest When Subcontracting with Contractors Debarred, Suspended, or Proposed for Debarment (NOV 2021)

FAR 52.209-9 Updates of Publicly Available Information Regarding Responsibility Matters (OCT 2018)

FAR 52.209-10 Prohibition on Contracting with Inverted Domestic Corporations (NOV 2015)

FAR 52.215-2 Audit and Records - Negotiation (JUN 2020) – Alternate II (AUG 2016)

FAR 52.215-8 Order of Precedence - Uniform Contract Format (OCT 1997)

FAR 52.216-7 Allowable Cost and Payment (AUG 2018) - Alternate II (AUG 2012)

FAR 52.216-11 Cost Contract – No Fee (APR 1984) - Alternate I (APR 1984)

FAR 52.216-15 Predetermined Indirect Cost Rates (APR 1998)

FAR 52.217-8 Option to Extend Services (NOV 1999)

FAR 52.217-9 Option to Extend the Term of the Contract (MAR 2000)

FAR 52.219-8 Utilization of Small Business Concerns (OCT 2018)

FAR 52.219-9 Small Business Subcontracting Plan (NOV 2021) - Alternate II (NOV 2016)

FAR 52.219-16 Liquidated Damages—Subcontracting Plan (JAN 1999)

FAR 52.219-28 Post-Award Small Business Program Re-representation (SEP 2021)

FAR 52.222-2 Payment of Overtime Premiums (JUL 1990)

The use of overtime is authorized under this contract if the overtime premium does not exceed $125.00.

FAR 52.222-3 Convict Labor (JUN 2003)

FAR 52.222-21 Prohibition of Segregated Facilities (APR 2015)

FAR 52.222-26 Equal Opportunity (SEP 2016)

FAR 52.222-35 Equal Opportunity for Veterans (JUN 2020)

FAR 52.222-36 Equal Opportunity for Workers with Disabilities (JUN 2020)

FAR 52.222-37 Employment Reports on Veterans, (JUN 2020)

FAR 52.222-40 Notification of Employee Rights Under the National Labor Relations Act (DEC 2010)

FAR 52.222-50 Combating Trafficking in Persons (NOV 2021)

FAR 52.222-54 Employment Eligibility Verification (NOV 2021)

FAR 52.223-6 Drug-Free Workplace (MAY 2001)

FAR 52.223-18 Encouraging Contractor Policies to Ban Text messaging While Driving (JUN 2020)

FAR 52.225-1 Buy American Act—Supplies (NOV 2021)

FAR 52.225-13 Restrictions on Certain Foreign Purchases (FEB 2021)

FAR 52.227-1 Authorization and Consent (JUN 2020) – Alternate I (APR 1984)

FAR 52.227-2 Notice and Assistance Regarding Patent and Copyright Infringement (JUN 2020)

FAR 52.227-11 Patent Rights—Ownership by the Contractor (MAY 2014)

FAR 52.227-14 Rights in Data - General (MAY 2014) - Alternate IV (DEC 2007)

FAR 52.227-16 Additional Data Requirements (JUN 1987)

FAR 52.228-7 Insurance - Liability to Third Persons (MAR 1996)

FAR 52.232-20 Limitation of Cost (APR 1984)

FAR 52.232-23 Assignment of Claims (MAY 2014)

FAR 52.232-25 Prompt Payment (Jan 2017) - Alternate I (FEB 2002)

FAR 52.232-33 Payment by Electronic Funds Transfer-System for Award Management (OCT 2018)

FAR 52.232-39 Unenforceability of Unauthorized Obligations (JUN 2013)

FAR 52.232-40 Providing Accelerated Payments to Small Business Subcontractors (NOV 2021)

FAR 52.233-1 Disputes (MAY 2014)

FAR 52.233-3 Protest after Award (AUG 1996) - Alternate I (JUN 1985)

FAR 52.233-4 Applicable Law for Breach of Contract Claim (OCT 2004)

FAR 52.242-1 Notice of Intent to Disallow Costs (APR 1984)

FAR 52.242-3 Penalties for Unallowable Costs (SEP 2021)

FAR 52.242-13 Bankruptcy (JUL 1995)

FAR 52.243-2 Changes - Cost-Reimbursement (AUG 1987) - Alternate V (APR 1984)

FAR 52.244-2 Subcontracts (JUN 2020) – Alternate I (JUN 2020)

FAR 52.244-5 Competition in Subcontracting (DEC 1996)

FAR 52.244-6 Subcontracts for Commercial Items (JAN 2022)

FAR 52.245-1 Government Property (SEP 2021) - Alternate II (APR 2012)
Title to property purchased with an acquisition cost of $5,000 or more shall vest in the Government, unless otherwise noted in writing by the Contracting Officer.

FAR 52.246-25 Limitation of Liability - Services (FEB 1997)

FAR 52.249-5 Termination for Convenience of the Government (Educational and Other Nonprofit Institutions) (AUG 2016)

FAR 52.249-14 Excusable Delays (APR 1984)

FAR 52.253-1 Computer Generated Forms (JAN 1991)

HHSAR 352.203-70 Anti-Lobbying (DEC 2015)

HHSAR 352.222-70 Contractor Cooperation in Equal Employment Opportunity Investigations (DEC 2015)

HHSAR 352.223-70 Safety and Health (DEC 2015)

HHSAR 352.224-70 Privacy Act (DEC 2015)

HHSAR 352.224-71 Confidential Information (DEC 2015)

HHSAR 352.227-70 Publications and Publicity (DEC 2015)

HHSAR 352.231-70 Salary Rate Limitation (DEC 2015)

HHS FAR Class Deviations

FAR 52.232-40 PROVIDING ACCELERATED PAYMENTS TO SMALL BUSINESS SUBCONTRACTORS (NOV 2021) **[(DEVIATION APR 2020)]**

(a)**[(1) In accordance with 31 U.S.C. 3903 and 10 U.S.C. 2307, u]**,~~U~~pon receipt of accelerated payments from the Government, the Contractor shall make accelerated payments to its small business subcontractors under this contract **[in accordance with the accelerated payment date established]**, to the maximum extent practicable and prior to when such payment is otherwise required under the applicable contract or subcontract, **[with a goal of 15 days]** after receipt of a proper invoice and all other required documentation from the small business subcontractor **[if a specific payment date is not established by contract.**

(2) The Contractor agrees to make such payments to its small business subcontractors without any further consideration from or fees charged to the subcontractor].

(b) The acceleration of payments under this clause does not provide any new rights under the Prompt Payment Act.

(c) Include the substance of this clause, including this paragraph (c), in all subcontracts with small business concerns, including subcontracts with small business concerns for the acquisition of commercial items.

(End of clause)

PART III

SECTION J - LIST OF ATTACHMENTS

A. Statement of Work
B. Rate Agreement
C. Small Business Subcontracting Plan

EXHIBIT F

Phoebe Award Summary: 058184-003

PIs and Campus RAs always are responsible for reading and understanding all of the award terms and conditions found in the award document. The Phoebe Award Summary is provided as a courtesy to summarize certain elements of the award. Errors found on the PAS should be reported to Froylan Fernandes at ffernandes@berkeley.edu.

PI Summary

Funding Change	**$55,122**
Project Title	**Health and Neurodevelopmental Outcomes in Infants at Risk for Neonatal Opioid Withdrawal Syndromes: Effects of Timing and Duration of Prenatal Opioid Exposure & Postnatal Management with ESC**
Principal Investigator	Sam Pimentel
Lead Unit	PSTAT Statistics
SPO/IAO Contact	Artawood Chitamitara
Sponsor	009564 Columbia University
Prime Sponsor	003600 DHHS FDA Food and Drug Administration
Award Transaction Comment	**Additional Budget Period 9/30/2024 - 09/29/2025 and Additional Funding $55,122.**
Award Type	Contract
Transaction Type	Modification
Sponsor Award Number	1(GG018863-01)
Sponsor Modification Number	01

Financial Information

BFS Chart of Accounts

Fund	Dept. ID	Function	CF1	CF2
86475	13090	44		PSPIM

Budget Periods

Phoebe Award Number	Begin Date	End Date	Anticipated	Obligated	Funding Change
058184-002	9/30/23	9/29/24	$52,555	$52,555	
058184-003	**9/30/24**	**9/29/25**	**$55,122**	**$55,122**	**$55,122**

Anticipated Total **$107,677** for the project period **9/30/23** – **9/29/25**

Fund Advance

Authorized Amount: **$52,555**
Effective Date: **5/28/24**

Indirect Cost Information

Rate	Base Type	On/Off Campus	Waiver/Reduction
60.5%	MTDC	On	

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Comments and Special Terms

General Comments

Please review award document carefully for intellectual property, procurement, financial, and other terms and conditions.

Referenced Document

E-Verify applies

Informed Participation: please review document type "Informed Participation" in Phoebe Search under this award record for further information.

This award is subject to the Research Terms and Conditions. Additional information can be accessed here: https://www.nsf.gov/awards/managing/rtc.jsp

This award is subject to the Uniform Guidance 2 CFR 200. Additional information can be accessed here: https://www.ecfr.gov/cgi-bin/text-idx?tpl=/ecfrbrowse/Title02/2cfr200_main_02.tpl

Principal Investigators are responsible for informing all members of the project team that procuring, obtaining, providing, or using any telecommunications equipment produced by Huawei Technologies Company, ZTE Corporation (or any subsidiary or affiliate of such entities), Hytera Communications Corporation, Hangzhou Hikvision Digital Technology Company, Dahua Technology Company (or any subsidiary or affiliate of such entities), or any other entity reasonably believed to be owned or controlled by, or otherwise connected to, the government of a covered foreign country is strictly prohibited. Note that personal device use, including cell phone use, except for personal use, is included in the prohibition. In addition, PIs are advised to work closely with Supply Chain Management on procurement of any third-party services. Any known breach of the ban must be reported to SPO as soon as reasonably possible.

Compliance Review

Type	Protocol Number	Approval Status	Approval Date	Expiration Date
Financial disclosure		Negative		

Reporting Requirements

Reports listed here are final reports only. Please see your award terms for required interim reports and schedules.

Final technical report due:	As required
Final intellectual property (patents and inventions) report due:	As required

Other Details

CFDA	
Activity Type	Applied research
Project Type	Regular
FDP/RTC	No
Equipment Title	Other
Phoebe Proposal ID(s)	20233529, 36833

SAPO: G19718

Amendment to a Subcontract / Subaward Under a Federal Contract

Federal Awarding Agency: Food and Drug Administration
Amendment No.: 01
Federal Awarding Agency Contract Number: 75F40123C00211
Subcontract No.: 1(GG018663-02)

PTE - Contractor		Subrecipient - Subcontractor
The Trustees of Columbia University in the City of New York	Entity Name	The Regents of the University of California
subawards-CUMC@columbia.edu	Contact Email	spoawards@berkeley.edu
Lena Sun	Principal Investigator	Sam Pimentel

Project Title: Health and Neurodevelopmental Outcomes in Infants at Risk for Neonatal Opioid Withdrawal Syndromes (NOWS): Effects of Timing and Duration of Prenatal Opioid Exposure (POE) & Postnatal Management with Eat-Sleep-Console (ESC)

Cumulative Budget Period(s) (Agreement Start Date) Start Date:	(End Date of Latest Budget Period) End Date:	Amount Funded This Action	Total Amount of Funds Obligated to Date
09/30/2023	09/29/2025	$ 55,122.00	$ 107,677.00

Subrecipient Cost Share ☐ | Subject to FFATA ☐ | Subrecipient UEI (Unique Entity Identifier - May leave blank if unchanged from prior Agreement): GS3YEVSS12N6

Amendment(s) to Original Terms and Conditions

This Amendment revises the above-referenced Subcontract Agreement as follows:

☒ **Additional Budget Period**

Additional budget period 09/30/2024 - 09/29/2025 is hereby added to this Subaward.

☐ **No Cost Extension**

☒ **Additional Funding**

Additional funding in the amount of $ 55,122.00 is hereby obligated to this Subaward.

☐ **Deobligation**

Carryover is Not Automatic Carryover across budget periods requires prior approval.

☐ **Carryover Authorized**

If carryover is not automatic, the "Total Amount of Funds Obligated to Date" stated above may not reflect the actual balance available. The Subrecipient is responsible for tracking unobligated balances and subsequent carryover approvals from prior budget periods. In the event that funding was not fully expended by the Subrecipient during the prior period, the Subrecipient is not authorized to use funds from any prior periods, unless approval is granted by the PTE.

☒ **Detailed Budget/Scope of Work/Notice of Award Attached** (Specify if the Budget and Scope of Work are "New", "Revised", or "Supplemental" in dropdown or "Other")

A Scope of Work & Budget is incorporated by attachment to this Amendment.

☒ **Other (See Below)**

CHANGE IN SUBCONTRACT NUMBER & SUBCONTRACT PURCHASE ORDER NUMBER (SAPO):
The subcontract number has changed from GG018663-01 to GG018663-02.
The SAPO has changed from G18498 to G19718.

For clarity: all amounts stated in this amendment are in United States Dollars.

All other terms and conditions of this Subcontract Agreement remain in full force and effect.

By an Authorized Official of Contractor:	By an Authorized Official of Subcontractor:
Signature: Rosa Rivera 8A41B0922D6C433...	Signature: [signature]
Date: 2/11/2025 | 12:15:34 PM PST	Date: Feb 10, 2025
Name: Rosa Rivera	Name: Margaret Nguyen
Title: Director	Title: Contract and Grant Officer Sponsored Projects Office

Attachment 1
Statement of Work and Budget

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Scope of Work / Biosketch
Subcontract for University of California, Berkeley

PI: Lena S. Sun, MD, FAAP, D.ABA (Columbia)
Subcontract Samuel Pimentel, PhD (UC Berkeley)

Project Title: "Health and Neurodevelopmental Outcomes in Infants at Risk for Neonatal Opioid Withdrawal Syndromes (NOWS): Effects of Timing and Duration of Prenatal Opioid Exposure (POE) & Postnatal Management with Eat-Sleep-Console (ESC)"
Project start / end: 9/1/2023 – 8/31/2027

Samuel D. Pimentel (Contributor, 10% effort in Years 1 through 4)
Dr. Pimentel will contribute to this project as the lead statistician. He will oversee the design and construction of matched samples using the data in the Kaiser Permanente Birth Cohort, and will direct the statistical analyses of these samples. He will also participate in drafting manuscripts and will oversee the work of the graduate student researcher at UC Berkeley. Dr. Pimentel is Assistant Professor of Statistics at the University of California, Berkeley.

erso
Engineering Research Support Organization

University of California, Berkeley
Proposed Budget

Summary Budget

Ver.13.3 4/23

Principal Investigator:	Sam Pimentel		**9/1/23**
Title:	Health and Neurodevelopmental Outcomes in Infants at Risk for Neonatal Opioid Withdrawal Syndrome		**8/31/27**

		Year:	**Two**			
SALARIES	Faculty		19,164			
	Grad. Student Researchers		12,554			
	Other Personnel		0			
	Salary Subtotal		31,717			
BENEFITS	Benefits Subtotal		2,627			
	Personnel Subtotal		34,344			
TRAVEL	Domestic		0			
	Foreign		0			
	Travel Subtotal		0			
EQUIPMENT	**Equipment Subtotal**		0			
SUPPLIES	Laptops		0			
	Publications		0			
	Other		0			
	Consultants		0			
	Expendable Research Supplies		0			
	Supply/Expense Subtotal		0			
Total Direct Costs			34,344			
Modified Total Direct Costs			34,344			
Indirect Costs			20,778			
	TOTAL COST FOR YEAR		**55,122**			

BUDGET JUSTIFICATION

SENIOR PERSONNEL:

Principal Investigator (Sam Pimentel): Professor Pimentel, at the University of California at Berkeley, will be the Principal Investigator (PI) of this project and will provide overall direction and oversight of the research project. Responsibilities include overseeing the design and the analysis of multivariate matched samples from the Kaiser Permanente database, conducting outcome analyses, and drafting and editing manuscripts, especially sections on methodology and results. He will also work with Prof. Lena Sun in the Department of Anesthesiology at the Columbia University Medical Center . In addition to overall project responsibility, the PI will supervise one Graduate Student Researcher (GSR) working on the project. He will commit 1.2 summer month(s) per year.

OTHER PERSONNEL:

Graduate Student Researcher (TBD): The GSR will assist the PI, as directed, in conducting research and contribute to the drafting and dissemination of results. The GSR will commit 3 summer months in years 1 and 2, and 2 summer months in years 3 and 4.

Salary Escalations

Escalation Group	FY24	FY25	FY26	FY27	FY28
Faculty, effective 7/1	4.00%	4.00%	4.00%	4.00%	4.00%
Academic Researchers (ARs), effective 7/1/23 and annually on 7/1	4.50%	3.50%	3.50%	3.50%	4.00%
Non-Academic, effective 7/1	4.00%	4.00%	4.00%	4.00%	4.00%
Postdoctoral Researchers (Postdocs), effective 10/1/23 and annually on 10/1	7.50%	3.50%	3.50%	3.70%	3.00%
Graduate Student Researchers (GSRs), effective 10/1/23 and annually on 10/1	6.40%	6.40%	6.40%	6.40%	6.40%

Salaries are based on actual salaries at time of submission and are projected to include yearly escalations as per the table above. Postdoc and GSR salaries are based on experience level and escalated annually in October. All other titles escalate in July.

FRINGE BENEFITS:

The University of California, Berkeley Composite Fringe Benefit Rates (CFBR) have been reviewed and federally approved by the Department of Health and Human Services (DHHS) on 06/25/2020 for use by all fund sources for UC Berkeley's FY20-21. Rates beyond June 30, 2021 are estimates and are provided for planning purposes only. Future CFBR rates are subject to review and

approval by DHHS on an annual or bi-annual basis. Fringe benefits are assessed as a percentage of the respective employee's salary. The benefit rates are as follows:

In January 2023, the campus submitted the fiscal year 2023-24 proposed composite benefit rates (CBRs) to the federal government. For budget planning purposes, the submitted proposed CBR rates listed below are being used in this proposal. Proposed UCB Composite Benefit Rates (1/2023)

	Approved		**Proposed**		**Projections for Planning Purposes -->**		
CBR Rate Group	**FY20**	**FY21**	**FY22**	**FY23**	**FY24**	**FY25**	**FY26**
Limited	17.4%	16.4%	14.4%	14.0%	12.2%	12.2%	12.2%
Students (Graduate and Undergraduate)	2.4%	2.4%	2.6%	2.8%	2.3%	2.3%	2.3%

For more information, please see: http://www.spo.berkeley.edu/policy/benefits/benefits.html

The University of California provides full remission of tuition, fees, and graduate student health insurance to all graduate students who are employed on-campus 45% time or greater during the academic year. For FY22-23, the rate for out-of-state remission is $17,975 per semester, which is escalated annually in the budget at a rate of 4% each year. For FY22-23, the rate for in-state remission is $10,424 per semester, which is escalated annually in the budget at a rate of 4% each year. Additional information regarding the fee remission program and fees can be found at: http://grad.berkeley.edu/financial/fee-remissions/ and https://registrar.berkeley.edu/tuition-fees-residency/tuition-fees/fee-schedule.

INDIRECT COSTS:

Indirect costs are based on University negotiated rates with the cognizant federal authority and are applied at a rate of 60.50% for FY21 using the modified total direct cost (MDTC) formula for a total amount of $79,564 as per the approved rate agreement dated 06/25/2020. Modified total direct costs exclude equipment, capital expenditures, charges for patient care, student tuition remission, participant support costs, rental costs of off-site facilities, scholarships, and fellowships as well as the portion of each subgrant and subcontract in excess of $25,000. For more information, please see: http://www.spo.berkeley.edu/policy/fa.html. The rates after June 30, 2022 are provisional and subject to change based upon our updated federally negotiated indirect cost rate agreement.

EXHIBIT G

FW: 75F40123C00211 P00001 Notice of Modification - Termination for Convenience

From: Sun, Lena S Y. (lss4@cumc.columbia.edu)

To: spi@berkeley.edu; polskymermin@sbcglobal.net

Date: Tuesday, May 20, 2025 at 04:08 PM PDT

From: Lusk, Amanda <Amanda.Lusk@fda.hhs.gov>
Date: Friday, March 7, 2025 at 3:13 PM
To: Sun, Lena S Y. <lss4@cumc.columbia.edu>
Cc: Whitt, James <James.Whitt@fda.hhs.gov>, Johnson, Mary <Mary.Johnson@fda.hhs.gov>
Subject: [EXTERNAL] 75F40123C00211 P00001 Notice of Modification - Termination for Convenience

You don't often get email from amanda.lusk@fda.hhs.gov. Learn why this is important

Good afternoon,

Please see attached the signed unilateral modification P00003 to FDA Contract No. 75F40123C00211. Please note that the full termination of this contract is taken for the Government's convenience and is as a result of recent Presidential Executive Orders.

Please confirm receipt of the modification P00003.

Amanda Lusk
Contract Specialist IService Contracts Branch

Division of Acquisition Operations (DAO)
Office of Acquisitions and Grants Services (OAGS)
Office of Finance, Budget, and Acquisitions (OFBA)
U.S. Food and Drug Administration (FDA)
Tel: (240) 402-0264
Amanda.Lusk@fda.hhs.gov

Termination for Covenience Notice.docx 75F40123C00211 3-7-2025.pdf
254.5kB

75F40123C00211 P00003.pdf
90.9kB

EXHIBIT H

NOTICE OF TERMINATION TO PRIME CONTRACTORS

ATTN: The Trustees of Columbia University in the City of New York, Attn: Lena Sun, 630 W. 168th Street, Fl 4, New York, NY 10032
Subject: Notice of Termination for Government's Convenience of Contract 75F40123C00211

(a) Effective date of termination. You are notified that Contract No. 75F40123C00211 (referred to as "the contract") is terminated "completely" for the government's convenience under the clause entitled FAR 52.212-4 (l). The termination is effective "immediately upon receipt of this Notice."

(b) Cessation of work and notification to immediate subcontractors. You shall take the following steps:
  (1) Stop all work, make no further shipments, and place no further orders relating to the contract, except for—
    (i) The continued portion of the contract, if any;
    (ii) Work-in-process or other materials that you may wish to retain for your own account, provided no additional expenses are incurred by the Government; or
    (iii) Work-in-process that the contracting officer (CO) authorizes you to continue (A) for safety precautions, (B) to clear or avoid damage to equipment, (C) to avoid immediate complete spoilage of work-in-process having a definite commercial value, or (D) to prevent any other undue loss to the government. (If you believe this authorization is necessary or advisable, immediately notify the CO by telephone or personal conference and obtain instructions.)
  (2) Keep adequate records of your compliance with paragraph (b)(1) of this section showing the—
    (i) Date you received the Notice of Termination;
    (ii) Effective date of the termination; and
    (iii) Extent of completion of performance on the effective date.
  (3) Furnish notice of termination to each immediate subcontractor and supplier that will be affected by this termination. In the notice—
    (i) Specify your government contract number;
    (ii) State whether the contract has been terminated completely or partially;
    (iii) Provide instructions to stop all work, make no further shipments, place no further orders, and terminate all subcontracts under the contract, subject to the exceptions in paragraph (b)(1) of this section;

(iv) Provide instructions to submit any settlement proposal promptly; and
(v) Request that similar notices and instructions be given to its immediate subcontractors.

(4) Notify the CO of all pending legal proceedings that are based on subcontracts or purchase orders under the contract, or in which a lien has been or may be placed against termination inventory to be reported to the government. Also, promptly notify the CO of any such proceedings that are filed after receipt of this Notice.

(5) Take any other action required by the CO or under the Termination clause in the contract.

(c) Termination inventory.

(1) As instructed by the CO, transfer title and deliver to the government all termination inventory of the following types or classes, including subcontractor termination inventory that you have the right to take: "None".

(2) To settle your proposal, it will be necessary to establish that all prime and subcontractor termination inventory has been properly accounted for. For detailed information, see FAR 45.

(d) Settlements with subcontractors. You remain liable to your subcontractors and suppliers for proposals arising because of the termination of their subcontracts or orders. You are requested to settle these settlement proposals as promptly as possible. For purposes of reimbursement by the government, settlements will be governed by the provisions of FAR 49.

(e) Completed end items.

(1) Notify the CO of the number of items completed under the contract and still on hand and arrange for their delivery or other disposal (see FAR 49.205).

(2) Invoice acceptable completed end items under the contract in the usual way and do not include them in the settlement proposal.

(f) Patents. If required by the contract, promptly forward the following to the CO:

(1) Disclosure of all inventions, discoveries, and patent applications made in the performance of the contract.

(2) Instruments of license or assignment on all inventions, discoveries, and patent applications made in the performance of the contract.

(g) Employees affected.

(1) If this termination, together with other outstanding terminations, will necessitate a significant reduction in your workforce, you are urged to—

(i) Promptly inform the local State Employment Service of your reduction-in-force schedule in numbers and occupations, so the service can take timely action in assisting displaced workers;

(ii) Give affected employees maximum practical advance notice of the employment reduction and inform them of the facilities and services available to them through the local State Employment Service offices;
(iii) Advise affected employees to file applications with the State Employment Service to qualify for unemployment insurance, if necessary;
(iv) Inform officials of local unions having agreements with you of the impending reduction in force; and
(v) Inform the local Chamber of Commerce and other appropriate organizations that are prepared to offer practical assistance in finding employment for displaced workers of the impending reduction in force.

(2) If practicable, urge subcontractors to take similar actions to those described in paragraph (1) of this section.

(h) Administrative. The contract administration office named in the contract will identify the CO who will be in charge of the settlement of this termination and, upon request, provide the necessary settlement forms. Matters not covered by this notice should be brought to the attention of the undersigned.

(i) Please acknowledge receipt of this notice as provided below.

James G. Whitt -S
Digitally signed by James G. Whitt -S
Date: 2025.03.07 15:04:02 -05'00'

James G. Whitt, Contracting officer
Office of Acquisitions and Grants Services
Division of Acquisition Operations
11601 Landsdown Street, North Bethesda, MD 20852

ACKNOWLEDGMENT OF NOTICE

The undersigned acknowledges receipt of a signed copy of this notice on _____, 2025.
One signed copy of this notice is returned.

_____
The Trustees of Columbia University in the City of New York

By _____
(Name)

_____
(Title)

(End of notice)

EXHIBIT I

AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

1. CONTRACT ID CODE	PAGE OF PAGES
	1 2

2. AMENDMENT/MODIFICATION NO.	3. EFFECTIVE DATE	4. REQUISITION/PURCHASE REQ. NO.	5. PROJECT NO. *(If applicable)*
P00003	See Block 16C		

6. ISSUED BY	CODE	7. ADMINISTERED BY *(If other than Item 6)*	CODE
DAO		DAO	

DHHS/FDA/OAGS/DAO
ATTN: Telisha Wilson
10903 New Hampshire Ave.
WO2/3rd Floor
Silver Spring MD 20903

DHHS/FDA/OAGS/DAO
ATTN: Amanda K. Lusk
10903 New Hampshire Ave.
WO2/3rd Floor
Silver Spring MD 20903

8. NAME AND ADDRESS OF CONTRACTOR *(No., street, county, State and ZIP Code)*

COLUMBIA UNIVERSITY IN THE CITY OF NEW YORK
Attn: OLGA CARR
722 W 168TH STREET
4TH FLOOR
NEW YORK NY 100323702

CODE 135598093 FACILITY CODE

(x) 9A. AMENDMENT OF SOLICITATION NO.

9B. DATED *(SEE ITEM 11)*

x 10A. MODIFICATION OF CONTRACT/ORDER NO. 75F40123C00211

10B. DATED *(SEE ITEM 13)* 09/25/2023

11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS

☐ The above numbered solicitation is amended as set forth in Item 14. The hour and date specified for receipt of Offers ☐ is extended, ☐ is not extended.
Offers must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended , by one of the following methods: (a) By completing Items 8 and 15, and returning _____ copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted ; or (c) By separate letter or electronic communication which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGEMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment you desire to change an offer already submitted , such change may be made by letter or electronic communication, provided each letter or electronic communication makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

12. ACCOUNTING AND APPROPRIATION DATA *(If required)*
See Schedule

13. THIS ITEM ONLY APPLIES TO MODIFICATION OF CONTRACTS/ORDERS. IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.

CHECK ONE	
	A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: *(Specify authority)* THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A.
	B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES *(such as changes in paying office, appropriation data, etc.)* SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103(b).
	C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF:
X	D. OTHER *(Specify type of modification and authority)* FAR 52.212-4 (l) Termination for the Government's Convenience

E. IMPORTANT: Contractor ☒ is not ☐ is required to sign this document and return _____ copies to the issuing office.

14. DESCRIPTION OF AMENDMENT/MODIFICATION *(Organized by UCF section headings, including solicitation/contract subject matter where feasible.)*

Tax ID Number: 13-5598093
UEI: QHF5ZZ114M72
1. Termination for Convenience of the Government:
The contract identified in Block 10A is hereby terminated for the convenience of the Government effective 3/7/2025.
2. Scope of Termination:
This modification fully terminates the Contract.
3. Settlement of Contractor's Claims:
The Contractor is directed to immediately stop all work on the fully terminated Contract and to take actions necessary to protect and preserve any property in its possession in which the Government has an interest. The Contractor shall submit a final termination
Continued ...

Except as provided herein, all terms and conditions of the document referenced in Item 9 A or 10A, as heretofore changed, remains unchanged and in full force and effect.

15A. NAME AND TITLE OF SIGNER *(Type or print)*		16A. NAME AND TITLE OF CONTRACTING OFFICER *(Type or print)*	
		JAMES G. WHITT	
15B. CONTRACTOR/OFFEROR	15C. DATE SIGNED	16B. UNITED STATES OF AMERICA	16C. DATE SIGNED
_____ *(Signature of person authorized to sign)*		_____ *(Signature of Contracting Officer)*	

CONTINUATION SHEET	REFERENCE NO. OF DOCUMENT BEING CONTINUED	PAGE	OF
	75F40123C00211/P00003	2	2

NAME OF OFFEROR OR CONTRACTOR
COLUMBIA UNIVERSITY IN THE CITY OF NEW YORK

ITEM NO. (A)	SUPPLIES/SERVICES (B)	QUANTITY (C)	UNIT (D)	UNIT PRICE (E)	AMOUNT (F)
	settlement proposal to the Contracting Officer in accordance with FAR 49.303-1 within one (1) year of the effective date of termination. Failure to submit a timely proposal may result in a unilateral determination by the Contracting Officer. 4. Government Property: The Contractor shall comply with FAR 52.245-1, Government Property, to identify and dispose of any Government-furnished property or equipment associated with the terminated work. 5. Final Payment and Adjustments: Final adjustments to the Contract price, if any, as a result of this termination will be negotiated and documented in a subsequent modification. 6. Administrative Information: The effective date of this modification is March 7, 2025, and no further deliveries, performance, or funding obligations are authorized for the fully terminated Contract. Discount Terms: HHS NET 30P Period of Performance: 09/30/2024 to 03/07/2025				

EXHIBIT J

Phoebe Award Summary: 058184-003

PIs and Campus RAs always are responsible for reading and understanding all of the award terms and conditions found in the award document. The Phoebe Award Summary is provided as a courtesy to summarize certain elements of the award. Errors found on the PAS should be reported to Froylan Fernandes at ffernandes@berkeley.edu.

PI Summary

Funding Change	**$0**
Project Title	**Health and Neurodevelopmental Outcomes in Infants at Risk for Neonatal Opioid Withdrawal Syndromes: Effects of Timing and Duration of Prenatal Opioid Exposure & Postnatal Management with ESC**
Principal Investigator	Sam Pimentel
Lead Unit	PSTAT Statistics
SPO/IAO Contact	Artawood Chitamitara
Sponsor	009564 Columbia University
Prime Sponsor	003600 DHHS FDA Food and Drug Administration
Award Transaction Comment	**Termination effective March 7, 2025.**
Award Type	Contract
Transaction Type	Modification
Sponsor Award Number	1(GG018663-02)
Sponsor Modification Number	02

Financial Information

BFS Chart of Accounts

Fund	Dept. ID	Function	CF1	CF2
86475	13090	44		PSPIM

Budget Periods

Phoebe Award Number	Begin Date	End Date	Anticipated	Obligated	Funding Change
058184-002	9/30/23	9/29/24	$52,555	$52,555	
058184-003	**9/30/24**	**3/7/25**	**$55,122**	**$55,122**	**$0**

Anticipated Total **$107,677** for the project period **9/30/23** – **3/7/25**

Fund Advance

Authorized Amount: **$52,555**

Effective Date: **5/28/24**

Indirect Cost Information

Rate	Base Type	On/Off Campus	Waiver/Reduction
60.5%	MTDC	On	

Fiscal Comments

Reference "SAPO G19718" when submitting invoices.

Generated: April 15, 2025, 9:23 PM

Comments and Special Terms

General Comments

Please review award document carefully for intellectual property, procurement, financial, and other terms and conditions.

Referenced Document

E-Verify applies

Informed Participation: please review document type "Informed Participation" in Phoebe Search under this award record for further information.

This award is subject to the Research Terms and Conditions. Additional information can be accessed here: https://www.nsf.gov/awards/managing/rtc.jsp

This award is subject to the Uniform Guidance 2 CFR 200. Additional information can be accessed here: https://www.ecfr.gov/cgi-bin/text-idx?tpl=/ecfrbrowse/Title02/2cfr200_main_02.tpl

Principal Investigators are responsible for informing all members of the project team that procuring, obtaining, providing, or using any telecommunications equipment produced by Huawei Technologies Company, ZTE Corporation (or any subsidiary or affiliate of such entities), Hytera Communications Corporation, Hangzhou Hikvision Digital Technology Company, Dahua Technology Company (or any subsidiary or affiliate of such entities), or any other entity reasonably believed to be owned or controlled by, or otherwise connected to, the government of a covered foreign country is strictly prohibited. Note that personal device use, including cell phone use, except for personal use, is included in the prohibition. In addition, PIs are advised to work closely with Supply Chain Management on procurement of any third-party services. Any known breach of the ban must be reported to SPO as soon as reasonably possible.

Compliance Review

Type	Protocol Number	Approval Status	Approval Date	Expiration Date
Financial disclosure		Negative		

Reporting Requirements

Reports listed here are final reports only. Please see your award terms for required interim reports and schedules.

Final technical report due:	As required
Final intellectual property (patents and inventions) report due:	As required

Other Details

CFDA	
Activity Type	Applied research
Project Type	Regular
FDP/RTC	No
Equipment Title	Other
Phoebe Proposal ID(s)	20233529, 36833

SAPO: G19718

Amendment to a Subcontract / Subaward Under a Federal Contract

Federal Awarding Agency: Food and Drug Administration
Amendment No.: 2
Federal Awarding Agency Contract Number: 75F40123C00211
Subcontract No.: 1(GG018663-02)

PTE - Contractor		Subrecipient - Subcontractor
The Trustees of Columbia University in the City of New York	Entity Name	The Regents of the University of California
subawards-CUMC@columbia.edu	Contact Email	spoawards@berkeley.edu
Lena Sun	Principal Investigator	Sam Pimentel

Project Title: Health and Neurodevelopmental Outcomes in Infants at Risk for Neonatal Opioid Withdrawal Syndromes (NOWS): Effects of Timing and Duration of Prenatal Opioid Exposure (POE) & Postnatal Management with Eat-Sleep-Console (ESC)

Cumulative Budget Period(s) (Agreement Start Date)	(End Date of Latest Budget Period)	Amount Funded This Action	Total Amount of Funds Obligated to Date
Start Date: 09/30/2023	End Date: 03/07/2025	$ 0.00	$ 107,677.00

Subrecipient Cost Share ☐ | Subject to FFATA ☐ | Subrecipient UEI (Unique Entity Identifier - May leave blank if unchanged from prior Agreement): GS3YEVSS12N6

Amendment(s) to Original Terms and Conditions

This Amendment revises the above-referenced Subcontract Agreement as follows:

☐ **Additional Budget Period**

☐ **No Cost Extension**

☐ **Additional Funding**

☐ **Deobligation**

Carryover is **Not Automatic** Carryover across budget periods requires prior approval.

☐ **Carryover Authorized**

If carryover is not automatic, the "Total Amount of Funds Obligated to Date" stated above may not reflect the actual balance available. The Subrecipient is responsible for tracking unobligated balances and subsequent carryover approvals from prior budget periods. In the event that funding was not fully expended by the Subrecipient during the prior period, the Subrecipient is not authorized to use funds from any prior periods, unless approval is granted by the PTE.

■ **Detailed Budget/Scope of Work/Notice of Award Attached** (Specify if the Budget and Scope of Work are "New", "Revised", or "Supplemental" in dropdown or "Other")

A Notice of Termination is incorporated by attachment to this Amendment.

■ **Other (See Below)**

TERMINATION:
This modification revises the Project End Date per the termination of the Prime Award, effective 03/07/2025.

For clarity: all amounts stated in this amendment are in United States Dollars.

All other terms and conditions of this Subcontract Agreement remain in full force and effect.

By an Authorized Official of Contractor:	By an Authorized Official of Subcontractor:
Signed by: Rosa Rivera 8A41B0822D6C433...	Sabina Gafarova Digitally signed by Sabina Gafarova Date: 2025.03.24 12:02:51 -07'00'
Date: 4/8/2025 | 7:36:23 AM PDT	Date: 03/24/2025
Name: Rosa Rivera	Name: Sabina Gafarova
Title: Director	Title: Assistant Director

COLUMBIA UNIVERSITY MEDICAL CENTER

Sponsored Projects Administration

Office Location
154 Haven Avenue, 2nd Floor
New York, NY 10032
212.305.4191 Tel
212.305.3697 Fax

Mailing Address
630 West 168th Street
Mail Box 49
New York, NY 10032

Date: March 10, 2025

Re: 75F40123C00211

Dear Partner:

The University received notice from the U.S. government on March 7, 2025, that the above-referenced award has been terminated in full, effectively immediately.

Accordingly, we direct you to immediately stop all work on the above-referenced award and cause any lower tier subcontractor/subgrantee/supplier to stop work. You may not make further shipments or place further orders. We will also contact you shortly regarding the preparation of a termination settlement proposal. Such settlement proposal may include payment reflecting work performed prior to the notice of termination, plus reasonable charges you can demonstrate have resulted from the termination. Therefore, it is important to (a) document work performed and actual costs incurred; and (b) segregate any termination costs, which will need to be separately invoiced and are subject to government approval. You may not be paid for any work performed or costs incurred which reasonably could have been avoided, or which the government disallows.

Please note that it may be possible for the Principal Investigator to seek authorization from the U.S. government to continue work-in process (a) for safety precautions, (b) to clear or avoid damage to equipment, (c) to avoid immediate complete spoilage of work-in-process having a definition commercial value, or (d) to prevent any undue loss to the government. The Principal Investigator will consider whether any of these categories apply to work on this award and notify you if any such authorization is sought and received. Absent any such authorization, provided to you in writing, we cannot pay for expenses incurred after your receipt of this letter.

We will, of course, inform you if anything should change regarding the award's status. In the meantime, however, the termination is in effect and all activities on the award must cease.

Please confirm receipt of this communication and that you have stopped all work on the above-referenced award. Please also sign and return via email to [subawards-cumc@columbia.edu] the enclosed modification that revises the Project End Date per the termination of the Prime Award, effective March 7, 2025.

Thank you for your understanding and prompt attention to this matter.

Sincerely,
William J Berger
Assistant Vice President
Sponsored Projects Administration
The Trustees of Columbia University in the City of New York

cc: Lena Sun, MD, Emanuel M. Papper Professor of Anesthesiology and Professor of Pediatrics at the Columbia University Medical Center

AMENDMENT OF SOLICITATION/MODIFICATION OF CONTRACT

1. CONTRACT ID CODE	PAGE OF PAGES
	1 3

2. AMENDMENT/MODIFICATION NO.	3. EFFECTIVE DATE	4. REQUISITION/PURCHASE REQ. NO.	5. PROJECT NO. *(If applicable)*
P00001	See Block 16C		

6. ISSUED BY CODE DAO

DHHS/FDA/OAGS/DAO
ATTN: Howard S. Yablon
10903 New Hampshire Ave.
WO2/3rd Floor
Silver Spring MD 20903

7. ADMINISTERED BY *(If other than Item 6)* CODE

8. NAME AND ADDRESS OF CONTRACTOR *(No., street, county, State and ZIP Code)*

THE TRUSTEES OF COLUMBIA UNIVERSITY IN THE CITY OF NEW YORK 122686
Attn: WILLIAM BERGER
THE TRUSTEES OF COLUMBIA UNIVERSITY
630 W 168TH ST FL 4
NEW YORK NY 10032

CODE 122686 FACILITY CODE

(x) 9A. AMENDMENT OF SOLICITATION NO.

9B. DATED *(SEE ITEM 11)*

x 10A. MODIFICATION OF CONTRACT/ORDER NO. 75F40124C00087

10B. DATED *(SEE ITEM 13)* 08/15/2024

11. THIS ITEM ONLY APPLIES TO AMENDMENTS OF SOLICITATIONS

☐ The above numbered solicitation is amended as set forth in Item 14. The hour and date specified for receipt of Offers ☐ is extended, ☐ is not extended.
Offers must acknowledge receipt of this amendment prior to the hour and date specified in the solicitation or as amended , by one of the following methods: (a) By completing Items 8 and 15, and returning _____ copies of the amendment; (b) By acknowledging receipt of this amendment on each copy of the offer submitted ; or (c) By separate letter or electronic communication which includes a reference to the solicitation and amendment numbers. FAILURE OF YOUR ACKNOWLEDGEMENT TO BE RECEIVED AT THE PLACE DESIGNATED FOR THE RECEIPT OF OFFERS PRIOR TO THE HOUR AND DATE SPECIFIED MAY RESULT IN REJECTION OF YOUR OFFER. If by virtue of this amendment you desire to change an offer already submitted , such change may be made by letter or electronic communication, provided each letter or electronic communication makes reference to the solicitation and this amendment, and is received prior to the opening hour and date specified.

12. ACCOUNTING AND APPROPRIATION DATA *(If required)*
2024.699R1FS.25505.C24X1903ONDX215000000

13. THIS ITEM ONLY APPLIES TO MODIFICATION OF CONTRACTS/ORDERS. IT MODIFIES THE CONTRACT/ORDER NO. AS DESCRIBED IN ITEM 14.

CHECK ONE	
	A. THIS CHANGE ORDER IS ISSUED PURSUANT TO: *(Specify authority)* THE CHANGES SET FORTH IN ITEM 14 ARE MADE IN THE CONTRACT ORDER NO. IN ITEM 10A.
	B. THE ABOVE NUMBERED CONTRACT/ORDER IS MODIFIED TO REFLECT THE ADMINISTRATIVE CHANGES *(such as changes in paying office, appropriation data, etc.)* SET FORTH IN ITEM 14, PURSUANT TO THE AUTHORITY OF FAR 43.103(b).
	C. THIS SUPPLEMENTAL AGREEMENT IS ENTERED INTO PURSUANT TO AUTHORITY OF:
X	D. OTHER *(Specify type of modification and authority)* FAR 52.212-4 (l) Termination for the Government's Convenience

E. IMPORTANT: Contractor ☒ is not ☐ is required to sign this document and return _____ copies to the issuing office.

14. DESCRIPTION OF AMENDMENT/MODIFICATION *(Organized by UCF section headings, including solicitation/contract subject matter where feasible.)*

Tax ID Number: 13-5598093
UEI: QHF5ZZ114M72
FDABAA-24-00123, REFERENCE: FY24C3DP2

COR:
Jason James
jason.james@fda.hhs.gov
240-402-4948

CONTRACTOR TECHNICAL CONTACT:
Lena S. Sun MD
Continued ...

Except as provided herein, all terms and conditions of the document referenced in Item 9 A or 10A, as heretofore changed, remains unchanged and in full force and effect.

15A. NAME AND TITLE OF SIGNER *(Type or print)*		16A. NAME AND TITLE OF CONTRACTING OFFICER *(Type or print)*	
		HOWARD S. YABLON	
15B. CONTRACTOR/OFFEROR	15C. DATE SIGNED	16B. UNITED STATES OF AMERICA	16C. DATE SIGNED
_____ *(Signature of person authorized to sign)*		_____ *(Signature of Contracting Officer)*	

CONTINUATION SHEET	REFERENCE NO. OF DOCUMENT BEING CONTINUED	PAGE	OF
	75F40124C00087/P00001	2	3

NAME OF OFFEROR OR CONTRACTOR
THE TRUSTEES OF COLUMBIA UNIVERSITY IN THE CITY OF NEW YORK 122686

ITEM NO. (A)	SUPPLIES/SERVICES (B)	QUANTITY (C)	UNIT (D)	UNIT PRICE (E)	AMOUNT (F)
	LSS4@cumc.columbia.edu 212-305-2413 CONTRACTOR ADMINISTRATIVE CONTACT: Katherine Leon Grants-office@columbia.edu 202-305-6191 1. Termination for Convenience: The contract identified in Block 10A is hereby terminated for the convenience of the Government effective 3/7/2025. 2. Scope of Termination: This modification terminates the entire contract. 3. Settlement of Contractor's Claims: The Contractor is directed to immediately stop work on the terminated portion(s) of the contract and to take action necessary to protect and preserve any property in its possession in which the Government has an interest. The Contractor shall submit a final termination settlement proposal to the Contracting Officer in accordance with FAR 49.206-1 within 1 year of the effective date of termination. Failure to submit a timely proposal may result in a unilateral decision by the Contracting Officer. 4. Continued Performance of Non-Terminated Work (if applicable): The contractor shall continue performance of all work not terminated under this modification in accordance with terms and conditions of the contract. 5. Government Property (if applicable): The contractor shall comply with FAR 52.245-1, Government Property, to identify and dispose of any Government-furnished property or equipment associated with the terminated work. 6. Final Payment and Adjustments: Final adjustments to the contract price, if any, as a result of this termination will be negotiated and documented in a subsequent modification. 7. Administrative Information: The effective date of this modification is 3/07/2025, and no further deliveries, Continued ...				

CONTINUATION SHEET	REFERENCE NO. OF DOCUMENT BEING CONTINUED	PAGE	OF
	75F40124C00087/P00001	3	3

NAME OF OFFEROR OR CONTRACTOR

THE TRUSTEES OF COLUMBIA UNIVERSITY IN THE CITY OF NEW YORK 122686

ITEM NO. (A)	SUPPLIES/SERVICES (B)	QUANTITY (C)	UNIT (D)	UNIT PRICE (E)	AMOUNT (F)
	performance, or funding obligations are authorized for the termination portion(s) of the contract. A subsequent modification will be forthcoming once a termination settlement proposal has been received by the Government, and fair and reasonable termination costs can be determined. All other terms and conditions remain unchanged. Discount Terms: HHS NET 30P Payment: FDA PAYMENT SVCS Attn: FDA Vendor payment Team COLE RM8050 8455 Colesville Road Silver Spring MD 20993 Appr. Yr.: 2024 CAN: 699R1FS Object Class: 25505 CenterTag: C24X1903ONDX215000000 Period of Performance: 09/01/2024 to 03/07/2025 Change Item 1 to read as follows(amount shown is the obligated amount):				
1	BAA Contract, REFERENCE FY24C3DP2 Systematic Reviews of Vulnerable Pediatric Populations at Risks for Adverse Neurodevelopmental Outcome from Exposure to Opioid Analgesics Anesthetic and Sedative Agents Invoicing Schedule: See Attachment 2 Obligated Amount: $0.00				0.00

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Attorneys for Plaintiffs and the Proposed Class
[Additional counsel listed on signature page]

UNITED STATES DISTRICT COURT

NORTHERN DISTRICT OF CALIFORNIA

NEETA THAKUR, KEN ALEX, NELL GREEN NYLEN, ROBERT HIRST, CHRISTINE PHILLIOU, and JEDDA FOREMAN, on behalf of themselves and all others similarly situated,

Plaintiffs,

v.

DONALD J. TRUMP, in his official capacity as President of the United States; DEPARTMENT OF GOVERNMENT EFFICIENCY ("DOGE"); AMY GLEASON, in her official capacity as Acting Administrator of the Department of Government Efficiency; NATIONAL SCIENCE FOUNDATION;

[*caption cont'd next page*]

Case No. 3:25-cv-04737-RL

DECLARATION OF CHRISTINE PHILLIOU

The Honorable Rita F. Lin

BRIAN STONE, in his official capacity as Acting Director of the National Science Foundation;
NATIONAL ENDOWMENT FOR THE HUMANITIES;
MICHAEL MCDONALD, in his official capacity as Acting Chairman of the National Endowment for the Humanities;
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY;
LEE ZELDIN, in his official capacity as Administrator of the U.S. Environmental Protection Agency;
UNITED STATES DEPARTMENT OF AGRICULTURE;
BROOKE ROLLINS, in her official capacity as Secretary of the U.S. Department of Agriculture;
AMERICORPS (a.k.a. the CORPORATION FOR NATIONAL AND COMMUNITY SERVICE);
JENNIFER BASTRESS TAHMASEBI, in her official capacity as Interim Agency Head of AmeriCorps;
UNITED STATES DEPARTMENT OF DEFENSE;
PETE HEGSETH, in his official capacity as Secretary of the U.S. Department of Defense;
UNITED STATES DEPARTMENT OF EDUCATION;
LINDA MCMAHON, in her official capacity as Secretary of the U.S. Department of Education;
UNITED STATES DEPARTMENT OF ENERGY;
CHRIS WRIGHT, in his official capacity as Secretary of Energy;
UNITED STATES DEPARTMENT OF HEALTH AND HUMAN SERVICES;
ROBERT F. KENNEDY, JR., in his official capacity as Secretary of the U.S. Department of Health and Human Services;
UNITED STATES CENTERS FOR DISEASE CONTROL;
MATTHEW BUZZELLI, in his official capacity as Acting Director of the Centers for Disease Control;
UNITED STATES FOOD AND DRUG ADMINISTRATION;
MARTIN A. MAKARY, in his official capacity as Commissioner of the Food and Drug Administration;
UNITED STATES NATIONAL INSTITUTES OF HEALTH;
JAYANTA BHATTACHARYA, in his official capacity as Director of the National Institutes of

Health;
INSTITUTE OF MUSEUM AND LIBRARY SERVICES;
KEITH SONDERLING, in his official capacity as Acting Director of the Institute of Museum and Library Services;
UNITED STATES DEPARTMENT OF THE INTERIOR;
DOUG BURGUM, in his official capacity as Secretary of the Interior;
UNITED STATES DEPARTMENT OF STATE;
MARCO RUBIO, in his official capacity as Secretary of the U.S. Department of State;
DEPARTMENT OF TRANSPORTATION;
SEAN DUFFY, in his official capacity as Secretary for the U.S. Department of Transportation,

Defendants.

DECLARATION OF CHRISTINE PHILLIOU

I, Christine Philliou, declare as follows:

1. I have personal knowledge of the facts contained in this declaration and, if called as a witness, could and would testify to these facts.

2. I am a Professor of History at the University of California, Berkeley. I have held this position since 2021. From 2015 to 2021, I held the position of associate professor at the University. Previously I served as an assistant professor and then associate professor at Columbia University (2006-2015) and as a lecturer at Yale University (2004-2006).

3. I hold a B.A. from Columbia University and an M.A. and Ph.D. from Princeton University.

4. I am the author of two books: *Turkey: A Past Against History* (University of California Press, 2021) and *Biography of an Empire: Governing Ottomans in an Age of Revolution* (University of California Press, 2010), as well as dozens of articles and book chapters.

5. My work has received numerous recognitions, including a Fulbright-Hays Research Fellowship, a Brookings Institution Research Award, and the Lenfest Distinguished Faculty Award, and offers of fellowships from Stanford University and the American Council of Learned Societies.

6. In addition to my research and teaching, I founded the Program in Modern Greek and Hellenic Studies at the Institute for European Studies, the Turkish Ottoman and Post-Ottoman Studies Initiative at the Center for Middle Eastern Studies, and the Istan-Polis collaborative research project, which has drawn students and scholars from Berkeley, Greece, Turkey and elsewhere.

7. These programs have as their aim reframing our understanding of the area we call the Middle East and the Eastern Mediterranean and understanding anew connections between the seemingly separate nations-states and people of the region.

8. The programs have received recognitions including the Nikos Kazantzakis endowment from the Modern Greek Studies Foundation and grants from the Elios Foundation, the Pan-Cretan Association, the Peder Sather Center for Advanced Study, and the National Endowment for the Humanities.

9. A central focus of my work has been to help change the way students and scholars see the role of Christians, as well as Muslims and Jews, in the Ottoman Empire. Revealing the forms and extent of informal power in the Ottoman Empire offers a new lens on that part of the world and that period of history. It also shines an instructive light on a society in which people from different backgrounds found ways to live and prosper together.

10. A true and correct copy of my curriculum vitae is attached as **Exhibit A**.

Grant Funding for the Istan-Polis Project

11. A key feature of my recent work has been the Istan-Polis Project, which seeks both to produce new scholarly knowledge about one of the world's great cities, and to bring that knowledge to the public. The centerpiece of the public-facing effort is a novel interactive website that brings, to anyone with an Internet connection, previously unavailable data about the historical demography and topography of Istanbul.

12. The Istan-Polis project was conceived and initiated in 2021. To make the vision a reality, however, the project needed funding. For that, we turned to the National Endowment for the Humanities (NEH).

Application for Grant Funding (RZ-292650-23)

13. On November 29, 2022, through the Regents of the University of California, I submitted to the NEH an Application for Federal Domestic Assistance titled “Visualizing Local Christian Communities in Muslim Cosmopolitan Istanbul in the 19th and 20th Centuries.” The application consisted of a completed form and the following attachments: a team member list, narrative proposal, work plan, list of key personnel, resumes for key personnel, bibliography, appendices, list of funding received, and agreement (collectively, the “Grant Application”). A true and correct copy of the Grant Application is attached hereto as **Exhibit B**.

14. The purpose of the grant was to fund a project to reconstruct and analyze the history of Istanbul's Orthodox Christian communities in the final Ottoman century. The grant would provide funding for, among other things, (1) a review of census registers in Ottoman Turkish that were released to scholars only in the last 10 years, each of which contains 1000-6000 entries, and (2) an analysis of population counts and other sources with demographic information in Greek and French. We planned to complete historical profiles of dozens of different neighborhoods in Istanbul.

15. The grant would also fund development of a public-facing website to display the results of our data projects and to feed further research, collaboration, and a range of conventional (print) scholarly publications. The website would be designed both for scholars and, especially through the visualizations and interactive maps, for non-specialists including educators and a general audience. The project as a whole would form the basis for a new subfield of inquiry and serve to enhance understanding of the varied experiences of Orthodox Christians as a religious and ethnic minority within the changing landscape and shifting political and social conditions of the 19th and early 20th century.

16. The website would serve as a resource for Greek diaspora communities in the U.S. as well. The project's focus on the experience of this minority was intended to provide new tools for scholars seeking to clarify how the tensions between cosmopolitanism and nationalism were manifested in cities globally. It was also aimed to benefit lay people interested in genealogy.

17. As a capstone, the director and key collaborators would give public talks about the project to publicize and disseminate the project's research findings.

18. The Grant Application proposed a cumulative budget of $249,842 in NEH funds over three years. This budget would partially fund the salaries and benefits for myself, a Graduate Student Researcher, and a Finance Director. It would also fund travel and research expenses for key academic collaborators on the project and a post-doctoral researcher.

Award of Grant Funding (RZ-292650-23)

19. On September 22, 2023, the University of California, Berkeley and I received a letter from Shelly Lowe, the chair of the NEH, approving Project Application RZ-292650-23 for funding (the "Offer Letter"). The Offer Letter stated that NEH "has approved an award of $246,347.00 in support of your institution's project" and noted that the award documents from the NEH Office of Grant Management, which provide information on the period of performance and the terms and conditions that apply to the project, were available in NEH's electronic grant management system. A true and correct copy of the Offer Letter is attached hereto as **Exhibit C**.

20. In response to the award of the grant, my team and I planned for and then began executing the steps laid out in the grant application. We reached out to community members in Istanbul to establish the relationships that would lead to us being given access to churches, schools, and other community spaces that are closed to the public; we set up and expanded our data research team in order to develop our public-facing website for the project; we started investing time and resources into our first winter meeting and our first summer *in situ*, both in 2024; we assembled the archival sources and bibliography that would be needed to carry out the data collection and analysis; and we publicized the grant widely on websites and social media in order to build a public community to which we would disseminate our findings. We set up purchase orders for independent contractors, purchased airline tickets, reimbursed expenses for international and domestic travel, hired student workers, and paid vendors for lodging and catering. Some of these expenses have been invoiced and paid by NEH according to the terms of the grant. But there remains an encumbrance on our ledgers in the amount of $46,750 to pay our contractors—which has not been reimbursed—and budgeted amounts of $80,904 which have been designated to cover Project expenses through the full term of the grant. In incurring these expenses, we relied on the grant provisions that stated NEH would provide reimbursement for covered costs once they had been invoiced. And we bypassed other opportunities and diverted resources to the Project because we knew that by its terms the NEH letter stated the grant would last three years.

21. In the first year of the grant, we built the infrastructure for the project and the foundation for the website. The team members traveled to Berkeley for our first winter meeting in January 2024, some went to Europe in June 2024 for a related seminar on digital methods, and in June-July 2024 we all met in Istanbul for our *in situ* seminar. We hired and contracted with project managers to coordinate transcription and other work on the census register project, and spent funds on the project's website infrastructure. We also successfully tested the proof of concept for the website, posting 360-degree photographs of Orthodox churches in Istanbul that had been closed for decades.

22. Overall, the team in Year 1 of the grant focused on the Old City of Istanbul. We received special permission from the Ecumenical Patriarchate of Constantinople (Istanbul) to get access to these now-closed churches and schools. Art historians, architectural historians, and photographers helped to produce 360-degree pictures for the Project website. These pictures were revelatory: not only did people get to see inside churches that are closed to the public, but the churches looked different architecturally from what most people expected and their history turned out to be one that no one had before taken note of. The website has become a treasure to people with Greek heritage, and other heritages tracing their lineage to Istanbul, around the world. The Archbishop of North and South America, Elpidophoros, was so moved that he recorded and posted to YouTube his own 360-degree tour of the Orthodox Theological School on the island of Heybeliada (Chalki) in Istanbul, which has been closed for half a century but remains a site of global cultural and geopolitical significance. We unloaded the 360-degree photos of churches and schools of Istanbul to Google Eart for the first time, and the Patriarchate plans to link to them in its official website.

23. Our *in situ* seminar for Year 1 was life-changing for the students, undergraduate and graduate, who accompanied us, and the experience has shifted their own research trajectories in multiple significant ways. We were also joined by some of the world's top experts in Ottoman and Islamic architecture and urban studies, who not only shared their expertise with us but also got access to these spaces themselves for the first time in their lives.

24. Year 2 of the grant was to focus on the other side of the Bosporus (the Frankish Quarter). I believe that it would have produced similarly dramatic, perspective-changing results.

25. Year 3 of the grant would have centered on neighborhoods up and down the Bosporus. I believe that it, too, would have had significant and lasting impact.

Termination of Grant Funding (RZ-292650-23)

26. On April 2, 2025, the University of California, Berkeley, received an email from the address "Grant_Notifications@nehemail.onmicrosoft.com." Although it was not sent from an "neh.gov" email address, the email appeared to be from Michael McDonald, Acting Chairman for the National Endowment for the Humanities (the "Termination Email"). A true and correct copy of this email is attached hereto as **Exhibit D**.

27. Attached to the Termination Email was a letter, apparently from Michael McDonald, cancelling grant RZ-292650-23, effective the prior day, April 1 ("the Termination Letter"). A true and correct copy of this letter is attached hereto as **Exhibit E**.

28. The Termination Letter, which purports to be "in accordance with the termination clause of your Grant Agreement," reads in relevant part:

> Your grant no longer effectuates the agency's needs and priorities and conditions of the Grant Agreement and is subject to termination due to several reasonable causes, as outlined in 2 CFR §200.340. NEH has reasonable cause to terminate your grant in light of the fact that the NEH is repurposing its funding allocations in a new direction in furtherance of the President's agenda. The President's February 19, 2025 executive order mandates that the NEH eliminate all non-statutorily required activities and functions. *See Commencing the Reduction of the Federal Bureaucracy,* E.O. 14217 (Feb. 19, 2025). Your grant's immediate termination is necessary to safeguard the interests of the federal government, including its fiscal priorities. The termination of your grant represents an urgent priority for the administration, and due to exceptional circumstances, adherence to the traditional notification process is not possible. Therefore, the NEH hereby terminates your grant in its entirety effective April 1, 2025.
>
> *See* Exh. E at p. 1.

Harm Suffered from Termination of Grant Funding

29. The Istan-Polis Project, its staff, and I have suffered direct and immediate harm as a result of the cancellation of the grant. This is a particularly critical interval for the Project because we are completing the second year of a three-year grant in which we have invested significant time and money.

30. For example, when I received the Termination Letter, I was in the middle of planning a seminar in Istanbul for this summer. As a result of the grant termination, this seminar cannot proceed unless I urgently find replacement funding. Thus, the time I spent on its planning is likely to represent both sunk cost and opportunity cost. Further, even if I find replacement funding, the time I must now spend fundraising rather than doing project work is a real cost.

31. I am concerned that staff who were depending on funds provided by the grant will be without a livelihood. I am aware that the Project has outstanding invoices for researchers who have done difficult and painstaking work for which they have not been paid; I am concerned that these researchers may not be paid, even for work they have already performed. And I am concerned that they will be without future income.

32. As a result of the Termination Letter, I do not believe that we can continue our work under the grant. I have had to cancel or postpone indefinitely our main activity that was to happen this June and next year. Work on the website has been disrupted because the flow of information has been disturbed. I and my team are now unable to continue surveying and adding photographs from other areas of Istanbul. In addition to what I have just described, my staff and I have begun to consider cutbacks in our work plans and goals for the year. As far as I know, we do not have any alternate funding source in place.

33. I have observed that people working on the Project are demoralized, confused, and disappointed. Like them, I do not understand what is wrong with our grant or why it would violate any stated policy of the Administration. I am unsure of how to proceed. As noted below, we have submitted an appeal of the termination, but given the text and tone of the Termination Letter, I am not optimistic.

34. I believe my research team is doing something valuable for society. I do not understand why the NEH thought this work needed to be terminated. The 360-degree photos—dependent entirely on this grant—are immensely valuable. They give a worldwide community remote access to a precious piece of its heritage. I am deeply concerned that the end of the grant could mean an end to that access, and the closing of a remarkable window that was just opened.

Appeal from Termination of Grant (RZ-292650-23) Funding

35. On April 30, 2025, the University of California, Berkeley submitted to NEH via email an *Appeal of Termination of Award No. RZ-292650-23* (the "Appeal Letter"). A true and correct copy of this appeal letter is attached hereto as **Exhibit F**.

36. The Appeal Letter notes that "[a]lthough no statute or regulation requires UC to exhaust any administrative appeal process, the University is filing this appeal in accordance with Section XIII of the General Terms and Conditions for Awards to Organizations." *See* Exhibit F at p. 2, n.2.

37. The Appeal Letter contains three sections that in sequence explain why the grant should not have been terminated: (I) Section 200.340 Does Not Permit Termination of the Award; (II) The General Terms and Conditions Do Not Permit Termination of the Award; and (III) This Award is Not Inconsistent with Agency Priorities. *See* Exhibit F at pp. 2, 3, and 4.

38. The Award of Grant Funding remains unavailable to the Istan-Polis Project pending appeal.

Role of Class Representative

39. I am willing to take on the responsibilities of serving as a class representative. I understand that I will need to stay informed of developments in the lawsuit, communicate regularly with my attorneys, and act in the best interests of the class. I do not have any conflicts of interest that would prevent me from taking on this responsibility.

40. I have been in communication with other UC researchers, who would be members of the class, who have suffered the same general type of harm as I describe above, from the abrupt termination of their previously approved research grants. This harm is widespread and I believe it will only increase in scope and impact if classwide relief is not granted.

I declare under penalty of perjury under the laws of the State of California and the United States that the foregoing is true and correct.

Executed this 28 day of May, 2025.

Signed by:
Christine Phillion
4C88C57347D847B...
Christine Phillion

EXHIBIT A

Christine Philliou

Professor, Department of History
Chair, Middle Eastern Languages and Cultures Department
University of California, Berkeley

262 Social Sciences Building
University of California
Berkeley, CA 94720
philliou@berkeley.edu
Tel. (339) 927-2728

Academic Training

2004 **Princeton University**, Princeton, New Jersey
Ph.D. - History
Dissertation title: *Worlds old and new: Phanariot networks and the remaking of Ottoman governance, 1800-1850*
Advisor: Molly Greene (second advisor: Peter Brown)

1998 **Princeton University**
M.A. – Near Eastern Studies

1994 **Columbia College, Columbia University,** New York, New York
B.A. - History, with honors (*cum laude*) [Modern Greek Studies Minor]

Fundraising and Program Building

2022 Nikos Kazantzakis Visiting Scholar Program: $1 million
*Modern Greek Studies Foundation donation (endowment)
*additional current use funds totalling ~$40000

2020- İstanPólις Digital Humanities Collaboratorative (istanpolis.org)
*core group of scholars from Greece, Turkey and the US, undertaking a range of data projects based on Ottoman Turkish and Greek sources for the period 1821-1923
*Focus on human geography and the built environment of Istanbul and environs
*Ottoman Census Register Working Group–meets monthly, tabulating data sets from Istanbul neighborhood censuses 1821-1870
*established website to display the results of the projects (2021)
*developed and manage team of IT/Data experts to develop mapping and visualization features as well as a relational database
*applied for and received several grants for projects within this collaborative (OBI, Peder Sather Institute, etc.)
*National Endowment for the Humanities Collaborative Grant (see below)

2022- Ottoman and Post-Ottoman Studies Working Group
*organized and sponsored ~10 events in the 2022-3 academic year
*oversee and supervise graduate student coordinators

2021 Graduate Student Exchange program with Institute for Mediterranean Studies
*raised funds for eight initial grants of $5000 each (now one annually) for Berkeley grad students to conduct research in Crete
*donors included Elios Foundation; Diane and Markos Kounalakis; Modern Greek Studies Foundation; Pan-Cretan Association (total raised : $45000 + annual $5K)

2020 Modern Greek/Hellenic Studies Program
*Established program at Institute for European Studies

2020 Turkish, Ottoman and Post-Ottoman Studies (TOPOS)
*Established program at Center for Middle East Studies

Publications

Books

2025 [forthcoming] *Toward a New Defterology* (Istos Publishers, Istanbul). Handbook/reference guide for researchers in Ottoman history to decipher non-Muslim names written in Ottoman Turkish

2023- *Post-Ottoman: A World Under Construction* [Under contract with Princeton University Press; drafted]

2021 *Turkey: A Past against History* (University of California Press)

2010 *Biography of an Empire: Governing Ottomans in an Age of Revolution* (University of California Press, Middle East History list)

Translations/foreign editions

2025 Ukrainian edition of *Turkey: A Past Against History*, NikaCentre Publication

2023 *Τουρκία Η Αντιπολίτευση στν Ιστορία*, Alexandria Publications [Greek editions of Turkey: A Past Against History]

2022 *Türkiye: Tarihe Muhalif Bir Geçmiş* FOL Kitap (entering second edition) [Turkish edition of *Turkey: A Past Against History*]

2022 *Bir İmparatorluk Biyografisi*, İşbankası Kültür Yayınları [Turkish edition of *Biography of an Empire*]

2021 *Βιογραφία μίας Αυτοκρατορίας* Alexandria Publications [Greek edition of *Biography of an Empire*]

Scholarly Articles and Book Chapters

2025 "Invisible Ink: Erasures and Revelations in Valide Han, Istanbul" in *Istanbul Annual/YILLIK 6*

2025 "Dilemmas of Imperium in imperio: Reflections on Phanariot Governance, 1700-1821," in Phanariot Materialities, eds. Namık Günay Erkal, Haris Theodorellis-Rigas, and Firuzan Melike Sümertaş. Koç University Publications [forthcoming]

2025 "From Household to Dynasty: Phanariot Houses in Historical Perspective," invited Introduction/Preface to Phanariot Materialities Exhibition Volume [forthcoming]

2025 "The Dilemmas of Imperium in Imperio: Phanariots After the Mavrocordatoi, 1769-1821," in Bibliotheca Vivens II. Intelelctual Entanglements and Self-Fashioning of a Greek-Ottoman Elire (1641-1730) [Harrasowitz 2025] [forthcoming]

2025 "1710." Essay on the entrance of Phanariots to the Danubian (Romanian) Principalities in 1710 and its global significance, for Global History of Greece, initiated and organized by the French Institute in Athens [invited/commissioned and in press]

2024 "A Hellenist Among Persianists," in the feature "In and Out of Persian" with Nile Green, Sumit Guha, et al for Comparative Studies in Society and History [invited]

2024 "Between the Temple and the Palace," Inaugural Vassilis Lambropoulos Endowed Essay, University of Michigan Program in Hellenic Studies

2023 "Istanpolis: Field Notes," in *Journal of Ottoman and Turkish Studies Association*, special issue on digital humanities and Ottoman studies

2022 "Rum Geographies: An Introduction" - editor of special issue of *Journal of Ottoman and Turkish Studies* (Spring 2022) focusing on the cultural geographies of Greek Orthodox Christians in 19th- and 20th-century Istanbul

2022 "Preface," in Barlow Der Mugrdechian, Ümit Kurt, and Ara Sarafian eds., *The State of the Art of the Early Turkish Republic Period*, Volume 17 of the Armenian Series at the Press at California State University Fresno

2021 "Interventions," Introduction, co-authored and co-curated section with

Cemal Kafadar, Koray Durak, in *YILLIK/Istanbul Annual journal*

2021 "Liberalism and the Path to Treason in the Ottoman Empire, 1908-1923," in Karen Barkey, Sudipta Kaviraj, eds. *Negotiating Democracy and Religious Pluralism: India, Pakistan and Turkey*

2015 "The Armenian Genocide and the Politics of Knowledge," PublicBooks.org,

2016 "Nationalism, Internationalism and Cosmopolitanism in the Ottoman/Post-Ottoman World: Comparison and Commensurability," forthcoming in *Comparative Studies in South Asia, Africa, and the Middle East*

2013 "USSR South: Soviet Encounters with South Asia, Africa, and the Middle East," introduction to themed section in 2013 issue of *Comparative Studies in South Asia, Africa, and the Middle East*

2012 "The Ottoman Empire and the Imperial Turn," *Comparative Studies in Society and History* 54 (4): 721-745. Co-authored with Alan Mikhail [equal authors]
*Turkish translation in progress for: *Tarih ve Toplum Dergisi* [History and Society Journal]

2011 "Fixers in Motion: A Conversation" in *Comparative Studies in Society and History* 53(3): 692-707. A conversation with Andrew Shryock (editor, *CSSH*), Doug Rodgers (Anthropology, Yale University) and Craig Jeffrey (Geography, Oxford) on Phanariots as "pre-modern" fixers in comparative context with late 20th-century South Asian and Russian cases

2011 "When the clock strikes twelve: The inception of an Ottoman past in early Republican Turkey" for: "The Ottoman Empire from Present to Past: Memory and Ideology in Turkey and the Arab World," special issue of *Comparative Studies in Africa, Asia, and the Middle East* 31(1): 172-182—co-editor (with James Reilly (first editor), U of Toronto, and Amy Mills (co-second editor), U of South Carolina) and contributor

2010 "'Mad' about Kemalism: A satire in the early Turkish Republic," *Journal of Ottoman Studies* (festschrift for Rifa'at Abou-El-Haj), 36: 195-206.

2010 [in Turkish] "Osmanlı yönetiminde ve toplumsal hayatında Fenerliler," in *Toplumsal Tarih* (*Social History)* 200: 35-46 [Phanariots in Ottoman society and administration]

2009 "Communities on the verge: Unraveling the Phanariot ascendancy in Ottoman governance," in *Comparative Studies in Society and History* 51(1): 151-181.

2008 "The paradox of perceptions: Interpreting the Ottoman past through the national present, "in *Middle Eastern Studies* 44(5): 661-675.

2008 "A tale of two cities and an archive," in *International Journal of Turkish Studies* 14(1/2): 11-23.

Chapters in Collected/Conference Volumes

2020 "Liberalism and the Path to Treason in the Ottoman Empire 1908-1923," in Boris Kolonitskii, ed. *Cultures of Patriotism in World War One* (European University in St. Petersburg Press) [in Russian]

2011 "Families of empires and nations: Phanariot *hanedan*s from the Ottoman Empire to the world around it (1669-1856)," in *Transregional and Transnational Families in Europe and Beyond: Experiences since the Middle Ages*, edited by David Sabean, Simon Teutscher, Christopher Johnson, and Francesca Trivellato. New York (Berghahn Books): Chapter 9.

2011 "The Ottoman Empire between successors: Thinking from 1821 to 1922," in *Religion, Ethnicity, and Contested Nationhood in the Former Ottoman Space*, edited by Jorgen Nielsen. Leiden, Netherlands (Brill): 16-30.

2011 "The Absent Nineteenth Century: Personal and Political Autonomy in the Ottoman Empire," in *Untold Histories of the Middle East: Recovering voices from the nineteenth and twentieth centuries*, edited by Amy Singer, Christophe Neumann, and Aksin Somel; London (Routledge): 143-158.

2006 "Breaking the Tetrarchia and saving the Kaymakam: To be an ambitious Ottoman in 1821,". Rethymno, Crete (University of Crete): 175-188.

2003 [in Greek] "The Duties of Servitude: Service to the Ottoman State through the Eyes of Stephanos Vogorides, Prince of Samos," (in Greek) presented at the day-long conference, *Rum (Orthodox Christians) in the Service of the Sublime Porte* (in Greek), Penelope Stathi, ed., . Athens (Syllogos ton en Athenais Megalischoliton): 201-216.

2009 (Encyclopedia article) "Phanariots;" "Philike Hetaireia;" "Greek War of Independence," in Gabor Agoston and Bruce Masters, eds., *The Encyclopedia of the Ottoman Empire* New York (Facts on File): 457-8; 459; 240-3

Book Reviews

2024 M'hamed Oualdi, *A Slave Between Empires*, reviewed in *Archivum Ottomanicum* [forthcoming]

2023 Helen Pfeifer, *Empire of Salons: Conquest and Community in Early Modern Ottoman Lands,* reviewed in *The Middle East Journal 76/3 (Winter 2022-3): 427-9.*

2021 Dimitris Kamouzis, *The Greeks in Turkey: Elite Nationalism and Minority Politics in Early Republican Istanbul*, reviewed in *Journal of Modern Greek Studies 39/2 (October 2021): 481-4.*

2021 Konstantina Zanou, *Transnational Patriotism in the Mediterranean: Stammering the Nation*, reviewed in *Historein 19/2 (2021).*

2012 Stephen Dale, *The Muslim Empires of the Ottomans, Safavids, and Mughals*, for *Insight Turkey* 14 (2): 197.

2011 *The Eastern Mediterranean Under Ottoman Rule: Crete, 1645-1840*, edited by Antonis Anastasopoulos, reviewed for *International Journal of Middle East Studies* 43 (1): 154-5.

2009 *Living in the Ecumenical Ottoman Empire: Essays in Honor of Suraiya Faroqhi*, edited by Vera Costantini and Markus Koller, Brill, reviewed for *Insight Turkey* 11 (4): 169.

2008 *Ways to Modernity in Greece and Turkey: Encounters with Europe, 1850-1950.* Edited by Anna Frangoudaki and Caglar Keyder ; *Journal of Islamic Studies* 20(1): 122-4.

2008 *Women in the Ottoman Balkans. Edited by Irvin Schick and Amila Buturovic* for *Middle Eastern Studies* 44 (6): 1009-1010.

Fellowships and Grants

2024 UC Berkeley Vice Chancellor for Research Subvention Grant for *Toward a New Defterology* publication ($3K)

2023-2026 National Endowment for the Humanities Collaborative Grant, "Visualizing Local Christian Communities in Cosmopolitan Muslim Istanbul, 1821-1923" ($250K over three year) [related to the Istanpolis digital collaborative, please see below]

2023-2024 Peder Saether Center for Advanced Study grant ($25K) with co-PI Apostolos Spanos, University of Agder, Norway, for project entitled: "Digital methods in pedagogy for the urban history of the Mediterranean"

2023-4	France-Berkeley Fund grant ($12K) with Andreas Guidi, INALCO Paris, for collaborative project, "Digital methods for the study of mobilities in the Aegean region, 1821-1945"
2023	Othering and Belonging Institute, Berkeley: $5000 grant for DH project, "Christian-Jewish Religious Diversity and Intercommunality in Islamicate Istanbul"
2023	Institute for Slavic, East European and Eurasian Studies Subvention Grant, for translation of *Turkey: A Past Against History* into Ukrainian ($3000)
2022	Schoff Subvention grant, Columbia University, University Seminars, for translation of *Turkey: A Past Against History* into Greek ($3000)
2022	Townsend Center for the Humanities Subvention grant, for translation of *Turkey: a Past Against History* into Turkish ($1800)
2020-22	Peder Saether Institute for Advanced Studies Grant, in conjunction with Einar Wigen (University of Oslo) ($20K) for "Exploring the Ottoman World: Translation and Interconfessional Relations in the Long 19th Century"
2021	Schoff Subvention grant, Columbia University, University Seminars, for translation of *Biography of an Empire* into Greek ($3000)
2020-2021	Humanities Research Fellowship, Division of Arts and Sciences, UC Berkeley [sabbatical report enclosed]
2018-2019	Townsend Center for the Humanities, University of California Berkeley, Faculty Fellowship
2018-2021	Stanford Humanities Center, Stanford University, External Faculty Fellowship [Declined]
2018-2021	Burkhardt Fellowship, American Council of Learned Societies [Declined]
2018-2019	Stanford Center for Advanced Studies in Behavioral Sciences [Declined]
2013	Senior fellowship, Collegium Budapest/CEU Institute for Advanced Study
2012	Fellowship, Shelby Cullom Davis Center for Historical Studies, Princeton University [*2011-2013 Theme*: Authority and Legitimation]
2010	Subvention grant: *Institute of Turkish Studies* for *Biography of an Empire*

2009	Schoff Subvention grant: Columbia University Seminars
2009-2011	Cornell University Society of Fellows-NEH two-year post-doctoral fellowship, Department of Near Eastern Studies, (Declined)
2006	Koç Residential Center for the Study of Anatolian Civilizations senior fellowship (Declined)
2004	NEH/American Research Institute in Turkey Post-Doctoral Research Fellowship
2003-2004	American Council of Learned Societies' Eastern European Studies Dissertation Writing Fellowship
2000-2001	Fulbright-Hays International Diss. Research Fellowship
2001	American Research Institute in Turkey Diss. Research Grant
2000	Social Science Research Council Dissertation Research Grant
2000-2001	Fulbright-IIE grants (2000-2001 to Greece, 1998-1999 to Turkey) awarded, declined
1996-1998	Foreign Language Area Studies Fellowship (three consecutive years) for Turkish (1996-1997) and Arabic (1997-1998)
1996-1999	Seeger and Kostopoulos Grants in Hellenic Studies, Princeton University

Invited Presentations

2024	Cal Performances "Fractured Histories" 2024-2026 seasons, video interview on fractured histories, history and the arts
2024	Braudel Symposium, Stanford University/Berkeley November 15-16 Panel on "Scale"
2024	Mediterranean Intersections, College of the Redlands, November 16-17 Panel on Mamluks as Mediterranean actors
2025	"Opposition in the Late Ottoman Empire and Early Turkish Republic," Annual Kemal Karpat Distinguished Lecture in Turkish Studies, University of Wisconsin, Madison [invited/nominated]
2025	Deconstructing the Bazaar in the early 19th-century Istanbul: two case studies," Dissections works-in-progress series, Middle East Studies Center, CUNY Grad Center, New York

2024 Keynote address, "The Dilemmas of Imperium in Imperio," Phanariot Materialities conference, Koc Unviersity, Research Center for Anatolian Civilizationa [conference and planned exhibit inspired by first chapter of my *Biography of an Empire* book]

2024 "Imperium in imperio," Frei Universitat Berlin, project on Knowledge Transfer in Early Modern Southeast Europe

2024 "An Old Story: Turkey's Relationship to the Ottoman Past," annual distinguished lecture for the Claus M. Halle Institute for Global Research at Emory University and in collaboration with the American-Turkish Friendship Council (ATFC)

2024 "Quiet Revolutions and the Ends of the Ottoman Empire," invited lecture at Columbia University Sabanci Center for Turkish Studies

2023 Presenter, panel on opposition in the Turkish Republic, conference on the centenary of the Turkish Republic, Sabanci Center for Turkish Studies, Columbia University

2023 Discussant, "Waterfront" documentary film screening, invited by director Milos Jovanovic, UCLA History Department (Balkan/Serbian history)

2023 Invited speaker, *Turkey: A Past Against History*, University of Pennsylvania, Ottoman and Persian Studies Lecture Series

2023 "Research into the Shadows: Karagiozis in Asia Minor," Stavros Niarchos Public Humanities Initiative, University Seminar in Modern Greek Studies, University Seminar in Ottoman and Turkish Studies, Sabanci Center for Turkish Studies, Columbia University

2023 "Invisible Cities: Istanbul in the Nineteenth Century through Ottoman Census Registers," Brown University, Classics and Modern Greek Studies Department

2023 Moderator, "Contested Meanings of Zionism" –public debate with speakers Ethan Katz and Ussama Makdisi, UC Berkeley Law School

2023 "Hiding in Plain Sight: The Istanpolis DH Collaborative," at Stanford CESTA

2023 "Hiding in Plain Sight: The Istanpolis DH Collaborative," at Anatolian Civilizations Center online talks, Koç University (Turkey)

2023 Keynote panelist, discussant, Western Ottomanists Workshop, UCLA

2022	Book presentation of *Biography of an Empire* (in Greek, for Greek edition), Institute for Mediterranean Studies, Crete (discussants: Eleutheria Zei, Nikos Sigala, Moderator Marinos Sariyannis)
2022	"What's the Story? History and the Meanings of 1922," Eleutherios Venizelos Distinguished Lecture/Visiting Professor, American College of Greece/Deree, on the centennial of the Asia Minor Catastrophe and the Greco-Turkish Population Exchange
2022	Discussant, History Department colloquium *Empire of Ideas*, with author William Kirby
2022	Invited speaker, "Phanariots: Post-national approaches to a pre-national culture," National and Kapodistrian University of Athens
2022	Panelist, "Perspectives on Cosmopolitan Istanbul in the Hit Netflix Series, 'The Club,'" Sephardic Studies Program, School of International Studies, University of Washington, Seattle
2021	Invited speaker (with precirculated paper), "Quiet Revolutions and the Ends of the Ottoman Empire," Shelby Cullom Davis Center, Department of History, Princeton University
2021	Invited speaker on *Turkey: A Past Against History*, Atatürk Institute, Boğaziçi University
2021	Panelist at Delphi Economic Forum panel, "Ottoman Views of the Greek Revolution of 1821"
2021	Invited speaker, W'OTSA'p in Ottoman Studies online talk, "The Greek Revolution in Ottoman Studies"
2021	Invited speaker, "Phanariots: A primer," at the Anglo-Turkish Society
2021	Invited speaker, "The Ottoman context of the Greek Revolution," conference organized by Roderick Beaton on 1821, Edinburgh University
2021	Keynote speaker: "Exiled Narratives and the End of the Ottoman Empire," conference on "Narrating Exile in and between the Ottoman Empire, Turkey, and Europe," Turkish Studies Network of the Low Countries
2021	Panelist, Ottoman and Turkish Studies Association panel, "The Greek Revolution in Ottoman Studies"
2021	Panelist, *The Delphi Forum*, "Ottoman Views of the Greek War of

Independence"

2021 Invited speaker, "Muhalifliğin kökenleri" (the roots of opposition and dissent in Modern Turkey), Özgür İktisat Serisi, Boğaziçi University [Free Economics Series, student-organized lecture series, Istanbul] [in Turkish]

2021 Invited speaker, "The Greek Revolution 200 Years On," American Hellenic Education and Progress Association of Northern California

2020 Keynote speaker: "New trends in the historiography of the early Turkish Republic," annual conference in Armenian Studies, Fresno State University

2020 Invited speaker: "Turning Points: The Culture and Politics of Opposition in the Ottoman Empire, 1918-1924," Department of History, University of Miami

2019 Discussant/evaluator: *Mapping Ottoman Epirus* project, Stanford University

2019 Discussant/presenter: *Western Ottomanists Workshop*, Clarement College

2018 Presenter: "Turkey, the Middle East, and the Ottoman Past," public lecture delivered at the Temple Sinai, Oakland

2018 Presenter, closing remarks: *Minorities at the 1919 Paris Peace Conference, Conference held at American University*

2017 Presenter/discussant: Book talk for Sarah Stein's *Extraterritorial Dreams: European Citizenship, Sephardi Jews and the Ottoman Twentieth Century*, at UCLA

2017 Presenter: "Of mansions and men: Phanariot houses and their afterlives in Istanbul," at University of Washington, Seattle

2016 Presenter: "Writing and repression in the Ottoman Second Constitutional Period," EUME, Wissenschaftskolleg zu Berlin

2016 Presenter: "The Musurus Mansion and the Phanariot past," Zentrum Moderner Orient, Berlin

2017 Presenter: "Writing and repression in the Second Constitutional period," Columbia University, University Seminar in Ottoman and Turkish Studies

2016 Presenter: "Liberalism and the path to treason in the late Ottoman Empire," UC Berkeley, workshop on Pluralism and Democracy (Karen Barkey and Sudipta Kaviraj, organizers)

2016	Discussant: "Between the Global and the International," UC Berkeley, workshop organized by Samera Esmeir, CMES/Rhetoric
2016	Presenter: "Interrogating the Post-Ottoman," Workshop at London School of Economics
2015	Panelist: Ronald Grigor Suny's *A History of the Armenian Genocide*, Yale University Macmillan Center, Center for European Studies
2015	Lecture: "Refugees, Immigrants, Borders: Historical Perspectives," Berkeley-Stanford-Davis Departments of History mixer
2015	Lecturer, "Phanariots in the Ottoman Empire," at Modern Greek Studies Program, Cal State Sacramento
2015	Discussant, Western Ottomanists Workshop, UC Davis
2014	Panelist, "Cultures of Governance in the Mediterranean," NYU, November,
2014	Discussant, "Non-Muslims as Ottoman social actors" American Historical Association Convention, Washington, DC
2013	Discussant, "Personalities and politics in 19th-century Constantinople" Association for Slavic, East European and Eurasian Studies Convention, Boston
2013	Chair, "After the Imperial Turn: Post-national Arab histories and the Ottoman past," Middle East Studies Association Convention, New Orleans
2013	Keynote panelist, The Arabic-speaking Levant and the Mandate System, conference held at Princeton University, Department of Near Eastern Studies
2013	"Turkish Studies and the Mediterranean," University of Illinois, Urbana-Champaign lecture series in Mediterranean and European Studies,
2013	Discussant, "New approaches to the early Turkish Republic," Council on European Studies convention, Amsterdam
2013	Closing remarks for "Imperial Epistemologies" conference, Columbia/Barnard
2013	"The ends of Turkish Studies," Georgetown University Turkish Studies Program
2013	Panel chair, *Honor and Shame in Ottoman and post-Ottoman Mediterranean*

Societies conference, Central European University

2013 "Burning down the house: Ottoman passages to the Middle East," presentation to the History Department, UC-Berkeley

2012 Special seminar, "The Ottoman Empire and the Imperial Turn," History Department, Central European University

2012 Cultural politics and the question of opposition in 20th-century Turkey," Center for Eastern Mediterranean Studies, Central European University

2012 "Turkey: A society opening or closing?" Presentation to George Soros and the Board of Trustees of Central European University

2012 Presentation at "The end of the Ottoman Empire as 20th century history," Birmingham, UK(declined)

2012 Presentation on current research to George Soros and the Board of Trustees of the CEU-Institute for Advanced Study

2012 "The Balkan Wars as seen from Istanbul," Balkan Worlds conference, Thessaloniki, Greece

2012 "Between the agony of defeat and the thrill of victory: Ottoman authority displaced, 1918-1923," Shelby Cullom Davis Center for Historical Studies, Princeton University

2011 "The Alpha and the Omega? Accounts of communal violence in Istanbul

in the 1820s," Workshop in Armenian and Turkish Studies (WATS), Amsterdam

2011 Eighteenth-century Crossroads in Ottoman Studies: discussant/co-organizer (Central European University, Budapest)

2011 "Secret agents: Making history in the final Ottoman century," Bosphorus University

2010 "'Tolerance' and Conflict from the Ottoman to the Arab World: The Holy Sites dispute of 1851," American University in Beirut

2009 "Ottoman Legacies in the Arab World and Turkey," MESA panel : discussant

2009 "Maryam's last word," Beshara Doumani presentation, Near Eastern Studies research seminar, NYU: commentator

2009	*The Great Powers in the Holy Land* conference, Columbia University: commentator
2009	"New order, old order, and the volatile synthesis of Ottoman governance, 1791-1821," Cornell University, European Studies Colloquium
2008	"The paradox of perceptions: Interpreting the Ottoman past through the national present," at *Ottoman Legacies in the Middle East and Balkans* panel of the Middle East Studies Association conference, Washington, DC
2008	"Interpreting Sovereignty: Ottoman Dragomans and the birth of the Tercüme Odası," at the *Asian Translation Traditions* conference, Bosphorus University, Istanbul
2008	"Phanariots: Narrating the Ottoman past, making the Ottoman present," at Historical *Intersections between Hellenism and Islam*, Simon Fraser University,Vancouver
2008	"Phanariots narrating the Ottoman past, making the Ottoman present," at *Entangled Lives in the Mediterranean* symposium, Stanford University Sephardic Studies/Mediterranean Studies Center
2008	"A view from the edge: Observing Istanbul's Nizam-i Cedid from Bucharest," at *Empire, Faith, and Conquest*, Russia/Islam program, Harriman Institute, Columbia University
2008	"The Ottoman Empire between successors: Thinking from 1821 to 1922" at *Religion, Ethnicity and Contested Nationhood in the Former Ottoman Space* workshop, Swedish Oriental Institute, Istanbul
2008	"The paradox of perceptions: Interpreting the Ottoman past through the national present," at the *Middle East Institute brown bag lunch series*, Columbia University, NY
2008	"Phanariot families: precipitating and adapting to the shift from the transregional to the transnational," at *Transregional and Transnational Families workshop*, German Historical Institute, Washington, DC (organized by David Sabean for forthcoming volume of the same title)
2008	"The paradox of perceptions: Interpreting the Ottoman past through the national present," at University of South Carolina, Columbia, SC *New Directions in Turkish Studies speaker series*
2007	"A tale of two cities and an archive," at Brown Bag lunch lecture series, *Near Eastern Studies Department*, Princeton University

2007	"New directions in late Ottoman Balkan history," [commentator] at *American Association for the Advancement of Slavic Studies* conference, New Orleans
2007	"The Ottoman Empire's Absent Nineteenth Century: Autonomous Subjects," at *Absences and Silences in Modern Middle East History* workshop, Istanbul (organized by Amy Singer, Hakan Erdem, Israel Gershoni, and Aksin Somel)
2007	*Sakip Sabanci International Research Award* ceremony address, Brookings Institution, Washington, DC
2007	"The Ottoman Empire's other nineteenth century: Autonomous subjects," New York University, New *Directions in Ottoman Studies lecture series*; Columbia University's Ottoman and Turkish Studies University Seminar
2006	"The Millet System and its discontents: Dealing with difference in the Ottoman Empire," Columbia University
2006	"Janus-faced or synthesis? Anatomy of an Ottoman ceremony," Princeton University, *Byzantium as Usable Past* conference
2006	"Families of empires and nations: Changing Ottoman politics in southeastern Europe one family at a time," presented at the European Social Science and History Conference (ESSHC), Amsterdam
2004;2005	"Performing Ottoman power: Journey to the borderlands in the 19th century,"presented at Borderlands Interdisciplinary Project of the Council of American Overseas Research Centers
2002	"Between Loyalty and Treachery: Staying Ottoman and Christian in the 'National Age', presented at the *American Historical Association* meeting
2001	"Central Power and Local Autonomy: The Autonomous Beylik of Samos, 1832-1912," presented at *Sabanci University*, Istanbul, Turkey
1998	"The Aftermath of 1922: Greek and Turkish Historiography of Smyrna/Izmir," presented to conference, "The Aftermath of the Treaty of Lausanne and the Greek-Turkish Population Exchange," *Oxford University*
1997	"An Ottoman View of the Greek Revolution in 1821: The *Tarih-i Cevdet* as a Historical Source," presented at the conference for graduate students of History at the *University of Crete*, Rethymnon, Greece
1997	"Social Conflict and Ottomanization: The Danube Vilayet of 1864", at Jusur Conference for Graduate Students in Near Eastern Studies, *UCLA*

Teaching Experience

University of California, Berkeley

2023 (104) History Lab

2023 (275) Foundational Literature for Ottoman Studies

2022 (280/285) Istanbul (grad seminar)

2022; 2021 (12) Lower-Div Lecture, The Middle East

2022 (109C) The Modern Middle East (upper-division lecture)

2023; 2021 (101) Undergraduate Thesis Seminar

2020 (103/39) Minorities and Majorities in the Eastern Mediterranean

2016 (285) The Ottoman Empire and Its Rivals (grad seminar)

2018 (285) The Ottoman Empire in World War One (grad seminar)

2016;2020 (100M) The Emergence of the Modern Middle East: The Ottoman Centuries (Lecture)

2022; 2021; 2018 (12) The Middle East (lower-div lecture)

2015;2019 (103/39) The Post-Ottoman World

2012 Central European University

2012 Literature of Empire
2012 Modern Turkey in Comparative Perspective

Columbia University

Seminars:
2007 The Ottoman Empire in the Arab World (W4703)

2011 Modern Turkey (W4746)

2011 The Post-Ottoman World (W4732) (*covering topics in Turkey, Lebanon, Greece, Syria, Bulgaria, Israel/Palestine, Egypt, Iraq*)

2006 Hegemony and Rebellion in the Early Modern Middle East (W4701)

(*focusing on the Ottoman-Safavid conflict, 16th-18th centuries*)

2007 (Lecture Survey) The Ottoman Empire 1300-1922 (W3701)

Graduate Seminars:
2007;2011 The Ottoman Empire and its Rivals (G9702)

2011;2015 Sources for Ottoman History (paleography)

2015 Writing European and World History

Service Courses
2006-2008;
2010-2011 Contemporary Civilization (COCI C1101-2)

2009-2010 Senior Thesis Seminar (C4399)

2014 The Historian's Craft (G8910)

2014 Global Core: Greece Faces East

Advising

PhD theses
2024 Advisor for: Christin Zurbach, History (Berkeley) [Post-doc in History of Medicine at Huntington Library/Cedar Sinai]

2020 Orçun Can Okan, History (Columbia)—defended [research position at ERC project at Oxford]

2021 - *Advisor for:* Hilal Cemile Tümer (Berkeley)

2021- Co-advisor for Juliette Rosenthal (with Ethan Katz)

2022- Committee member for Aliosha Bielenberg (Rhetoric Dept)

2023 Committee member for Valentina Viktorovskaia (Russian history)

2022 Committee member for Griffin Brunk (Law School/History)

2016- Committee member for Harrison King (Russian/Turkish history)

2022 Committee member for Ricardo Rivera (Anthropology)

2021 Committee member for Thadeus Dowad (Art History) [TT position at Northwestern]

2020/2024 Committee member for Caleb Herman Adney (UCLA) [TT position at U of Oklahoma]

Committee member

2020 Patrick O'Callahan (UCLA)
2018 Kenan Tekin, MESAAS (Columbia)
2016 Emily Neumeier, Art History (UPenn) (TT Asst Prof, Temple)
2016 Kutlughan Soyubol, History (City University of New York) [TT position at Bosphorus University]
2016 Bilal Kotil, New School for Social Research
2015 Christopher Michael Low, History (Columbia) (U of Iowa)
2013 Stefania Costache, U of Illinois
2013 Jared Manasek, History (Pace)
2013 Dale Stahl, History (U Colorado Boulder)
2013 Aimee Genell, History (Assistant Professor at Boston University)
2013 Abhishek Kaicker, History (Tenured at UC Berkeley)
2011 Mostafa Minawi, NYU (Full Professor at Cornell)
2010 Bedross der Matossian, MESAAS (Full professor at U of Nebraska)
2008 Sam White, History (Full professor at Oberlin)

Conference and Workshop Organization (selected examples)

2022 "Dilemmas of Peace: Comparing the Greek and Armenian Communities of Istanbul/Constantinople in the Armistice Period, 1918-1923" UC Berkeley; co-organized with the UC Berkeley Armenian Studies Program and the UC Berkeley Hellenic and Modern Greek Studies Program

2021 "New Dimensions of 1821: A Pan-California Celebration of the Bicentennial of the Greek Revolution," funded by the Tsakopoulos Program in Hellenic Studies, Sacramento State University, and in conjunction with Sac State Hellenic Studies Program, UCLA Stavros Niarchos Foundation Center for the Study of Hellenic Culture, and Stanford University

Lectures/Panels Organized

March 2025 Annual Nikos Kazantzakis Lecture and residency Artemis Leontis (University of Michigan, Comparative Literature)

Feb. 2025 "The Built Environment and Social History/Demography of Istanbul," two-day international, interdisciplinary workshop at Berkeley, sponsored by NEH, Berkeley History of Art Dept., CMES, MELC, History

Jan. 2025 "Global Threats to Democracy," Lecture by former Prime Minister of Greece George Papandreou, panel discussion featuring Susan Hyde (Political Science), Maury Obstfeld (Economics), and Markos Kounalakis (Hoover Institution), reception

July 2024 Intensive in situ seminar on urban history and geography, sponsored by NEH, Historic Peninsula of Istanbul

March 2024 Annual Nikos Kazantzakis Lecture and residency, Nektaria Klapaki, University of Washington Seattle

Jan. 2024 "Digital Approached to the Study of Migration in the Aegean/Mediterranean Region," UC Berkeley, sponsored by NEH, France-Berkeley Fund, Peder Saether Center for Advanced Study, Armenian Studies Program

2022-23: Ottoman/Post-Ottoman Studies Working Group: oversaw and helped organize monthly lectures and meetings for interested graduate students and faculty featuring visiting speakers (8+ events in the course of the year)

Spring 2023: Nikos Kazantzakis Endowed lecture, featuring Niki Stavrou, CEO of Kazantzakis Estate, and Professor Pavlos Kavouras from University of Athens

Fall 2022: Nikos Kazantzakis signing/inaugural celebration

Spring 2022: Nina Ansary lecture, "The Unknown History of Women's Activism in Iran," at Social Science Matrix, supported by Social Sciences Development staff

Spring 2022: Problems and Methods in Digital Humanities and Urban History of the Balkans, featuring Grigor Boykov (Vienna) and Cengiz Kirli (Bosphorus University)

2021-present: monthly meeting on Zoom of the Ottoman Census Register Reading Group [core project of the Istanpolis collaborative]

Spring 2021: Zoom workshop for Istanpolis, including meeting with community leaders in Istanbul and in Greece (funded by Title VI grant from CMES)

Spring 2021: Panel discussion, "Turkish Netflix Series Ethos"

Spring 2021: Lecture series (Zoom) on Mediterranean Studies, featuring ERC-grant winners from the Institute for Mediterranean Studies, Rethymno, Crete (Greece)

Spring 2021: Zoom book talk for Lale Can, *Spiritual Subjects*, CMES

2020 "Turning Points: The Middle East and Balkans, 1918-1924," graduate student workshop; funded by Turkish Studies Initiative at Berkeley CMES. 16 graduate students from Harvard, Arizona, UCSD, UCI, Stanford, Ohio State, UT Austin, France, Switzerland, Turkey, London presented works in progress and were given feedback by prominent senior scholars.

2017 Berkeley Ottoman Seminar (Chania, Crete), July 2017: I funded the travel and accommodation for 6 faculty and grad student colleagues for a two-week intensive Ottoman reading seminar. Focus this year was on Ottoman newspapers in Istanbul between late 1918 and late 1923. Working toward an edited volume on the Ottoman press in Istanbul during the Armistice period.

2016 "Western Ottomanists Workshop," UC Berkeley: brought together roughly 20 graduate students in Ottoman History from the West coast, and organized panels with invited faculty as discussants and chairs; raised the funding from within UC Berkeley for the project [CMES, BCSR, History, ASEEES, Armenian Studies]

2012 "Re-shaping the Margins of Europe: Russian/Soviet and Ottoman/Turkish Transformations, 1900-1930," International workshop held in Paris sponsored by the Blinken Institute for European Studies and Columbia Global Centers [program enclosed in dossier]

2012 "Legacies," Columbia University, intensive one-day workshop in cooperation with the Bosphorus University History Department and Columbia University's Heyman Center for the Humanities [program enclosed in dossier]

2011 "Ottomans/Turks in Conflict, 1800-2010," Columbia University, graduate student workshop [program enclosed in dossier]

2010 "The Ottoman Empire from Present to Past: Memory and Ideology in Turkey and the Arab World," Columbia University, workshop leading to special issue of *CSSAAME (please see above for publication information)*

2007 "Tangled Empires: Humanitarianism and the Final Ottoman Century" (Columbia University) [one-day workshop organized under the auspices of the Center for International History's "In the Name of Humanity" series]

2006 "New Elites, Old Regimes: Trajectories of Imperial Change, 1700-1850" (Yale University) [a comparative treatment of the Ottoman, Safavid-Qajar Empires, the transition from Mughal to British India, and colonial to independent Latin America]

2005	"The Past of Ethnic Cleansing: The Greek-Turkish Population Exchange Eighty Years On" (Yale University)
2005	"New Perspectives on the Crimean War: An Inter-regional workshop" (Yale University) [a workshop for Russianists and Ottomanists to discuss new research agendas surrounding the causes and effects of the Crimean War (1852/3-1856)]
2005	Middle East Studies Association panel "Minority Identities in the Ottoman Empire and Turkey: History, Memory, and Space"
2002	American Historical Association panel "Encounters Between Muslims and Orthodox Christians: Religion and Empire in the National Age"

Service

Service to the History Dept at Berkeley

2024	Mid-career review committee member
2023	Course development team member for History 104 "Craft of History" course -new required course for History majors -taught the pilot semester of History 104
2022-2024	Vice-Chair for Curriculum, Department of History
2022	Equity Advisor
2017-2018	Modern Middle East/Arab World Search Committee Chair
2017-2018; 2021-2022; 2022-2023; 2023-2024	Departmental Advisory Committee Member
2016-2017	Late Modern Europe Search Committee Member
2016-2017	Undergraduate Prize Committee Member
2015-2016	Reading committee, Jewish History Search
2015-2016	Gender Equity Advisor

2015-2016 Graduate Affairs Committee Member

Service to UC Berkeley

2024-2027 External Chair, Department of Middle Eastern Languages and Cultures

2024-2025 Member, Advisory Committee, Townsend Center for the Humanities

2024 Staff recruitment committee member, IES (office manager)

2024 Staff recruitment committee member, CMES (events and publicity manager)

2023 Chair, Search Committee for Adjunct Professor of Armenian History

2023 Chair, Search Committee for Executive Director, Armenian Studies Program

2022 Berkeley delegate (one of two) to the Pharos Education Summit: Fulbright–IIE-led delegation of American universities to Greece, met with President Sakellaropoulou and leadership of the Ministry of Education and the 24 universities of Greece

2021-2024 Member, Faculty Senate Committee on Academic Freedom

2020 History Dept. Rep., Social Science Divisional Task Force on Fall Instruction

2016- Member, Faculty Steering Committee: Center for Middle East Studies
*FLAS selection committee, CMES: 2015-2016; 2016-2017; 2019-2020

2017- Member, Faculty Steering Committee: Armenian Studies Program

2022-3 Member, Faculty Steering Committee, Institute for Slavic, East European and Eurasian Studies

2017- Member, Faculty Steering Committee: Global Studies Program

2016- Member, Faculty Steering Committee: Center for Middle East Studies

Senate Service

2020-2023 Member, Faculty Senate Committee on Academic Freedom

Service to the Profession/Field

Society memberships

Middle East Studies Association; Modern Greek Studies Association; Ottoman and Turkish Studies Association; American Historical Association

2025- Consulting Editor, *Comparative Studies in Society and History*

2024 Program Committee member, Modern Greek Studies Association Symposium
2022 Committee member, Modern Greek Studies Association
Edmund Keeley book prize

2019- Editorial board member, *Istanbul Annual/YILLIK*, journal of the Istanbul Studies Foundation

Reviewer

Reviewer of manuscripts for Stanford University Press, Oxford University Press, Princeton University Press, University of California Press, Cambridge University Press; journals such as *Comparative Studies in Society and History*, *Journal of the Ottoman and Turkish Studies Association*, *Journal of Modern Greek Studies*, *Mediterranean Historical Review*, *Nationalism and Ethnicity*, *Journal of the Economic and Social History of the Orient*, *Journal of Modern History* ;*Reviewer of proposals: Austria National Science Foundation*

Spring 2023 Reviewer of 29 proposals for the Hellenic Foundation for Research and Innovation (Greek equivalent of the NEH)

2012-2015 Ottoman and Turkish Studies Association (Member of the Board—elected position, chair of O.L. Barkan Article Prize, 2013; member, graduate student essay prize, 2017)

2017 External reviewer for University of California Davis Middle East and South Asian Studies Program

2016 Raised $8000 and established the annual Vangelis Kechriotis Memorial Travel Fellowship for graduate students in Turkish/Ottoman Studies, under the auspices of the Ottoman and Turkish Studies Association

2014 Institute for Turkish Studies (Associate member—appointed position; grant selection committee)

2011-2018 Editorial collective member: *Comparative Studies in South Asia, Africa, and the Middle East* (co-editors Tim Mitchell and Anupama Rao)

2017- Editorial board member, Ottoman History series, Edinburgh University

Press (Kent Schull, ed.)

Past Employment

2015-2021 Associate Professor (with tenure), Department of History, UC Berkeley

2014-2015 Associate Professor (with tenure), Department of History, Columbia University, New York

2012-2014 Associate Professor (without tenure), Department of History, Columbia University, New York

2012-2013 [Visiting Professor, Central European University, Budapest; Senior Fellow, Collegium Budapest/CEU Institute for Advanced Study]

2012 [Visiting Fellow, Shelby Cullom Davis Center for Historical Studies, Princeton University]

2006-2012 Assistant Professor, Department of History, Columbia University, New York, New York

2004-2006 Lecturer, Center for International and Area Studies/History Yale University, New Haven, Connecticut

Honors and Awards

2014-2017 *Lenfest Distinguished Faculty Award*, Columbia University

2009; 2012 Untenured Faculty Career Development Award Columbia History Department

2007 *Brookings Institution-Sakip Sabanci International Research Award* [$20,000 prize]: Intention of the award to "stimulate new ideas, fresh thinking, and original research relevant to Turkish studies" in all fields of the humanities and social sciences.

2007 *MacDonald Faculty Grant*, Columbia Faculty of Arts and Sciences Junior Faculty Development Grant for summer research in Romania and Turkey (2007); in Turkey (2012)

1995 New York State Labor History Association Best Undergraduate Thesis prize

EXHIBIT B

OMB Number: 4040-0003
Expiration Date: 02/28/2025

APPLICATION FOR FEDERAL DOMESTIC ASSISTANCE - Short Organizational

*** 1. NAME OF FEDERAL AGENCY:**

National Endowment for the Humanities

2. CATALOG OF FEDERAL DOMESTIC ASSISTANCE NUMBER:

45.161

CFDA TITLE:

Promotion of the Humanities Research

*** 3. DATE RECEIVED:** Completed Upon Submission to Grants.gov **SYSTEM USE ONLY**

*** 4. FUNDING OPPORTUNITY NUMBER:**

20221130-RZ

* TITLE:

Collaborative Research

5. APPLICANT INFORMATION

* a. Legal Name:

The Regents of the University of California

b. Address:

* Street1: c/o Sponsored Projects Office	Street2: 1608 Fourth Street, Suite 220
* City: Berkeley	County/Parish: California
* State: CA: California	Province:
* Country: USA: UNITED STATES	* Zip/Postal Code: 94710-1749

c. Web Address:

http://

* d. Type of Applicant: Select Applicant Type Code(s): H: Public/State Controlled Institution of Higher Educ	* e. Employer/Taxpayer Identification Number (EIN/TIN): 94-6002123
Type of Applicant:	* f. UEI: GS3YEVSS12N6
Type of Applicant:	* g. Congressional District of Applicant: CA13
* Other (specify):	

6. PROJECT INFORMATION

* a. Project Title:

Visualizing Local Christian Communities in Muslim Cosmopolitan Istanbul in the 19th and 20th Centuries

* b. Project Description:

We seek NEH funding to develop an expansive and scholarly, public-facing website, in order to build new structures of knowledge and raise public awareness about Istanbul and its constituent Orthodox Christian communities in the 19th and 20th centuries. Drawing on but also bridging fragmented secondary scholarship of the last generation (in Greek, Turkish, French, as well as English), we are using a wide array of archival sources to carry out a systematic and comprehensive, granular reconstruction of the demography and topography of the Greek Orthodox communities of late Ottoman Istanbul (1821-1923). In doing so, we will be collaborating to produce articles, podcast interviews and ongoing blog posts, ArcGIS storymaps, relational databases and virtual as well as in-person exhibitions that grow out of the website, to write that group back into the history of the Ottoman Empire and modern Turkey, modern Greece and into the comparative study of urban spaces in this region.

c. Proposed Project: * Start Date: 10/01/2023 * End Date: 09/30/2026

APPLICATION FOR FEDERAL DOMESTIC ASSISTANCE - Short Organizational

7. PROJECT DIRECTOR

Prefix:	* First Name: Christine
Middle Name:	
* Last Name: Phillou	Suffix:
* Title: Associate Professor of History	* Email: philliou@berkeley.edu
* Telephone Number: 510.642.8208	Fax Number:
* Street1: 340 Stephens Hall	Street2: 1608 Fourth Street, Suite 220
* City: Berkeley	County/Parish: California
* State: CA: California	Province:
* Country: USA: UNITED STATES	* Zip/Postal Code: 94720-2314

8. PRIMARY CONTACT/GRANTS ADMINISTRATOR

☒ Same as Project Director (skip to item 9):

Prefix:	* First Name: Christine
Middle Name:	
* Last Name: Phillou	Suffix:
* Title: Associate Professor of History	* Email: philliou@berkeley.edu
* Telephone Number: 510.642.8208	Fax Number:
* Street1: 340 Stephens Hall	Street2: 1608 Fourth Street, Suite 220
* City: Berkeley	County/Parish: California
* State: CA: California	Province:
* Country: USA: UNITED STATES	* Zip/Postal Code: 94720-2314

APPLICATION FOR FEDERAL DOMESTIC ASSISTANCE - Short Organizational

9. * By signing this application, I certify (1) to the statements contained in the list of certifications** and (2) that the statements herein are true, complete and accurate to the best of my knowledge. I also provide the required assurances** and agree to comply with any resulting terms if I accept an award. I am aware that any false, fictitious, or fraudulent statements or claims may subject me to criminal, civil, or administrative penalties (U.S. Code, Title 18, Section 1001)

** I Agree ☒

** The list of certifications and assurances, or an internet site where you may obtain this list, is contained in the announcement or agency specific instructions.

AUTHORIZED REPRESENTATIVE

Prefix:	* First Name:	Middle Name:
	Jason	

* Last Name:	Suffix:
Cheung	

* Title:	* Email:
Contract and Grant Officer	jasoncheung91@berkeley.edu

* Telephone Number:	Fax Number:
510-642-8112	

* Signature of Authorized Representative:	* Date Signed:
Completed by Grants.gov upon submission.	Completed by Grants.gov upon submission.

OMB Number: 3136-0134
Expiration Date: 10/31/2024

Supplementary Cover Sheet for NEH Grant Programs

1. Project Director Major Field of Study: History: Near and Middle Eastern History

2. Institution Information Type: 1330: University

3. Project Funding

Outright Funds	249,842.00
Federal Match	0.00
Total from NEH	249,842.00
Cost Sharing	0.00
Total Project Costs	249,842.00

4. Application Information

Will this proposal be submitted to another NEH division, government agency, or private entity for funding?

☐ Yes
☒ No

If yes, please explain where and when:

Type of Application

☒ New
☐ Supplement

If supplement, list current grant number(s).

Primary project discipline	History: Near and Middle Eastern History
Secondary project discipline (optional)	History: European History
Tertiary project discipline (optional)	History: Other

RESEARCH & RELATED BUDGET - Budget Period 1

OMB Number: 4040-0001
Expiration Date: 12/31/2022

UEI: GS3YEVSS12N6 **Enter name of Organization:** The Regents of the University of California

Budget Type: ☒ Project ☐ Subaward/Consortium **Budget Period: 1** **Start Date:** 10/01/2023 **End Date:** 09/30/2024

A. Senior/Key Person

Prefix	First	Middle	Last	Suffix	Base Salary ($)	Months Cal.	Months Acad.	Months Sum.	Requested Salary ($)	Fringe Benefits ($)	Funds Requested ($)
	Christine		Philliou		158,600.00			0.61	10,668.00	1,493.00	12,161.00

Project Role: PD/PI

Additional Senior Key Persons: Add Attachment | Delete Attachment | View Attachment

Total Funds requested for all Senior Key Persons in the attached file:

Total Senior/Key Person: 12,161.00

B. Other Personnel

Number of Personnel	Project Role	Months Cal.	Months Acad.	Months Sum.	Requested Salary ($)	Fringe Benefits ($)	Funds Requested ($)
	Post Doctoral Associates						
1	Graduate Students		0.78		4,002.00	112.00	4,114.00
	Undergraduate Students						
	Secretarial/Clerical						
1	Finance Director	0.79			8,002.00	3,425.00	11,427.00

2 **Total Number Other Personnel**

Total Other Personnel: 15,541.00

Total Salary, Wages and Fringe Benefits (A+B): 27,702.00

C. Equipment Description

List items and dollar amount for each item exceeding $5,000

Equipment item | **Funds Requested ($)**

Additional Equipment: Add Attachment | Delete Attachment | View Attachment

Total funds requested for all equipment listed in the attached file:

Total Equipment:

D. Travel

		Funds Requested ($)
1.	Domestic Travel Costs (Incl. Canada, Mexico and U.S. Possessions)	
2.	Foreign Travel Costs	8,100.00
	Total Travel Cost	8,100.00

E. Participant/Trainee Support Costs

		Funds Requested ($)
1.	Tuition/Fees/Health Insurance	
2.	Stipends	
3.	Travel	
4.	Subsistence	
5.	Other	
	Total Participant/Trainee Support Costs	

Number of Participants/Trainees

F. Other Direct Costs

		Funds Requested ($)
1.	Materials and Supplies	
2.	Publication Costs	
3.	Consultant Services	3,800.00
4.	ADP/Computer Services	
5.	Subawards/Consortium/Contractual Costs	
6.	Equipment or Facility Rental/User Fees	
7.	Alterations and Renovations	
8.	Collaborator compensation	15,000.00
9.	Honorarium	14,247.00
10.		
11.		
12.		
13.		
14.		
15.		
16.		
17.		
	Total Other Direct Costs	33,047.00

G. Direct Costs

	Funds Requested ($)
Total Direct Costs (A thru F)	68,849.00

H. Indirect Costs

Indirect Cost Type	Indirect Cost Rate (%)	Indirect Cost Base ($)	Funds Requested ($)
MTDC	16.50	68,849.00	11,360.00
		Total Indirect Costs	11,360.00

Cognizant Federal Agency
(Agency Name, POC Name, and POC Phone Number)

I. Total Direct and Indirect Costs

	Funds Requested ($)
Total Direct and Indirect Institutional Costs (G + H)	80,209.00

J. Fee

Funds Requested ($)

K. Total Costs and Fee

	Funds Requested ($)
Total Costs and Fee (I + J)	80,209.00

L. Budget Justification

(Only attach one file.) Philliou_Budget_Justification_11_18_22 Add Attachment Delete Attachment View Attachment

RESEARCH & RELATED BUDGET - Budget Period 2

OMB Number: 4040-0001
Expiration Date: 12/31/2022

UEI: GS3YEVSS12N6 **Enter name of Organization:** The Regents of the University of California

Budget Type: ☒ Project ☐ Subaward/Consortium **Budget Period: 2** **Start Date:** 10/01/2023 **End Date:** 09/30/2024

A. Senior/Key Person

Prefix	First	Middle	Last	Suffix	Base Salary ($)	Months Cal.	Months Acad.	Months Sum.	Requested Salary ($)	Fringe Benefits ($)	Funds Requested ($)
	Christine		Philliou		163,358.00			0.61	10,988.00	1,539.00	12,527.00

Project Role: PD/PI

Additional Senior Key Persons: Add Attachment | Delete Attachment | View Attachment

Total Funds requested for all Senior Key Persons in the attached file:

Total Senior/Key Person: 12,527.00

B. Other Personnel

Number of Personnel	Project Role	Months Cal.	Months Acad.	Months Sum.	Requested Salary ($)	Fringe Benefits ($)	Funds Requested ($)
	Post Doctoral Associates						
1	Graduate Students		0.77		4,002.00	112.00	4,114.00
	Undergraduate Students						
	Secretarial/Clerical						
1	Finance Director	0.85			9,000.00	3,852.00	12,852.00

2 **Total Number Other Personnel**

Total Other Personnel: 16,966.00

Total Salary, Wages and Fringe Benefits (A+B): 29,493.00

C. Equipment Description

List items and dollar amount for each item exceeding $5,000

Equipment item	Funds Requested ($)

Additional Equipment: Add Attachment | Delete Attachment | View Attachment

Total funds requested for all equipment listed in the attached file:

Total Equipment:

D. Travel

		Funds Requested ($)
1.	Domestic Travel Costs (Incl. Canada, Mexico and U.S. Possessions)	
2.	Foreign Travel Costs	8,100.00
	Total Travel Cost	8,100.00

E. Participant/Trainee Support Costs

		Funds Requested ($)
1.	Tuition/Fees/Health Insurance	
2.	Stipends	
3.	Travel	
4.	Subsistence	
5.	Other	
	Total Participant/Trainee Support Costs	

Number of Participants/Trainees

F. Other Direct Costs

		Funds Requested ($)
1.	Materials and Supplies	
2.	Publication Costs	
3.	Consultant Services	3,800.00
4.	ADP/Computer Services	
5.	Subawards/Consortium/Contractual Costs	
6.	Equipment or Facility Rental/User Fees	
7.	Alterations and Renovations	
8.	Collaborator compensation	15,000.00
9.	Honorarium	15,369.00
10.		
11.		
12.		
13.		
14.		
15.		
16.		
17.		
	Total Other Direct Costs	34,169.00

G. Direct Costs

	Funds Requested ($)
Total Direct Costs (A thru F)	71,762.00

H. Indirect Costs

Indirect Cost Type	Indirect Cost Rate (%)	Indirect Cost Base ($)	Funds Requested ($)
MTDC	16.50	71,762.00	11,841.00
		Total Indirect Costs	11,841.00

Cognizant Federal Agency
(Agency Name, POC Name, and POC Phone Number)

I. Total Direct and Indirect Costs

	Funds Requested ($)
Total Direct and Indirect Institutional Costs (G + H)	83,603.00

J. Fee

Funds Requested ($)

K. Total Costs and Fee

	Funds Requested ($)
Total Costs and Fee (I + J)	83,603.00

L. Budget Justification

(Only attach one file.) Philliou_Budget_Justification_11_18_22 Add Attachment Delete Attachment View Attachment

RESEARCH & RELATED BUDGET - Budget Period 3

OMB Number: 4040-0001
Expiration Date: 12/31/2022

UEI: GS3YEVSS12N6 **Enter name of Organization:** The Regents of the University of California

Budget Type: ☒ Project ☐ Subaward/Consortium **Budget Period: 3** **Start Date:** 10/01/2023 **End Date:** 09/30/2024

A. Senior/Key Person

Prefix	First	Middle	Last	Suffix	Base Salary ($)	Months Cal.	Months Acad.	Months Sum.	Requested Salary ($)	Fringe Benefits ($)	Funds Requested ($)
	Christine		Philliou		168,259.00			0.61	11,318.00	1,584.00	12,902.00

Project Role: PD/PI

Additional Senior Key Persons: Add Attachment | Delete Attachment | View Attachment

Total Funds requested for all Senior Key Persons in the attached file:

Total Senior/Key Person: 12,902.00

B. Other Personnel

Number of Personnel	Project Role	Months Cal.	Months Acad.	Months Sum.	Requested Salary ($)	Fringe Benefits ($)	Funds Requested ($)
	Post Doctoral Associates						
1	Graduate Students		0.75		4,002.00	112.00	4,114.00
	Undergraduate Students						
	Secretarial/Clerical						
1	Finance Director	0.82			9,003.00	3,853.00	12,856.00

2 **Total Number Other Personnel**

Total Other Personnel: 16,970.00

Total Salary, Wages and Fringe Benefits (A+B): 29,872.00

C. Equipment Description

List items and dollar amount for each item exceeding $5,000

Equipment item	Funds Requested ($)

Additional Equipment: Add Attachment | Delete Attachment | View Attachment

Total funds requested for all equipment listed in the attached file:

Total Equipment:

D. Travel

		Funds Requested ($)
1.	Domestic Travel Costs (Incl. Canada, Mexico and U.S. Possessions)	
2.	Foreign Travel Costs	8,100.00
	Total Travel Cost	8,100.00

E. Participant/Trainee Support Costs

		Funds Requested ($)
1.	Tuition/Fees/Health Insurance	
2.	Stipends	
3.	Travel	
4.	Subsistence	
5.	Other	
	Number of Participants/Trainees / **Total Participant/Trainee Support Costs**	

F. Other Direct Costs

		Funds Requested ($)
1.	Materials and Supplies	
2.	Publication Costs	
3.	Consultant Services	4,000.00
4.	ADP/Computer Services	
5.	Subawards/Consortium/Contractual Costs	
6.	Equipment or Facility Rental/User Fees	
7.	Alterations and Renovations	
8.	Collaborator compensation	15,000.00
9.	Honorarium	16,874.00
10.		
11.		
12.		
13.		
14.		
15.		
16.		
17.		
	Total Other Direct Costs	35,874.00

G. Direct Costs

	Funds Requested ($)
Total Direct Costs (A thru F)	73,846.00

H. Indirect Costs

Indirect Cost Type	Indirect Cost Rate (%)	Indirect Cost Base ($)	Funds Requested ($)
MTDC	16.50	73,846.00	12,184.00
		Total Indirect Costs	12,184.00

Cognizant Federal Agency
(Agency Name, POC Name, and POC Phone Number)

I. Total Direct and Indirect Costs

	Funds Requested ($)
Total Direct and Indirect Institutional Costs (G + H)	86,030.00

J. Fee

Funds Requested ($)

K. Total Costs and Fee

	Funds Requested ($)
Total Costs and Fee (I + J)	86,030.00

L. Budget Justification

(Only attach one file.) Philliou_Budget_Justification_11_18_22 Add Attachment Delete Attachment View Attachment

RESEARCH & RELATED BUDGET - Cumulative Budget

		Totals ($)
Section A, Senior/Key Person		37,590.00
Section B, Other Personnel		49,477.00
Total Number Other Personnel	6	
Total Salary, Wages and Fringe Benefits (A+B)		87,067.00
Section C, Equipment		
Section D, Travel		24,300.00
1. Domestic		
2. Foreign	24,300.00	
Section E, Participant/Trainee Support Costs		
1. Tuition/Fees/Health Insurance		
2. Stipends		
3. Travel		
4. Subsistence		
5. Other		
6. Number of Participants/Trainees		
Section F, Other Direct Costs		103,090.00
1. Materials and Supplies		
2. Publication Costs		
3. Consultant Services	11,600.00	
4. ADP/Computer Services		
5. Subawards/Consortium/Contractual Costs		
6. Equipment or Facility Rental/User Fees		
7. Alterations and Renovations		
8. Other 1	45,000.00	
9. Other 2	46,490.00	
10. Other 3		
11. Other 4		
12. Other 5		
13. Other 6		
14. Other 7		
15. Other 8		
16. Other 9		
17. Other 10		

Section G, Direct Costs (A thru F)	214,457.00
Section H, Indirect Costs	35,385.00
Section I, Total Direct and Indirect Costs (G + H)	249,842.00
Section J, Fee	
Section K, Total Costs and Fee (I + J)	249,842.00

BUDGET JUSTIFICATION

UCB PI: (Christine Philliou)
Title: Visualizing Local Christian Communities in Muslim Cosmopolitan Istanbul in the 19th and 20th Centuries)

A. SENIOR/KEY PERSONNEL

A.1. Principal Investigator (Christine Philliou): Christine Philliou will provide overall direction and oversight of the project including drafting and dissemination of results. Christine Philliou will spend 3 summer months total in Istanbul, Turkey working on this project and receive 0.81 summer month per year paid by this NEH grant. In Year 1, she will receive $10,668 in salary and $1,493 in benefits at 14.0%; in Year 2, she will receive $10988 in salary and $1539 in benefits at 14.0% and in Year 3 she will receive $11318 in salary and $1584 in benefits at 14.0%. In addition to overall project responsibility, they will supervise one Graduate Student Researcher (GSR) working on the project and a postdoctoral scholar based in Brandenburg, Germany. Although Philliou will not receive grant funds as compensation, Philliou will go on leave during Year 3 of the project and devote Year 3 to project completion.

B. OTHER PERSONNEL

B.1. Graduate Student Researcher (GSR): The GSR will assist the PI, as directed, in conducting research and contribute to the drafting and dissemination of results. The GSR will work at an hourly rate of $25/hour for 160 hours per year during the summer months each year of the project period. In Year 1 the GSR will be paid $4002 total plus $112 in student rate benefits for 3 summer months; in Year 2, the GSR will be paid $4002 total plus $112 in student rate benefits for 3 summer months; in Year 3, the GSR will be paid $4002 total plus $112 in student rate benefits for 3 summer months.

B.2. GIAS Finance Director, Gia White: Ms. White will provide financial administration for this grant to be housed at Global, International and Area Studies. Ms. White is integral to the project as she will provide administrative services for this project. She will track the budgeted categories, will implement all travel and purchasing, and will provide monthly reports to the PI with requests for follow up. She will also track all required reporting deadlines, gathering the needed information from the PI and other participants, and entering it in the NEH online reporting system to meet all interim and final reporting deadlines. Ms. White will work .78 months in a 12 month year during the project period and receive $8002 in salary and $3425 in benefits at a rate of 42.8% in Year 1. In Year 2, Ms. White will work .87 months in a 12 month year and receive $9000 in salary and $3852 in benefits at 42.8%. In Year 3, Ms. White will work .87 months in a 12 month year and receive $9003 in salary and $3853 in benefits at 42.8%.

The PI and GSR salaries are based on current actual salaries and are projected to include a 3% annual cost-of-living increase (and merit, if applicable) effective each year. Postdoc salaries are based on experience level.

C. FRINGE BENEFITS

The University of California, Berkeley Composite Benefit Rates (CBR) have been reviewed and federally approved by the Department of Health and Human Services (DHHS) for use by all fund sources for FY21. Rates beyond June 30, 2021 are estimates and are provided for planning purposes only. Future CBRs are subject to review and approval by DHHS on an annual or bi-annual basis. Fringe benefits are assessed as a percentage of the respective employee's salary. The benefit rates are as follows:

	Submitted, Pending Federal Approval		*Projections for Planning Purposes*		
CBR Rate Group	**FY22**	**FY23**	**FY24**	**FY25**	**FY26**
Academic	35.9%	35.4%	35.4%	35.4%	35.4%

Staff	43.8%	42.8%	42.8%	42.8%	42.8%
Limited	14.4%	14.0%	14.0%	14.0%	14.0%
Employees with No Benefit Eligibility	4.2%	5.3%	5.3%	5.3%	5.3%
Students	2.6%	2.8%	2.8%	2.8%	2.8%

For more information, please see: https://cfo.berkeley.edu/about-us/financial-planning-analysis/central-resource-management/composite-benefit-rates-cbr

The University of California provides full remission of tuition, fees, and graduate student health insurance to all graduate students who are employed on-campus 45% time or greater during the academic year. The rate for in-state remission is $10,424.00 per semester, which is escalated annually in the budget at a rate of 5% per year. The rate for out-of-state remission is $17,975.00 per semester, which is escalated annually in the budget at a rate of 5% per year. Additional information regarding the fee remission program can be found at: http://grad.berkeley.edu/financial/fee-remissions/

D. EQUIPMENT

N/A

E. TRAVEL

Foreign: A travel budget of $24,300 ($8,100/year) is requested for the PI and 3 key collaborators (Professor Panagiotis Poulus, Professor Emily Neumeier and Professor Aimee Genell) for a team meeting to discuss research progress and trouble shooting at the data collection site of Istanbul, Turkey. The amount includes airfare, meals/lodging, ground transportation, and, if applicable. In Year 1, 1 flight from the US West coast to Istanbul for Christine Philliou at $1000 plus meals/lodging at $150 per day for 7 days for $1050. The total for Philliou's travel is $2050. Also in Year 1, the grant will cover, 2 East coast flights to Istanbul for Emily Neumeier and Amiee Genell at $800 each plus meals/lodging at $150 per day for 7 days for 2 people a total of $2050. The total for Neumeier and Genell's travel is $3700. Also in Year 1, 1 flight from Europe to Istanbul for Panagiotis Poulus at $300 plus meals/lodging at $150 per day for 7 days for $1050. The total for Poulos's travel is $1350. The total travel in Year 2 is $8,100.

In Year 2, 1 flight from the US West coast to Istanbul for Christine Philliou at $1000 plus meals/lodging at $150 per day for 7 days for $1050. The total for Philliou's travel is $2050. Also in Year 2, the grant will cover, 2 East coast flights to Istanbul for Emily Neumeier and Amiee Genell at $800 each plus meals/lodging at $150 per day for 7 days for 2 people a total of $2050. The total for Neumeier and Genell's travel is $3700. Also in Year 2, 1 flight from Europe to Istanbul for Panagiotis Poulus at $300 plus meals/lodging at $150 per day for 7 days for $1050. The total for Poulos's travel is $1350. The total travel is $8,100.

In Year 3, 1 flight from the US West coast to Istanbul for Christine Philliou at $1000 plus meals/lodging at $150 per day for 7 days for $1050. The total for Philliou's travel is $2050. Also in Year 3, the grant will cover, 2 East coast flights to Istanbul for Emily Neumeier and Amiee Genell at $800 each plus meals/lodging at $150 per day for 7 days for 2 people a total of $2050. The total for Neumeier and Genell's travel is $3700. Also in Year 3, 1 flight from Europe to Istanbul for Panagiotis Poulus at $300 plus meals/lodging at $150 per day for 7 days for $1050. The total for Poulos' travel is $1350. The total travel in Year 3 is $8,100.

OTHER DIRECT COSTS

F. Consultant Services: For 4 data consultants based in Turkey and Greece (4 per year at $8 per hour for 1450 hours) across the project period. In Year 1, the grant covers $3800 in data consultant services during 3 summer months in Turkey and Greece; in Year 2 the grant covers $3800 in data consultant

services during 3 summer months in Turkey and Greece and in Year 3, the grant covers $4000 in data consultant services during 3 summer months in Turkey and Greece.

G. Honorarium for 3 Key collaborators: (Aimee Genell, Emily Neumeier and Ayse Ozil) will receive $5000 in honoraria each for their research contributions to the project during the 3 summer months of each project year. In Year 1, the grant will cover $15,000 in honorarium for these 3 scholars; in Year 2 the grant will cover $15000 in honorarium for these 3 scholars and in Year 3, the grant will cover 15000 in honorarium for these 3 scholars. Although these scholars will not receive grant funding to cover their salary, they will also conduct research for this project for an additional 4 months per project year.

H. Honorarium to Postdoctoral scholar: Firuza M. Sumertas will conduct research for the project while based in Germany and Turkey. In Year 1, she will receive an honoraria of $14,247 and in Year 2 she will receive an honoraria for $15,369 and in Year 3 she will receive an honoraria of $16,874.

I. INDIRECT COSTS

Indirect costs are based on University negotiated rates with the cognizant federal authority and are applied at a rate of 16.5%. Indirect costs are applied using the Modified Total Direct Cost (MTDC) formula, per rate agreement dated June 25, 2020. Modified total direct costs exclude equipment, capital expenditures, charges for patient care, student tuition remission, rental costs of off-site facilities, scholarships, and fellowships, participant support costs and the portion of each subgrant and subcontract in excess of $25,000. For more information, please see: http://www.spo.berkeley.edu/policy/fa.html. The rates after July 1, 2022 are provisional and subject to change based upon our updated federally negotiated indirect cost rate agreement.

OMB Number: 4040-0010
Expiration Date: 12/31/2022

Project/Performance Site Location(s)

Project/Performance Site Primary Location ☐ I am submitting an application as an individual, and not on behalf of a company, state, local or tribal government, academia, or other type of organization.

Organization Name: The Regents of the University of California

UEI: GS3YEVSS12N6

* Street1: c/o Sponsored Projects Office

Street2: 1608 Fourth Street, Suite 220

* City: Berkeley County:

* State: CA: California

Province:

* Country: USA: UNITED STATES

* ZIP / Postal Code: 94710-1749 * Project/ Performance Site Congressional District: CA-013

Project/Performance Site Location 1 ☐ I am submitting an application as an individual, and not on behalf of a company, state, local or tribal government, academia, or other type of organization.

Organization Name: Sabanci University

UEI:

* Street1: 34956 Tuzla

Street2:

* City: Istanbul County:

* State:

Province:

* Country: TUR: TURKEY

* ZIP / Postal Code: * Project/ Performance Site Congressional District:

Additional Location(s) Add Attachment Delete Attachment View Attachment

ATTACHMENTS FORM

Instructions: On this form, you will attach the various files that make up your grant application. Please consult with the appropriate Agency Guidelines for more information about each needed file. Please remember that any files you attach must be in the document format and named as specified in the Guidelines.

Important: Please attach your files in the proper sequence. See the appropriate Agency Guidelines for details.

1) Please attach Attachment 1	team.pdf	Add Attachment	Delete Attachment	View Attachment
2) Please attach Attachment 2	narrative.pdf	Add Attachment	Delete Attachment	View Attachment
3) Please attach Attachment 3	workplan.pdf	Add Attachment	Delete Attachment	View Attachment
4) Please attach Attachment 4	resumes.pdf	Add Attachment	Delete Attachment	View Attachment
5) Please attach Attachment 5	bibliography.pdf	Add Attachment	Delete Attachment	View Attachment
6) Please attach Attachment 6	appendices.pdf	Add Attachment	Delete Attachment	View Attachment
7) Please attach Attachment 7	funding received.pdf	Add Attachment	Delete Attachment	View Attachment
8) Please attach Attachment 8	agreement.pdf	Add Attachment	Delete Attachment	View Attachment
9) Please attach Attachment 9		Add Attachment	Delete Attachment	View Attachment
10) Please attach Attachment 10		Add Attachment	Delete Attachment	View Attachment
11) Please attach Attachment 11		Add Attachment	Delete Attachment	View Attachment
12) Please attach Attachment 12		Add Attachment	Delete Attachment	View Attachment
13) Please attach Attachment 13		Add Attachment	Delete Attachment	View Attachment
14) Please attach Attachment 14		Add Attachment	Delete Attachment	View Attachment
15) Please attach Attachment 15		Add Attachment	Delete Attachment	View Attachment

Project Team

1. Philliou, Christine (Project Director), Professor, University of California, Berkeley, USA
2. Genell, Aimee (Key collaborator), Assistant Professor, University of West Georgia, USA
3. Neumeier, Emily (Key collaborator), Assistant Professor, Temple University, USA
4. Zlimen, Leo (Key collaborator), CEO, Ladris Technologies, Nevada City, USA
5. Ozil, Ayse (Key collaborator), Associate Professor, Sabanci University, Turkey
6. Poulos, Panagiotis (Key collaborator), Assistant Professor, National and Kapodistrian University of Athens, Greece
7. Sumertas, Firuzan Melike (Key collaborator), Visiting Scholar, University of California, Berkeley

International working group:

1. Achladi, Eva (Librarian, Sakkoulidis Collection of the Sismanoglio Cultural Center, Greek Consulate in Istanbul)
2. Kamouzis, Dimitris (Researcher, Centre for Asia Minor Studies, Athens)
3. Tsilenis , Savvas (Istanbul Greek, and Emeritus Professor of Architecture, Athens)
4. Güvenç, Murat (Professor, Sociology, Kadir Has University, Istanbul)
5. Istikopoulou, Lida (author of multiple books on Istanbul Greek civil associations, historian, Athens)
6. Kolovos, Elias (Associate Professor, Ottoman History, University of Crete)
7. Amygdalou, Kalliopi (Researcher, Architectural Historian, ELIAMEP, Athens)
8. Andrikos, Nikos (Assistant Professor, University of Ioannina, Greece)
9. Örs, İlay (Anthropologist-Ethnographer, author of book on Istanbul Greek emigres to Athens, Instructor at American College of Greece)
10. Alexandris, Alexis (Istanbul Greek, diplomat and historian, author of seminal books on the Greek minority of Istanbul in the 20th century)
11. Mills, Amy (Geographer, author of book about the Kuzguncuk neighborhood of Istanbul)
12. Feldman, Walter (Musicologist, professor at NYU Abu Dhabi, specialist in Ottoman court music)
13. Stamatopoulos, Dimitris (Professor, History, University of Macedonia, Thessaloniki)
14. Simons, Olaf (Lecturer, University of Gotha, director of FactGrid (WikiBase) linked database project)
15. Zurbach, Christin (PhD candidate, History, UC Berkeley)
16. Tümer, Hilal (PhD candidate, History, UC Berkeley)
17. Onayli, Kutay (PhD candidate, Near Eastern Studies, Princeton)
18. Bali, Marilena (researcher, MA student, University of Crete, Rethymno)
19. Papaioannou, Nikos (PhD candidate, archivist at Ecumenical Patriarchate, Istanbul)
20. Arvaniti, Maria (PhD candidate, National and Kapodistrian University, Athens)
21. Bekmen, Büşranur (PhD student, Marmara University, Istanbul)
22. Eren Topal, Alp (post-doc, University of Oslo)
23. Hur, Gül (PhD candidate, Sabanci University, Istanbul)

Advisory Board:

1. Gavroglou, Kostas, Professor at National and Kapodistrian University of Athens, former Minister of Education of Greece; founding director of the Anthemion digital archive of the Greeks of Istanbul (a major repository for the sources we will be utilizing)
2. Vingas, Lakis, President, Yeniköy Greek Community Foundation; project manager of the Association of Greek Foundations (RUMVADER); former representative of the Non-Muslim Foundations
3. Kafadar, Cemal, Vehbi Koç Professor of Turkish Studies, Harvard University
4. Anastassiadou, Merope, Professor, INaLCO, Paris
5. Bamman, David, Associate Professor in the School of Information, UC Berkeley
6. Campos, Michelle, Associate Professor in Jewish Studies and History, Penn State College of Liberal Arts
7. Singer, Amy, Sylvia K. Hassenfeld Chair in Islamic Studies and Professor of History, Brandeis University; former president of Ottoman and Turkish Studies Association
8. Georgopoulou, Maria, Director, Gennadios Library, American School of Classical Studies at Athens
9. Greene, Molly, Professor of History and Hellenic Studies, Princeton University
10. Ouzounoglou, Nikolaos, Chairman of the Ecumenical Federation of Constantinopolitans at Athens
11. Behar, Cem, Emeritus Professor of Economics, Boğaziçi University
12. Exertzoglou, Haris, Professor, History, University of the Aegean, Greece
13. Eldem, Edhem, Professor, History, Bosphorus University; College de France
14. Kavouras, Pavlos, Professor, Cultural Anthropology, National and Kapodistrian University of Athens

Narrative

Project Overview:

We seek NEH funding for an expansive, scholarly, and public-facing website, in order to build new structures of knowledge and raise public awareness about cosmopolitan Istanbul and its constituent Orthodox Christian communities in the 19th and 20th centuries. Drawing on but also bridging fragmented secondary scholarship of the last generation (in Greek, Turkish, French, as well as English), we are using a wide array of archival sources to carry out a systematic and comprehensive, granular reconstruction of the demography and topography of the Greek Orthodox communities of late Ottoman Istanbul (1821-1923). In doing so, we will be collaborating to produce scholarly articles, ongoing blog posts and interviews, ArcGIS story maps, relational databases, and virtual as well as in-person exhibitions that grow out of the website, to 1) write these communities back into the history of the Ottoman Empire, modern Turkey, and modern Greece, as well as into the comparative study of urban spaces in this region; and 2) to spatialize our conception of this group and their interconnections with surrounding communities and the city and region as a whole. Spotlighting the local Christian communities of Istanbul will shed light on the possibilities for inclusion and belonging of non-Muslims in a Muslim state. Our project will also offer a tangible way to visualize the tensions between cosmopolitanism and nationalism that have been present in cities across space and time.

Significance and Impact

Turkish President Recep Tayyip Erdoğan sent shockwaves around the world in summer 2020 with his decision, by fiat, to change the status of the Hagia Sophia in Istanbul. Originally the Roman/Byzantine imperial cathedral and a major world heritage site, Erdoğan reverted it from a museum to a mosque. The international community and the Turkish opposition expressed outrage, but none were able to fully explain the motives behind this dramatic gesture. The incident also laid bare how poorly understood the historical relationship between Greek Orthodoxy and Islam is in the world today. Unlike the stark encounter between Latin Christendom and Islam that prompted the Crusades, the worlds of Islam and Orthodox Christianity have been intertwined, its adherents much more familiar to each other over the centuries. Hagia Sophia, a Byzantine creation, was not destroyed with the Ottoman conquest of Constantinople in 1453, but rather appropriated and converted to a mosque. At their height in the 19th century, the communities of Orthodox Christians in Istanbul, the capital of the Muslim, Ottoman Empire, numbered more than 200,000-- a substantial plurality of the city's inhabitants. The presence of Orthodox Christians in the Ottoman Empire, and particularly in the capital city of Istanbul, has not been historicized or integrated into the structures of knowledge or the visual-spatial conceptions we have about the city or the histories of Europe and the Middle East more broadly.

We seek NEH funding to develop an expansive website that is both scholarly and public-facing, a dynamic and collaborative intellectual space that will build new structures of knowledge, spatialize and visualize our knowledge, and raise public awareness about Istanbul and its constituent Orthodox Christian communities in the 19th and 20th centuries. Together we will develop a series of archival, data, interpretive, and interactive projects that will feed into and be displayed on our website, which is already under construction (istanpolis.org)[1]. Drawing on but also bridging fragmented secondary scholarship of the last generation (in Greek, Turkish, French, as well as English), we are using a wide array of archival sources to carry out a systematic and comprehensive, granular reconstruction of the demography and topography of the Greek Orthodox communities of 19th-century Istanbul. In doing so, we will be collaborating to produce articles, ArcGIS story maps and data visualizations, open source databases, and virtual exhibitions, aimed at preserving the cultural heritage of these groups and writing them back into the history of the Ottoman Empire, modern Turkey, and modern Greece, and into the comparative study of Muslim-Christian relations in urban spaces across the Middle East and Europe in the 19th century.

This project makes empirical, conceptual, methodological, and comparative contributions to the humanities. It will provide the empirical foundation for more interpretive and theoretical discussions about Istanbul as an example of multi-ethnic and multi-confessional cities undergoing modernization in

the 19th century. We use a relational approach, wherein we account for the internal diversity of the Orthodox Christian communities, cultures, literatures, and collective memories linked to Istanbul. We also explore the relationships between members of these communities and those of the Muslim, Jewish, Greek Catholic, and Armenian communities, the Ottoman and modern Greek states, and European colonial states that sought to define these communities in often conflicting ways. Taken together, this project decenters the Greek- and Turkish-nationalist experience of modernity and challenges its normativity and hegemony in the fields of European and Middle East studies, while simultaneously recasting Orthodox Christian subjects from the margins to the center of key questions in the making of the "Middle East" and "Europe" in the modern world.

Substance and Context

Our project is situated at the intersection of three key historiographic trends in Ottoman, Greek, Middle Eastern/Balkan and global history of the 19th century: recent scholarship on ethnic-confessional diversity in early modern cities and empires; national historiographies of both Greece and Turkey; and debates on global processes of the long 19th century. These three trends all implicate, and yet pass over the particularities of the Orthodox Christian communities of Istanbul. Through our systematic and collaborative study of the changing urban fabric and the place of Orthodox Christians, we seek to provide new perspectives on all of these global processes–and a new kind of history of both the Middle East and Europe.

First, scholars have made many assumptions and grand claims about what ethnic and confessional diversity in pre-modern societies has meant, and how life was structured in such areas. Until the 1990s, scholars had passed over the question of diversity when studying cities in multiethnic empires in favor of studying one or another confessional or ethnic group, assuming that there were clear boundaries between them (Marcus 2010; Gibb and Bowen 1958; Braude and Lewis 1982). More recently, historians have looked at imperial diversity to argue for a pre-modern "tolerance," remarkable for having existed before and outside the European Enlightenment and the advent of notions about individual rights and equality (Barkey 2008; Mazower 2004). Still others have attempted to synthesize the two approaches, aspiring to devise a vocabulary to express the spaces of fraternization as well as the social and economic boundaries (Trivellato 2019) in "cosmopolitan" urban spaces. In contrast, our collaboration foregrounds--and our sources make possible--systematic, spatial reconstruction and analysis about the demography and topography of such a "cosmopolitan" space, precisely in the era when diversity began to give way to homogenization of nation-states.

Second, national frameworks, whether Greek or Turkish, render invisible the experience and agency of Orthodox Christian communities in Istanbul. On the one hand, Greek studies dedicates little space to the more than five centuries of Ottoman rule. The traditional timeline tells of centuries of darkness and oppression, leading to the 18th- century Greek Enlightenment, culminating in the Greek Revolution in 1821 and the establishment of the Greek state in 1830. From that point on, the center of politics and the driver of history is Athens, the national capital, while the majority of Orthodox Christians remained resident in the Ottoman Empire, centered in Istanbul. On the other hand, Ottoman and Turkish Studies treat the experience of Orthodox Christians, particularly those in Istanbul, as marginal, and assumes these communities to have been incidental to the history of the empire. This is an acute paradox when we speak of the 19th century, as Ottoman Christians became the pawns in international politics between the Ottoman Empire and Christian powers of Europe. The latest generation of revisionist Ottoman studies unwittingly reinforces this erasure, if only because most scholars of Ottoman history do not know Greek, and cannot problematize the internal workings and changing communal structures of Orthodox Christians, the largest and most politically significant minority across the Balkans and Middle East throughout the Ottoman centuries.

Third, historiography of the global 19th century focuses on processes of modernization, nation-state formation, colonialism, and more recently, the formation of international law. All of these focus on states--modern nation-state formation, colonial state projects, modernization of the state apparatus, and international law as a vehicle for inter-state relations and European supremacy. In focusing on people, and

place, in the local, grounded, demographically significant and yet bounded urban space of Istanbul, we shift the focus and show the different ways these macro-changes appear (and do not appear) in people's lives and local surroundings. We use the capital city as a window onto larger population movements as well as social, political, and economic processes.

We divide the city's Orthodox Christian communities into two broad chronological periods. The first period starts in 1821 with the outbreak of the Greek Revolution, which forever changed the political predicament of Orthodox Christians in the Ottoman Empire, and ends in 1860 with the communal reforms that established a Permanent Mixed National Council for Orthodox Christians in the empire, setting up a new structure of governance for them in the empire and the city. The second period starts with those reforms and extends until the final dissolution of the Ottoman Empire and the 1923 Treaty of Lausanne, which assigned the status of a minority under international protection to the Greeks of Istanbul in the new framework of the Turkish Republic.

In addition to the two temporal bounds of our study, there are three geographic regions that order our analysis. Region I is the Historic Peninsula of the city, known as the Golden Horn. It is home to the Hagia Sophia, the Ottoman Palace, and the Grand Bazaar, as well as the Orthodox Patriarchate and adjoining neighborhoods. This was the historic, economic-artisanal, and political-administrative heart of the city. Region II lies across the Golden Horn, on the European shore of the Bosphorus, and includes the urban districts of Galata, Pera/Beyoğlu, and the working-class areas of Tatavla, Feriköy and Kasımpaşa. These areas, and particularly Galata and Pera/Beyoğlu, were home to European embassies and by extension were the heart of westward-oriented commercial life of the city. Region III includes the string of villages along the European and Asian shores of the Bosphorus that were ultimately incorporated into the city as it expanded throughout the 19th and 20th centuries, as well as the four Princes' Islands just off the shore, where there were important church holdings and holiday homes of the rising middle and upper classes of the city, with Orthodox Christians and other non-Muslim groups disproportionately represented.

As we study the developments in each of three regions across two time periods in our analysis, we will also be attentive to six key themes. First, the legal-administrative life of the city is the prerequisite for understanding the constituent neighborhood and parish communities. On the broadest level, Greek Orthodox Christians constituted a legal community, as non-Muslims subject to Ottoman law. There were constant struggles between clerical and lay groups among the Greek Orthodox, and between the older and emergent elites. This situation was further complicated by contested visions among Ottoman policymakers regarding non-Muslim populations in the era of reform. Our project team, focusing on this legal-administrative theme, will elaborate on these structural changes and read our sources with an eye to tracking how they played out in daily life.

Our second theme is demography and migration. Building on urban microhistories of Istanbul for the population as a whole (Anastassiadou 2012; Behar 2003), we will closely track the settlement and migration patterns across the city, paying particular attention to where clusters of people from various parts of the empire settled in Istanbul neighborhoods, which professions those people practiced, and examine how these urban mobility patterns changed between 1821 and 1860, and again after 1860 under changing circumstances. Growing out of settlement and migration, our third theme is occupation and social class. The traditional exclusion of Greeks from the military-administrative ranks of the empire as non-Muslims resulted in their regular involvement in trade, money-lending, and other urban occupations in the early modern period. This project seeks to trace these historical actors in Ottoman, Greek, and other international archival documentation (there is for example the family archive of the Zarifis banking family and others in the British National Archives). Mapping will help us see highly used routes, characteristics of the goods they exchanged and the frequency of their transmission, the features of their companies, among others.

The cultural processes of the Ottoman "long nineteenth century" make up our fourth theme, meant to be a dynamic analytical framework for understanding social change both on intra- and inter-communal level. The rise of a non-Muslim middle class from the 1860s was accompanied by the formation of a new cultural environment comprising voluntary associations and social clubs, the

expansion of printing and the Greek-language press, reading rooms and public libraries, and western-style entertainment venues. Within this Ottoman "civil society" (Göçek 1996) new forms of sociality emerged and developed in the city, alongside traditional forms and modes of social interaction that persisted and transformed in response to the overall change. It is in this context that we will display and analyze literature, music, theater, and entertainment involving Orthodox Christians on the website.

Fifth, we focus on material culture and the built environment--the surrounding "stage" for all the other structures and processes of the four previous themes. In order to investigate the ever-shifting physical topography of Istanbul, we aim to catalog all sites relevant to the Orthodox Christian communities of the city, including churches, monasteries, cemeteries, and communal and commercial institutions such as schools and workplaces. These catalogs will include information about when, where, and by whom/which community these sites were built. We will also track whether there were any changes of these sites such as the movement of a school or an orphanage from one place to another. This theme connects up directly with our interactive visualizations/maps of Istanbul, examining how these sites are embedded in the larger urban environment; how they were produced, designed, and related to each other, and what role the built environment played in the life and social-professional activities of the city's inhabitants.

Sixth, we take up networks and connections--both intra- and inter-communal. Employing sociological and digital humanities methods we will investigate the relationships across families, patronage and professional networks, and school and parish communities; and relationships between Orthodox Christians and their non-Orthodox Christian neighbors, co-workers, and trading partners; and the dynamics between Orthodox communities and the state.

Methods and Execution

The scope and range of sources needed for this project make it far too ambitious for any single scholar to undertake. While the central frame of the project is the urban space of Istanbul in its entirety, we will pivot between the micro (at the parish, neighborhood, and family level), and the macro (migration and trade linking the city to Greece as well as diverse regions of the Balkans and Middle East; the place of Istanbul in the economy and politics of the broader region and empire) in order to build new structures of knowledge about the city. We intend to draw on the expertise of colleagues in the US and abroad–-in Turkey and Greece, as well as several other European countries. Our team brings together scholars from a range of disciplinary and methodological approaches: history, architectural history, geography, anthropology, musicology, digital humanities/IT, and sociology. Our team is intergenerational, and uniquely brings an intimate knowledge of Istanbul Greeks themselves--the few still resident in the city and the many in Athens and across the globe today. All of these elements, and particularly the participation of those in the community today, shows that we aim to synthesize the widest range of scales and perspectives--from the granular to the global.

The most significant corpus of sources we will tackle includes more than 200 census registers (see the appendices for samples), in Ottoman Turkish, Greek, and French. Ottoman census registers for the Greek Orthodox community (1821 through the 1860s) demand the knowledge of Ottoman Turkish paleography and of Greek language and naming conventions. Each register contains 1000-6000 entries, and these registers were only released to scholars in the last 5 years. These are the cornerstone for our collaborative study: our team has begun transliterating and tabulating these registers, which are broken down by region of the city and include all the neighborhoods of Istanbul[2]. We are converting this information into machine-readable data sets in spreadsheet form. Ottoman state registers will be compared and contrasted to communities' registers of various types (general, parish etc.), as well as an array of administrative documents, in order to draw the complex picture of the way community policies were implemented both on the central and local level. In addition, the census registers of citizens of Greece resident in Istanbul, kept by the Greek embassy from 1879 through 1924, are equally rich. The Greek state was established in 1830, leaving out the vast majority of Greek Orthodox Christians, who remained in the Ottoman Empire. Until now we have only spotty, speculative knowledge about the many citizens of Greece who chose to live and work in Ottoman domains, and particularly in Istanbul, rather

than to remain in Greece. No one has ever attempted to tabulate and analyze who these people were and what might have been the pull factors for them to leave the nation-state and choose to live in the empire. The data in these registers will allow us to map, for the first time, the migration patterns, social-occupational profile, and social and kin networks of this emergent community within the preexisting Orthodox Christian communities of the city. Finally, from the 1870s on we have the *Annuaire Oriental*, an annual French-language business directory of the city, focusing on the Pera/Galata region and a true treasure trove of data when we compare and correlate it with the other two types of census registers. A handful of these have already been coded and are ready for processing and interpretation.

While the census registers are the foundation for our collaboration and website, there are several other types of archival sources from the communal and Ottoman imperial archives that we will utilize. These include Ottoman court records, community bylaws, parish and Patriarchate records, and, particularly for the period after 1860, a wealth of Greek-language published sources about the history and contemporary life of Istanbul Greek communities. In an important sense, the collaborative work of the team will lie in determining the selection of these sources to enable a coherent and yet capacious, comparative set of projects, and thus structures of knowledge that can shift our understanding of these communities living within and beyond the city of Istanbul.

The website we propose to develop will be a dynamic space of collaboration as the network hub and intellectual space/arena, as well as the preliminary publication venue for these reconstructions. The Istan-polis site will feature the interconnections of individuals' original research on specific questions (in the form of articles, interviews, and digital exhibits), as well as collaborative analysis and synthesis of the demographic and topographic data assembled from the primary sources (the interactive maps, visualizations, and query features for the population data). We already have a special journal issue in the Fall 2022 *Journal of Ottoman and Turkish Studies*, entitled, "Rum (Orthodox Christian) geographies," which is the product of our initial collaboration, and which feeds into our website. There is also a major exhibition in the early stages of planning by one of our key collaborators, about the material culture and architecture of one of the most central neighborhoods for Greek life in the city. We envision a cascade of conventional (non-digital) edited volumes focusing on specific themes within our project such as migration at local, regional and global levels or the making of the neighborhoods of Istanbul. We also aim for special journal issues that will bring the Greek experience to the focus area of the journals such as economy, urbanity, or nationalism.

The Project Director and all 6 Key Collaborators will meet regularly on Zoom (we have been convening monthly meetings since early 2021) and will all have an active role in providing content for the website and in developing projects that grow out of the website. Each will lead their working groups in the research and writing of interpretive articles and data mapping and visualization of their respective themes within the larger project. In collaboration with our IT team at UC Berkeley and Kadir Has University in Istanbul, we will analyze and interpret the data, using ArcGIS and NetworkX technologies. The topics include: 1) demography and migration patterns; 2) changing communal legal-administrative structures; 3) socio-economic and occupational affiliations and identities; 4) music, culture, social spaces, and collective memory/oral history; 5) the built environment, including architecture and topography; and 6) and the structures and functions of the Orthodox Patriarchate and its three Metropolitan Sees in the city.

At the same time, we will be collaborating to correlate this data with existing information in scholarship and interpreting/analyzing the results to put it in a larger context, neighborhood by neighborhood. As the granular data comes into sharper focus, we will develop techniques and do the ancillary research to integrate it into our existing knowledge of the city, teaming up with geographers, architectural historians, musicologists, and anthropologists in both Greek and Turkish studies. The digital humanities component, then, will feed back into our analysis of the urban space, of the subcommunities at the neighborhood, parish, family, and professional levels, and allow us to address in a deeper way than ever before what community meant, within and across confessions in this world city. We then plan to think outward to other case studies--both within Istanbul, building out to consider communities of Armenians, Jews, and Muslims, for instance; and beyond the city, as we will be convening panel

discussions and collaborative exhibits online and eventually in person to compare our findings with cities in the larger region such as Izmir, Alexandria, Thessaloniki, Budapest, Cairo, Baghdad, Beirut and Jerusalem, using Istanbul as our point of reference.

While the team will be collaborating and generating data sets throughout the year in each of the three years, several research trips and intensive in situ seminars and workshops will be necessary to complete this project and the constituent data sets. A plenary session (location TBD) within the first three months of each year will bring together the Project Director and Key Collaborators to share research and formulate a plan for the summer intensive seminar.

Each of the three summers, the entire group will convene in Istanbul for a collaborative workshop. Each year's meeting will focus on one of the three regions in turn. We will make an in-depth tour of the key sites in each region, cataloguing which structures are still extant and which have been built over/destroyed, in order to create the most detailed base map possible. We will process as many of the Ottoman census registers as possible in the course of these two weeks (offering a competitive opportunity for graduate students from the US and abroad who are interested in learning these paleography skills) and use these data sets for further mapping of the key regions. Our hope is that these summer seminars may continue beyond the three-year grant period, pending funding, and that such seminars, along with our growing website, will form the nucleus of this new and sustained subfield of Greek/Ottoman/Istanbul studies.

The website, as the outcome of our efforts and the wellspring for future collaborations, will consist of several interconnected features populated at different points during the three-year grant: all will connect a) data sets we are generating from census registers and other archival sources, b) collaborative writing of articles, and c) IT visualization of data.

1. A series of historical "community profiles" for each of the 48 constituent communities of the city (Regions I, II, and III)—this is the first time this is being done in English
2. A series of feature articles on the key themes of the project with visual examples
3. Samples of original primary sources--linked to the open source database containing all of our census data, stored and searchable on our Google Drive database
4. A "Who's Who" directory/prosopography of prominent Istanbul Greeks from this period--linked to our searchable database
5. Storymaps and interactive digital maps--incorporating the data we will be compiling from the census registers, neighborhood by neighborhood, and for each of the chronological periods (early-mid 19th century, mid-late 19th century, 1908-1923)
6. Links to related projects, such as the Digital Ottoman Studies platform, OpenJerusalem (granular reconstruction of all confessional communities in Jerusalem in the 19th and 20th centuries), the Houshamadyan Project to reconstruct Armenian life in Ottoman Anatolia, and the current NEH-funded project on Jews of the Middle East.

History of the Project and Productivity

In 2000 and 2001, then graduate student Christine Philliou organized two international workshops on "Greek-Ottoman civilization" which took place in Greece (Chios in 2000; Samos in 2001), with funding from Princeton University and the Cultural Section of the American Embassy in Athens. Ayşe Özil also a grad student at the time, participated in these workshops and went on to complete her dissertation and first book on Greek Orthodox communities in Anatolia, and has since written important articles on topics such as changing property regimes for Greek Orthodox in Istanbul. Philliou has organized countless workshops, conferences, and directed collaborative projects about Greek, Ottoman, and modern Turkish history, as well as comparative urban history over the course of her career at Princeton, Yale, Columbia, and UC Berkeley. Panagiotis Poulos (National and Kapodistrian University, Athens), an award-winning scholar of Ottoman-Greek music, has directed multiple collaborative projects with international funding, on topics such as Ottoman monuments in Greece and social-musical spaces of interconfessional and especially Greek-Jewish-Muslim interaction in Istanbul. They, and several other collaborators on this project, such as Firuzan Melike Sumertas, an architectural historian who recently

completed her dissertation on 19th-century Istanbul Greek intellectuals and their memory of the Byzantine past, are part of the new generation of scholars who conduct research in both Ottoman Turkish and Greek. Aimee Genell's focus has been on late Ottoman history, sovereignty and international law, and she has been training in digital methods, specifically ArcGIS for mapping Istanbul in the 1908-1923 period. Emily Neumeier has done path-breaking work on the built environment, material culture, and digital methods for tracking social and cultural history in the early 19th-century Balkans and Istanbul, and also has knowledge of Greek and Ottoman Turkish.

Christine Philliou in 2020 began assembling a working group and larger collaborative digital humanities project called "Istan-polis," that has developed into this application for NEH funding. Our Istan-polis working group meets monthly to develop the intellectual scope and aims of the project, and our Ottoman population registers working group, with some members from the working group and several others in the US and abroad, also meets monthly to confer about issues and problems in deciphering and transcribing the registers. Our IT working group, again made up of a few people from the core working group and several others, meets weekly to troubleshoot and develop solutions and methods to organize, analyze, visualize and display the data we are collecting. We also have a subcommittee, composed of members of the working group, that is developing the public humanities dimension of the website and the project as a whole. We have the necessary experts assembled, the technology and methods developed, and the sources prepared to begin our work—what remains are the resources to launch and execute the project.

We recently prepared a special issue for the *Journal of Ottoman and Turkish Studies*, Fall 2022, entitled, "Rum Geographies," which includes contributions on Istanbul in a comparative context with other areas of Greek Orthodox settlement in the Ottoman Empire. In Spring 2022, Christine Philliou organized a comparative conference on the Greek and Armenian communities of Istanbul in the Post-WWI Armistice period (1918-1923) to take place at UC Berkeley. Philliou has published both of her books with University of California Press, and that press has expressed interest in publishing an innovative atlas of Istanbul, which this project would certainly support and feed into. We are confident that we would have the interest of several top university presses for a range of projects that derive from the website we are proposing.

We have the enthusiastic endorsement from and cooperation of the Ecumenical Orthodox Patriarch Bartholemew [3] and his Holy Synod, as well as the leaders of the still-extant Greek community of Istanbul and of the Worldwide Federation of Istanbul Greeks and the Center for Asia Minor Studies in Athens. We see their cooperation and collaboration as crucial, not only for the access they will provide to their highly guarded archives, but for the intimate knowledge of the city and its Greek Orthodox communities, past and present, that they have.

Collaboration

The project director and key collaborators[4] specialize in various chronological periods and (early-mid 19th century, late 19th-early 20th century, 20th century) and historical approaches (legal, political, social, cultural, architectural, digital humanities) within and across Greek and Ottoman, and Balkan and Middle East studies. Each of us has spent years in the archives; five of us are fluent in both Greek and Turkish, and six have expert reading knowledge in Ottoman Turkish paleography. As a result, we are well-prepared to spearhead this large collaborative research and writing project.

Project director Christine Philliou is Professor of History at UC Berkeley. A political and social historian of the Ottoman Empire and modern Turkey and Greece as parts of the post-Ottoman world, she has published on the role of Orthodox Christian elites in Ottoman governance, on the effects of the Greek Revolution on Ottoman Christian communities and on Ottoman governance as whole, on Ottoman legacies in the Balkans and Middle East, on the "imperial turn" in Ottoman studies, and on politics of dissent and opposition in the urban fabric of Istanbul. She is the author of *Biography of an Empire: Governing Ottomans in an Age of Revolution* (University of California Press, 2011) and *Turkey: A Past Against History* (University of California Press, 2021), and is currently working on a synthetic book about the post-Ottoman world, under contract with Princeton University Press. Philliou has worked extensively

in archives in Turkey, Greece, Romania, Bulgaria, France and the UK, and with documents in Ottoman Turkish, Greek, and French as well as English. Deeply inspired by the spatial turn in digital humanities, Philliou will oversee the themes of demography, topography, and migration, with a special focus on the early-mid 19th century. She will also supervise the project website and workflow between working groups and the IT/DH team members. She will spend approximately 3 summer months on the project during the first two years and will be on leave during Year 3 to devote her time to the project.

Key collaborator Aimee Genell (BFA, Cooper Union, Ph.D. Columbia University) is an Assistant Professor at the University of West Georgia. Her research focuses on the history of the late Ottoman Empire and its entanglements with Europe. Her manuscript, *Empire by Law: The Ottoman Origins of the Mandate System in the Middle East* (under contract, Columbia University Press), examines the Ottoman genealogy of the post-imperial political order in the Middle East. Her second project, "Empire under Occupation," examines the fragmentation of imperial space, networks and institutions during the Armistice period (1918-1923). Her project will result in two publications: a book on the end of the Ottoman Empire and a scholarly and public-facing interpretive website, with an Arc-GIS mapping tool that enables researchers to track people, ideas, demographic changes, and economic and labor networks throughout the imperial domains during the Armistice. Genell will oversee data visualization and Arc-GIS mapping and will contribute to building story maps for 3 summer months each year and 4 months during each academic year to the project.

Key collaborator Emily Neumeier (Ph.D. University of Pennsylvania) is Assistant Professor of Art History at Temple University. She specializes in the visual and spatial cultures of the Eastern Mediterranean, with a focus on the Ottoman Empire. She is currently preparing a book manuscript that presents an alternative history of Ottoman architecture from the view of the provinces in Greece and Albania during the Age of Revolutions period. Neumeier has already published several articles examining Ottoman views of antiquity in Greece and nationalist discourses through art in venues like the *International Journal of Islamic Architecture* and *History and Anthropology*. She is also presently co-editing a volume titled *Hagia Sophia in the Long 19th Century* (under contract, Edinburgh University Press), which explores the making of a modern monument by uncovering a range of local encounters with Hagia Sophia in the late Ottoman Empire and early Turkish Republic. Neumeier has considerable experience conducting fieldwork and archival research in Turkey and Greece, and her main research languages are Greek and Ottoman Turkish. She also has training in digital humanities technologies, especially mapping and GIS, and extensively engages in public scholarship, serving, for example, as editor and frequent host of the *Ottoman History Podcast*. With her specialization in art and architectural history, Neumeier will oversee the theme of material culture and the built environment and contribute to the Arc-GIS mapping of sites in Istanbul. Neumeier will devote 3 summer months each year to the project and 4 months during each academic year to the project.

Key collaborator Leo Zlimen (BA, History, Arabic, and Near Eastern Civilizations, UC Berkeley) is a software engineer for Ladris Technologies, a startup that he helped co-found together with another Berkeley grad. Zlimen has extensive experience in digital methods, particularly in deriving network analyses from sources with missing or partially complete data. Zlimen is an original collaborator on the project with Philliou, helping her to develop the concept and computational methods. He will design and oversee the creation of our network analysis, interactive story maps, data visualization, and anchoring of our data sets in an easily accessible database for maximum sustainability.

Key collaborator Ayşe Özil (BA, MA Boğaziçi University, PhD Birkbeck College, University of London) is associate professor of History at Sabanci University in Istanbul. Before joining Sabancı University, she was a post-doctoral fellow at Princeton University and a visiting researcher at Leiden University. Her research interests focus on the history of Greek communities in the late Ottoman Empire in relation to social networks, modern institutionalization, and urbanization. Exploring the inter-relationship between the Ottoman and Greek worlds, her work has drawn on a comparative examination of Ottoman, Greek, and British archival sources. She is the author of *Orthodox Christians in the Late Ottoman Empire: A Study of Communal Relations in Anatolia* (Routledge, 2013) which offers a critical reappraisal of the non-Muslim communal system in the Ottoman Empire. She has published in journals

such as *International Journal of Turkish Studies*, *Journal of the Ottoman and Turkish Studies Association,* and *Turkish Historical Review* and in multiple edited volumes. Her current work explores the social history of lower income groups in Beyoglu, Istanbul. She is also working on a project on trade companies and the modernization of commercial buildings (*han*) in Galata, Istanbul and has just published an online exhibition on the *han*s of the Galata port where Greek merchants were key agents of global trade: https://artsandculture.google.com/story/HQWhQ-nXDqLkBg. Her research has been supported by the American School of Classical Studies at Athens, Koç University's Research Center for Anatolian Civilizations (Anamed), Alexander S. Onassis Public Benefit Foundation and the Scientific and Technological Research Foundation of Turkey (Tübitak). Özil will oversee the theme of institutionalization -social, legal, educational- in the late Ottoman period and will devote 3 summer months each year to the project and 4 months during each academic year to the project.

Key collaborator Panagiotis C. Poulos (BA, PhD SOAS, University of London) is Assistant Professor of Ethnomusicology at the Department of Music Studies at the National and Kapodistrian University of Athens[5] and a member of the Ethnomusicology and Cultural Anthropology Laboratory of the same department. His research centers on the musical traditions of the Islamic world, the cultural history of late Ottoman and Turkish music and arts with a focus on the role and status of non-Muslim communities, intercommunal relations and the history of everyday life in Ottoman cities. Poulos is one of the founding members of the research team sonorCities, he is Scientific Co-Coordinator of the research project *Histories, Spaces and Heritages at the Transition from the Ottoman Empire to the Greek state* (funded by the French School at Athens, 2017-2021) and Principal Investigator of the research project *Intercommunal Musical Geographies of Late Ottoman Istanbul* (funded by the Hellenic Foundation for Research and Innovation 2019-2022). In 2013 he was awarded an honorable mention Ömer Lütfi Barkan Award by the Ottoman and Turkish Studies Association for his article, "Rethinking Orality in Turkish Classical Music: A Genealogy of Contemporary Musical Assemblages" (MEJC 4, 2011). Poulos will oversee the theme of culture and social life and will devote 3 summer months each year to the project and 4 months during each academic year to the project.

Key collaborator Firuzan Melike Sumertas (M.Arch, BA, METU, Ankara, Ph.D Boğaziçi University, İstanbul) is a visiting scholar at the History Department, UC Berkeley. Her research focused on the urban and architectural history of Istanbul during the Ottoman period. She is currently working on a major exhibition project on the urban, architectural and material culture of the Phanariots, the Greek Orthodox elite members of the Ottoman administrative circles. She has recently published an article on the same topic, with another colleague. Her M.A thesis focused on "Female Patrons of Architecture in Early Modern Istanbul", whereas her doctoral project inquired about the nineteenth-century scholarship on 'Old Istanbul,' particularly by the Greek-Orthodox intellectuals. During her Ph.D. research, she was awarded the Fulbright Cultural Exchange Scholarship and spent an academic year at Princeton University, Department of History. She also participated in the Erasmus Student Exchange Program and studied for one semester at the University of Crete, Department of History and Archaeology. Additionally, she was awarded scholarships from significant research institutions such as ARIT – Istanbul, AKMED – Antalya, EFA – Athens, SNF – Athens, Bodossaki Foundation – Athens, and NEC – Bucharest, TUBITAK – Ankara. Her research languages are Ottoman, Turkish, and Greek. Sümertaş will oversee the data collection processes in general and provide the link between the primary sources in Ottoman Turkish and Greek to their transformation into data sets. She will also contribute to the spatialization and visualization of the data sets on the urban context of Istanbul. Sumertas will devote 3 summer months each year to the project and 4 months during each academic year to the project.

Workplan

Various aspects of the project will be overseen by Project Director Christine Philliou and the Key Collaborators (Özil, Poulos, Genell, Zlimen, Sumertas, Neumeier) as follows. Each year of the grant, we move through the content by region and chronological period. Christine Philliou will oversee, giving special thematic emphasis to demography and migration patterns

Year 1 Months 1-6: (10/23-3/24)
Region I: The Historic Peninsula (1821-1860)
-Generate historical/demographic profiles for the 15 communities/parishes within the Historic Peninsula of the city (Philliou oversees grad student researchers)
-Data entry and analysis of Ottoman census registers for the 15 communities of the Historic Peninsula (Philliou oversees; Sumertas facilitates)
-Key collaborators generate articles, bibliography, Greek-language source material on the 15 communities of the Historic Peninsula according to their specialized themes
-IT team adds material on the 15 communities of Historic Peninsula to the website, with visual material

Year 1 Months 6-12: (3/24-9/24)
Region I: The Historic Peninsula (1860-1923)
-In situ meeting for the working group, site visits to the 15 communities/parishes of the Historic Peninsula
-Key Collaborators integrate Greek-language material post-1860 according to the dedicated themes
-Generate prosopography of rising middle class/professional classes who were active in the communities of the Historic Peninsula post-1860s
--Special focus on Phanar (a.k.a. Fener) (community that is the center of the Orthodox Church and Patriarchate and is located on the Historic Peninsula)

Year 2 Months 1-6 (10/24-3/25)
Region II: Galata, Pera, and Kasımpaşa-Tatavla (1821-1860)
-Generate historical/demographic profiles for the 10 communities/parishes within the Galata, Pera, and Kasımpaşa-Tatavla (Philliou oversees grad student researchers)
-Data entry and analysis of Ottoman census registers for the 7 communities of Region II (Philliou oversees; Sumertas facilitates)
-IT team adds material on the 7 communities of Region II to the website, with visual material

Year 2 Months 6-12 (3/25-9/25)
Region II: Galata, Pera, and Kasımpaşa-Tatavla (1860-1923)
-In situ meeting of the working group, focusing on (and visiting) the 10 communities of Region II
-Key collaborators Integrate Greek-language material post-1860 according to the dedicated themes
-Generate prosopography of rising middle class/professional classes of Region II post-1860s
-Special focus on Pera/Galata (a.k.a. Beyoğlu) (economic and cultural heart of the city's Orthodox Christian community)

Year 3 Months 1-6 (10/25-3/26)
Region III: European and Asian shores of the Bosphorus and the Princes Islands (1821-1860)
-Generate historical/demographic profiles for the 13 communities/parishes within the European and Asian shore communities and Princes Islands off the shore of the city (Philliou oversees grad student researchers)
-Data entry and analysis of Ottoman census registers for Region III (Philliou oversees; Sumertas facilitates)
-Key Collaborators generate articles, bibliography, Greek-language source material on the 13communities of Region III according to their specialized themes
-IT team adds material on the 13 communities of Region III to the website, with visual material

Year 3 Months 6-12 (3/26-9/26)
Region III: European and Asian shores of the Bosphorus and the Princes Islands (1860-1923)
-In situ meeting of the working group, focusing on (and visiting) the 13 communities of Region III
-Key collaborators integrate Greek-language material post-1860 according to the dedicated themes

-Generate prosopography of rising middle class/professional classes who were active in the communities of Region III post-1860s
-Special focus on two Bosphorus villages-cum-neighborhoods (Arnavutköy and Yeniköy)

Final Product and Dissemination

Our project to reconstruct and analyze the history of Istanbul's Orthodox Christian communities in the final Ottoman century will result in a robust, public-facing website that will display the results of our data projects and feed further research, collaboration, and a range of conventional (print) scholarly publications. The website, as well as its constituent and derivative projects will appeal to scholars in a range of relevant fields, and the visualizations and interactive maps on the website in particular will appeal to non-specialists, including educators and a general audience. Taken together they will form the basis for a new subfield of inquiry and serve as an invaluable resource for understanding the varied experiences of a religious and ethnic minority within the changing urban landscape and shifting political and social conditions of the 19th and early 20th century. It will also be an invaluable resource for Greek diaspora communities in the US-many Greek Americans trace their heritage back to Istanbul and its environs, but have never had the tools to historicize, let alone visualize their family heritage. Training our gaze upon the local Christian communities of Istanbul will generate broader insights for humanities scholars of the possibilities for inclusion and belonging of religious minorities within the state. Our project's focus on the materiality of the experience of this minority will provide new tools for scholars seeking to clarify how the tensions between cosmopolitanism and nationalism were manifested in cities globally.

In terms of sustainability, all of our data will be stored in GoogleDrive, which is both very secure and will be automatically maintained and updated as digital technologies change. In this way, we avoid the possibility of our data storage method and website becoming obsolete, and ensure that our project will be sustained and will be linked up with hundreds of other data projects, which will surely contain important correlative data.

In conjunction with the website and its constituent projects, the director and key collaborators will give a number of public talks. Venues could include the range of Hellenic Studies and Ottoman/Turkish studies programs in North America (Yale, Princeton, Columbia, UCLA, Stanford, Penn, U. Chicago) as well as institutions such as the Institute for Mediterranean Studies on Crete, the Koc University Research Center for Anatolian Civilizations and the American Research Institute in Turkey, Sabanci University, Kadir Has University, the National and Kapodistrian University in Athens, Centre for Asia Minor Studies in Athens, the Center for Eastern Mediterranean Studies at Central European University, and various institutes in Germany, France, and the UK. In addition to these academic settings, we would work to present our findings to broader general audiences, including faith communities and in Greece and Turkey, starting with the Ecumenical Patriarchate in Istanbul, the North American Archdiocese in New York, and interested parishes. There has never been a more timely moment in which to develop this project, as we close in on the centennial of the abolishment of the Ottoman Sultanate, the establishment of the Turkish Republic, and the Greco-Turkish population exchange of 1923, mandated by the Treaty of Lausanne, which forever changed the legal and socio-political circumstances of the Orthodox Christian community of Istanbul.

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[1] See appendices for screenshot of Istanpolis homepage.
[2] See appendices for a sample map with Istanbul city regions.
[3] See appendices for a statement of commitment from the Patriarch.
[4] See appendices for statements of commitment from the key collaborators.
[5] See appendices for commitment statement of cooperation between University of California, Berkeley and National and Kapodistrian University of Athens.

Workplan

	Year 1 (2023-2024)	**Year 2 (2024-2025)**	**Year 3 (2025-2026)**
October to March	Region I: The Historic Peninsula (1821-1860) -Generate historical/demographic profiles for the 15 communities/parishes within the Historic Peninsula of the city (Philliou oversees grad student researchers) -Data entry and analysis of Ottoman census registers for the 15 communities of the Historic Peninsula (Philliou oversees; Sumertas facilitates) -Key collaborators (Ozil, Poulos, Genell, Sumertas, Neumeier) generate articles, bibliography, Greek-language source material on the 15 communities of the Historic Peninsula according to their specialized themes -IT team led by Zlimen adds material on the 15 communities of Historic Peninsula to the website, with visual material	Region II: Galata, Pera, and Kasımpaşa-Tatavla (1821-1860) -Generate historical/demographic profiles for the 17 communities/parishes within the Galata, Pera, and European shore regions of the city (Philliou oversees grad student researchers) -Data entry and analysis of Ottoman census registers for the 17 communities of Region II (Philliou oversees; Sumertas facilitates) -IT team lead by Zlimen adds material on the 17 communities of Region II to the website, with visual material	Region III: European and Asian shores of the Bosphorus and the Princes Islands (1821-1860) -Generate historical/demographic profiles for the 10 communities/parishes within the Asian shore communities and Princes Islands off the shore of the city (Philliou oversees grad student researchers) -Data entry and analysis of Ottoman census registers for Region III (Philliou oversees; Sumertas facilitates) -Key Collaborators (Ozil, Poulos, Genell, Sumertas, Neumeier) generate articles, bibliography, Greek-language source material on the 10 communities of Region III according to their specialized themes -IT team led by Zlimen adds material on the 10 communities of Region III to the website, with visual material
March to September	Region I: The Historic Peninsula (1860-1923) -In situ meeting for the working group, site visits to the 15 communities/parishes of the Historic Peninsula -Key collaborators (Ozil, Poulos, Genell, Sumertas, Neumeier) integrate Greek-language material post-1860 according to the dedicated themes	-In situ meeting of the working group, focusing on (and visiting) the 17 communities of Region II -Key collaborators (Ozil, Poulos, Genell, Zlimen, Sumertas, Neumeier) integrate Greek-language material post-1860 according to the dedicated themes	Region III: European and Asian shores of the Bosphorus and the Princes Islands (1860-1923) -In situ meeting of the working group (Ozil, Poulos, Genell, Zlimen, Sumertas, Neumeier), focusing on (and visiting) the 10 communities of Region III

	-Generate prosopographies of rising middle class/professional classes who were active in the communities of the Historic Peninsula post-1860s --Special focus on Phanar (community that is the center of the Orthodox Church and Patriarchate and is located on the Historic Peninsula)	-Generate prosopographies of rising middle class/professional classes of Region II post-1860s -Special focus on Pera/Galata (economic and cultural heart of the city's Orthodox Christian community)	-Key collaborators (Ozil, Poulos, Genell, Zlimen, Sumertas, Neumeier) Integrate Greek-language material post-1860 according to the dedicated themes -Generate prosopographies of rising middle class/professional classes who were active in the communities of Region III post-1860s

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Sponsor: Molly Greene

Professional positions held:

Professor, Department of History, University of California, Berkeley, 2021-

Associate Professor (with tenure), Department of History, University of California, Berkeley, 2015-2021

Associate Professor (with tenure), Department of History, Columbia University, New York, 2014-2015

Associate Professor (without tenure), Department of History, Columbia University, New York, 2012-2014

Assistant Professor, Department of History, Columbia University,
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Lecturer, Center for International and Area Studies/History
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Major publications:

Turkey: A Past against History (University of California Press, 2021)
*Greek translation , 2022, Alexandria Publications
*Turkish translation, 2022, FOL Kitap publishers

Biography of an Empire: Governing Ottomans in an Age of Revolution (University of California Press, Fall 2010 Middle East History list)
*Greek translation forthcoming 2021, Alexandria Publications; Turkish translation, 2022 İşBankası Kültür Yayınları

"The Armenian Genocide and the Politics of Knowledge," PublicBooks.org, May 1, 2015
"Nationalism, Internationalism and Cosmopolitanism in the Ottoman/Post-Ottoman World: Comparison and Commensurability," forthcoming in *Comparative Studies in South Asia, Africa, and the Middle East (2016)*

"The Ottoman Empire and the Imperial Turn," *Comparative Studies in Society and History* 2012 54 (4): 721-745. Co-authored with Alan Mikhail [equal authors]

"Fixers in Motion: A Conversation" in *Comparative Studies in Society and History* 2011 53(3): 692-707. A conversation with Andrew Shryock (editor, *CSSH*), Doug Rodgers (Anthropology, Yale University) and Craig Jeffrey (Geography, Oxford) on Phanariots as "pre-modern" fixers in comparative context with late 20th-century South Asian and Russian cases

"When the clock strikes twelve: The inception of an Ottoman past in early Republican Turkey" for: "The Ottoman Empire from Present to Past: Memory and Ideology in Turkey and the Arab World," special issue of *Comparative Studies in Africa, Asia, and the Middle East* 2011 31(1): 172-182—co-editor (with James Reilly (first editor), U of Toronto, and Amy Mills (co-second editor), U of South Carolina) and contributor

"'Mad' about Kemalism: A satire in the early Turkish Republic," *Journal of Ottoman Studies* (festschrift for Rifa'at Abou-El-Haj), 2010 36: 195-206.

"Communities on the verge: Unraveling the Phanariot ascendancy in Ottoman governance," in *Comparative Studies in Society and History* 2009 51(1): 151-181.

"The paradox of perceptions: Interpreting the Ottoman past through the national present, "in *Middle Eastern Studies* 2008 44(5): 661-675.

"A tale of two cities and an archive," in *International Journal of Turkish Studies* 2008 14(1/2): 11-23.

"Families of empires and nations: Phanariot *hanedan*s from the Ottoman Empire to the world around it (1669-1856)," in *Transregional and Transnational Families in Europe and Beyond: Experiences since the Middle Ages*, edited by David Sabean, Simon Teutscher, Christopher Johnson, and Francesca Trivellato, 2011. New York (Berghahn Books): Chapter 9.

"The Ottoman Empire between successors: Thinking from 1821 to 1922," in *Religion, Ethnicity, and Constested Nationhood in the Former Ottoman Space*, edited by Jorgen Nielsen, 2011. Leiden, Netherlands (Brill): 16-30.

"The Absent Nineteenth Century: Personal and Political Autonomy in the Ottoman Empire," in *Untold Histories of the Middle East: Recovering voices from the nineteenth and twentieth centuries*, edited by Amy Singer, Christophe Neumann, and Aksin Somel; 2011 London (Routledge): 143-158.

"Breaking the Tetrarchia and saving the Kaymakam: To be an ambitious Ottoman in 1821," 2006. Rethymno, Crete (University of Crete): 175-188.

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ACADEMIC POSITIONS

Faculty Member (Associate Professor), Faculty of Arts and Social Sciences, **Sabancı University,** Spring 2021 – present.

Faculty Member (Assistant Professor), Faculty of Arts and Social Sciences, **Sabancı University,** Fall 2017 – Spring 2021.

Program Coordinator, MA programs in History and Turkish Studies, **Sabancı University,** 2018 – 2019.

Associate Professorship, **YÖK doçentlik**, 27 November 2017.

Visiting Professor, Faculty of Arts and Social Sciences, **Sabancı University,**
Fall 2015 – Fall 2017.

Lecturer, **Harvard** – **Sabancı Summer School**, Study Abroad Program,
Summer 2014 and Summer 2015.

Lecturer, Department of History, **Istanbul Bilgi University**,
Fall 2013 – Spring 2015.

Lecturer, Faculty of Arts and Social Sciences, **Sabancı University**,
Summer 2012 and Fall 2014.

Visiting Scholar, Institute for Area Studies, **Leiden University**, 2013 – 2014.

Postdoctoral Research Fellow, Seeger Center for Hellenic Studies, **Princeton University**, 2012 – 2013.

Alexander S. Onassis Foundation Lecturer, Department of History, **Boğaziçi University**,
Spring 2011.

Lecturer, Department of History, **Boğaziçi University**, 2009 – 2010 and Fall 2011.

EDUCATION

Ph.D., University of London, Birkbeck College, History, 2009
Supervisors: Mark Mazower and Frederick Anscombe

M.A., Boğaziçi University, History, 2001.
B.A., Boğaziçi University, Political Science and International Relations, 1998.

ACADEMIC PUBLICATIONS

Book:

- 2013 – Orthodox Christians in the Late Ottoman Empire: A Study of Communal Relations in Anatolia, London and New York: Routledge.

Articles and Book Chapters:

2022 "Greek Personal Names and the Question of Personal Identification in the Late Ottoman Empire: A Social Historical Approach," *Turkish Historical Review*, vol. 13 (2022) (AHCI, CC/A&H, ERIH Plus, Index Islamicus).

- 2021 – "Ottoman Reform, Non-Muslim Subjects, and Constitutive Legislation: The Reform Edict of 1856 and the Greek General Regulations of 1862," in Johanna Chovanec and Olof Heilo (eds.), Narrated Empires: Perceptions of Late Habsburg and Ottoman Multinationalism, London and New York: Palgrave Macmillan, pp. 169-190. DOI: 10.1007/978-3-030-55199-5_8.

- 2020 – "In the Towns of Western Anatolia at the Time of the Great War: Greek Responses to the Ottoman Boycott and the Forced Population Movement", in Mehmet Beşikçi, Selçuk Akşin Somel and Alexandre Toumarkine (eds.), Not All Quiet on the Ottoman Fronts: Neglected Perspectives on a Global War, 1914-1918, Würzburg: Ergon Verlag, pp. 103-118.

- 2020 – "A Traveller in One's Homeland: Local Interest in Archaeology and Travel Writing in the Ottoman Greek World in 19th-Century Anatolia," Adalya, vol. 23, pp. 497-515. (AHCI, CC/A&H).

- 2019a – "Whose Property Is It? The State, Non-Muslim Communities, and the Question of Property Ownership from the Late Ottoman Empire through the Turkish Nation State", Journal of the Ottoman and Turkish Studies Association, vol. 6, no. 1, pp. 211-235. DOI: 10.2979/jottturstuass.6.1.12 https://www.jstor.org/stable/10.2979/jottturstuass.6.1.12
- 2019b – "Millet Sistemine Farklı Bakmak: Osmanlı Rum Topluluklarında Toplumsal Yaşam, Devlet ve Kurumlar", in Yonca Cingöz (ed.), *Mübadil Kentler: Türkçe Konuşan Rum Ortodokslar*, Istanbul: Lozan Mübadilleri Vakfı Yayınları, pp. 10-15.

- 2018 – "Osmanlı'da 'Demokrasi' Pratikleri: Tarihyazımı Üzerine Bir Değerlendirme", in Ümit Kurt and Doğan Gürpınar (eds.), *Türkiye'de Tarih ve Tarihçilik: Kavramlar ve Pratikler*, Ankara: Heretik Yayınları, pp. 17-56.

PANAGIOTIS C. POULOS
Assistant Professor, Department of Music Studies, School of Philosophy, National and Kapodistrian University of Athens, Tel.: 0030 210 3634592, E-mail: ppoulos@music.uoa.gr

EDUCATION

2006 PhD in Music, Department of Music, Faculty of Arts and Humanities, SOAS, University of London. Title: "Inheriting innovation: a study of taksim within a 20th century lineage of Turkish tanbur players". Supervisor: Prof. Owen Wright

2000 BA (Hons) in Music Studies, Department of Music, Faculty of Arts and Humanities, SOAS, University of London

SCHOLARSHIPS AND AWARDS

2013 Ömer Lütfi Barkan Prize (Honorable Mention), Turkish Studies Association. Award for the article entitled: "Rethinking Orality in Turkish Classical Music: A Genealogy of Contemporary Musical Assemblages" (Middle East Journal of Culture and Communication 4, 2011)

2013 Fondazione Giorgio Cini - Istituto Interculturale di Studi Musicali Comparati, Venezia. Grant for participation at the seminar entitled: "Bîrûn: Armenian Composers in the Ottoman Tradition". Seminar convenor: Kudsi Erguner

2002-2003 Central Research Fund, Senate House, University of London. Grant for conducting doctoral dissertation fieldwork in Istanbul

2001-2003 Postgraduate Research Fund, Arts and Humanities Research Board. Doctoral dissertation scholarship

PROFESSIONAL APPOINMENTS

2021-current Assistant Professor, Department of Music Studies, School of Philosophy, National and Kapodistrian University of Athens

2019-2021 Lecturer, Department of Music Studies, School of Philosophy, National and Kapodistrian University of Athens

2014-2019 Lecturer, Department of Turkish and Modern Asian Studies, National and Kapodistrian University of Athens

2007-2013 Adjunct lecturer, Department of Turkish and Modern Asian Studies, National and Kapodistrian University of Athens

2004-5/2006-8 Adjunct lecturer, Department of Popular and Traditional Music, School of Music Technology, Educational Institute of Epirus

2000-2001 Postgraduate teaching assistant, Department of Music, Faculty of Arts and Humanities, SOAS, University of London. Convenor: Prof. Owen Wright

RESEARCH EXPERIENCE

2019-2022 Principal Investigator. Project: 'Intercommunal musical geographies of late Ottoman Istanbul', Ethnomusicology and Cultural Anthropology Laboratory, funded by Hellenic Foundation for Research and Innovation (H.F.R.I.).

2018-2019 Scientific coordinator (with E. Kolovos). Work-package: "Histories of Space in the Greek Revolution", part of the research project "Greek Revolution 1821: Digital Archive of the Research Centre for the Humanities".

2017-2021 Scientific coordinator (with E. Kolovos). Project: "Histories, Spaces and Heritages at the transition from the Ottoman Empire to the Greek state", funded by the French School of Athens - École française d'Athènes.

2012 Research associate, John S. Latsis Public Benefit Foundation-Scientific Projects 2012. Project: "Learning Culture through City Soundscapes-An Educational Tool". Coordinator: Eleni Kallimopoulou, University of Macedonia, Thessaloniki. Innovative Project Award, for DARIAH-EU VCC2 Workshop, Innovative Teaching Methods and Practices in Digital Humanities at DH 2014, Lausanne.

2011 Primary investigator, W.D.E. Coulson & Toni Cross Aegean Fellow, American Research Institute in Turkey, Istanbul. Project: "Ottoman cultural heritage and Turkish modernity: a study of Ottoman music house gatherings in Istanbul in the twentieth century"

SELECTED PUBLICATIONS

Books and edited volumes

Kolovos, E., Pallis, G. & Poulos, P.C. *Ottoman Monuments in Greece: Heritages under Negotiation*. Athens:Kapon Editions. (Forthcoming 2022)

Poulos, P. C. (2015). Music in the Islamic World: Sources, Perspectives, Practices. [e-book]. Hellenic Academic Libraries Link - Kallipos. Available at: http://hdl.handle.net/11419/4407 (In Greek)

Pennanen, R. P., Poulos P. C. & Theodosiou A. (Επιμ.) (2013). Ottoman Intimacies, Balkan Musical Realities. Helsinki: The Finnish Institute at Athens.

Articles and book chapters

Poulos, P.C. (2021). Between P. Nikousios and A. Mavrokordatos: Wojciech Bobowski/Ali Ufkî (1610;-1675) and the intercultural relations of the interpreters of the Porte, Από τη Χίο στην Πόλη και από εκεί στη Μολδοβλαχία, ed. Nicolaos Mavrelos, Gutenberg, Athens.

Kallimopoulou, E., Kornetis, K. & Poulos, P.C. (2020). From the Call to Prayer to the Silence of the Museum: Salonica's Soundscapes in Transition. Στο D. Kairidis and J. B. Kiesling (Επιμ.), Thessaloniki: A City in Transition, 1912-2012 (σσ. 227-242). London & New York, Routledge.

Poulos, P.C. (2019). Spaces of Intercommunal Musical Relations in Ottoman Istanbul. YILLIK: Annual of Istanbul Studies 1, 181-191.Poulos, P. C. (2017) At the House of Kemal: Private Musical Assemblies in Istanbul from the Late Ottoman Empire to the Turkish Republic. In R. Harris & M. Stokes (Eds), Theory and Practice in the Music of the Islamic World: Essays in Honour of Owen Wright (pp. 104-122). London: Routledge.

Poulos, P. C. (2014). Greeks and Turks meet the Rum: Making Sense of the Sounds of 'Old Istanbul'. In V. Lytra (Ed.), When Greeks and Turks Meet: Interdisciplinary perspectives on the relationship since 1923 (pp. 83-105). Aldershot: Ashgate.

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DFG Research Training Group 1913
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Degrees:

2021 Ph.D. in History, Boğaziçi University, İstanbul

2006 M.A. in Architectural History, Middle East Technical University, Ankara

2003 B.A. in Architecture, Middle East Technical University, Ankara

Research Positions:

2016-2017 Ph.D. Research Fellow, Istanbul Studies Center, Kadir Has University, İstanbul

2012-2013 Ph.D. Visiting Student Research Collaborator (Non-Degree), History Department, Princeton University, USA

Spring 2011 Erasmus Exchange Student, Department of History and Archeology, University of Crete, Greece

Professional Positions:

Part Time:

Spring 2017-Fall 2018, Instructor, MEF University, FADA, Department of Architecture

Full Time:

October 2022 Visiting Scholar, University of California, Berkeley

2021-2022, Postdoctoral Researcher, Brandenburg University of Technology, (Cottbus-Senftenberg)

April – Sept. 2021 Asst. Prof., Kent University (İstanbul), Department of Interior Design

2019 – 2021 Visiting Scholar, Kadir Has University (Istanbul), Department of Architecture

2013 – 2017 Research/Teaching Assistant, Boğaziçi University (Istanbul), History Department

Spring 2012 Project Assistant, (The Paul Getty Foundation Connecting Art Histories Initiative) Boğaziçi University (Istanbul), History Department

2008 – 2012 Instructor, Anadolu University (Eskişehir), Department of Architecture

2006 – 2008 Research Assistant, Anadolu University (Eskişehir), Department of Architecture

Awarded Institutional Affiliations

2019 AKMED Ph.D. Fellowship, Koç University, Antalya-Istanbul

2018 Residency Fellowship, French School at Athens, Greece

2016 Research Fellowship, Istanbul Studies Center, Kadir Has University, Istanbul

2015 American Research Institute in Turkey, Doctoral Research Fellowship

2013 Europe next to Europe (ENTE) Research Fellowship,

New Europe College, Institute for Advanced Study (Bucharest - Romania) (declined)

2011 Fulbright Scholarship, Visiting Student Researcher Grant (Princeton University, USA)

2011 Erasmus Student Exchange Grant, Boğaziçi University, (University of Crete, Greece)

Publications

Book Chapter

Theodorelis – Rigas, H. &; Sümertaş. F.M. (2021), "Archaeology as Epic: Language,

Transmission and Politics in the different editions of Patriarch Konstantios I's

Constantiniad (1820). In E.Balta (Eds.) Following the traces of Turkish-speaking

Christians. Harvard University, The Department of Near Eastern Languages and

Civilizations of Anatolia Publications, 103-136.

Journal Articles

Sümertaş. F.M. (2016), "Dr. Alexandros G. Paspatis'ten Dersaadet Rum Cemiyet-i Edebiyesi'ne: İstanbul'un Kara Surları Hakkında Bir Çalışma" Toplumsal Tarih, Issue 272, August 2016, The Economic and Social History Foundation Press, İstanbul, pp. 42-50

Kıvılcım Çorakbaş, F. & Sümertaş, F.M (2014), "Çifteler Köy Enstitüsü Yerleşkelerinin Mekânsal Süreklilik ve Dönüşümleri", (The Spatial Continuities and transformation of the Cifteler Village Institute's Campuses) Mimarlık, Issue 380, November – December 2014, Chamber of Architects Press, Ankara,

Sümertaş, F.M. (2009), "Tarih-i Ayasofya: An Inquiry on the 19th ct. Historicism on the Imperial Monument", Journal of Turkish Studies, Issue 33, Volume 2, 2009, Harvard University, Department of Near Eastern Languages and Civilizations, Boston, USA, pp: 149 – 159

Sümertaş, F.M. (2008), "Women and Power: Female Patrons of Architecture in 16th and 17th Century Istanbul" Edinburgh Architectural Research Volume 31, 2008, Edinburgh, Scotland, UK, pp: 83-89

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EDUCATION:

Columbia University, Ph.D. in History, October 2013 — New York, New York

The Cooper Union for the Advancement of Science and Art — New York, New York
B.F.A., May 2000

École nationale supérieure des beaux-arts, — Paris, France
Exchange program, 1998

PUBLICATIONS:

Empire by Law: The Ottoman Origins of the Mandates System in the Middle East (manuscript under contract, Columbia University Press)

"Late Ottoman Foreign Policy, International Relations and International law," *The I.B. Tauris Handbook of the Late Ottoman Empire: History and Legacy* (commissioned book chapter)

"The Future of the Ottoman Domains: Arab Provinces and Minority Rights in the early Armistice Press," Nationalities Papers, special issue "The Minority Question in Europe and the Middle East: From the 1919 Paris Peace Conference to Today" edited by Ariel Salzmann and Elizbeth F. Thompson (under review)

Mustafa Aksakal and Aimee M. Genell, "Salvation through War? The Ottoman Search for Sovereignty in 1914," The Justification of War and International Order: From the Past to the Present, edited by Lothar Brock and Hendrik Simon (Oxford University Press, forthcoming, spring 2021)

Lâle Can and Aimee M. Genell, "On Empire and Exception: Genealogies of Sovereignty in the Ottoman World," Comparative Studies in South Asia, Africa and the Middle East (2020) 40 (3): 468–473

"The Well-defended Domains: Eurocentric International Law and the Making of the Ottoman Office of Legal Counsel," edited by Lâle Can and Michael Christopher Low, The Subjects of Ottoman International Law (Bloomington: Indiana University Press, 2020)

"The End of Egypt's Occupation: Ottoman Sovereignty and the British Declaration of Protection," in Beyond Versailles: Sovereignty, Legitimacy, and the Formation of New Politics after the Great War, edited by Roberta Pergher and Marcus Payk (Bloomington: University of Indiana, 2019)

"The Well-defended Domains: Eurocentric International Law and the Making of the Ottoman Office of Legal Counsel," Journal of Ottoman and Turkish Studies, 3, 2 (November 2016): pp. 255–275

"Ottoman Autonomous Provinces and the Problem of "Semi-Sovereignty" in International Law," special issue "Autonomy and Federation in the Ottoman Empire," Journal of Balkan and Near Eastern Studies, 18, 6(2016): 533-549

"Were the Minority Treaties a Failure?" Review of Defending the Rights of Others: The Great Powers, the Jews, and International Minority Protection by Carole Fink. H-German (November 2005)

TEACHING AND PROFESSIONAL EXPERIENCE:

University of West Georgia, Assistant Professor of Islamic World History, 2017-present
University of California, Berkeley, Visiting Lecturer, 2016-2017
University of Miami, Visiting Assistant Professor, 2015-2016
Yale University, Postdoctoral Research Fellow, 2013-2015
Columbia University, Summer Teaching Scholar
Columbia University, Graduate Teaching Assistant, 2007-2011
Queens College, The City University of New York, Adjunct Lecturer, 2005-2006

FELLOWSHIPS AND HONORS:
Felton Jenkins, Jr. Hall of Fame Faculty Awards, University of West Georgia campus nominee for statewide award (October 2022)
High Impact Practices Implementation Committee Fellow, University of West Georgia (2020-present)
American Research Institute in Turkey, Research Fellowship, Istanbul (2019)
Berkeley Ottoman Summer Seminar, Tavronitis, Crete (2017)
National Endowment for the Humanities, Summer Scholar, World War I in the Middle East and North Africa, Georgetown University (2014)
Bradley-Johnson Postdoctoral Associate in International Security Studies at Yale University (2013-2015)
Mellon / American Council of Learned Societies Dissertation Completion Fellowship (2012)
Middle East Institute, Columbia University, Summer Research Fellowship (2012)
London School of Economics-Columbia University, Academic Exchange (spring 2012)
Mellon Interdisciplinary Graduate Fellowship, Center for Innovative Theory and Empirics, Columbia University (2012-2013)
Mellon Interdisciplinary Graduate Fellowship, Institute for Social and Economic Research and Policy, Columbia University (2011-2012)
Fulbright - Institute of International Education, Dissertation Research Grant, Turkey (2010)
Foreign Language and Area Studies, Summer Language Grant (2010), Ottoman and Turkish Summer School in Turkey, Harvard-Koç Universities
Mellon Seminar in British History, Columbia University (2010)
Howard and Natalie Shawn Summer Research Fellow, Columbia University, (2009)
Deutscher Akademischer Austauschdienst (German Academic Exchange Service), Bonn (2008)
Richard Hofstadter Faculty Fellowship in the Department of History, Columbia (2006-2012)
The Graduate Center, The City University of New York, New York, NY
Provosts' Fellowship (2004-2006)
The Cooper Union for the Advancement of Science and Art, New York, NY
Four-year full tuition scholarship, awarded January 1995

RESEARCH LANGUAGES: Ottoman Turkish, modern Turkish, German, French
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LEO ZLIMEN
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EXPERIENCE

Co-Founder & CEO - Ladris Technologies, Inc. - Nevada City, CA - ladris.com November 2018 - present

- Ladris puts accessible, powerful AI & data integration tools directly into the hands of business users
- Governments, institutions and private sector firms use Ladris to drive revenue & mitigate risk using data & ML
- Leads sales & business operations, raises capital, writes code
- Scaled from inception, bootstrapped, now financed, to stable cash flows & multi-year SaaS contracts

Business Development Lead - The Hoarding Project - Milwaukee, WI July 2021 - present

- Worked to launch a crypto arbitrage fund for those in need, à la a crypto version of the Gates Foundation
- Developed go-to-market strategy, financial securities & legal compliance, and built website

Fullstack Software Engineer - Istanpolis Collaborative - Berkeley, CA June 2021 - present

- Designed, built and maintained central website and online point of access for the project (istanpolis.org)
- Consulted for integration of disparate data and data integration project management

Programming Instructor - Coding4Youth Inc. - Remote April 2020 - Jan 2021

- Teaching K-12 students the basics of programming with Scratch and JavaScript, as well as front-end web development with HTML and CSS

Fullstack Dev & Event Planner - Biotechnology Calendar, Inc. - Grass Valley, CA May 2016 - August 2019

- Wrote & launched public-facing web app (Global Science Meetings) using vb.net, t-sql, html, css, js
- Implemented SEO w/Hubspot, ran social media handles, managed interns
- Coordinated scheduling, reservations, and catering for full-service life science trade shows across the country

EDUCATION

University of California, Berkeley

Graduated *cum laude* May 2021, GPA 3.81
Triple Major B.A., Near Eastern Civilizations - Islamic Civilization, History - late modern Europe, Arabic Literature
Relevant coursework: Sufism, Totalitarianism, Classical Arabic Literature, American Conservatism, Post-Ottoman Middle East, Ottoman history, Middle Eastern music, intermediate & advanced Arabic, anthropology of Central Asia, Beethoven, Weimar Germany, Imperial Russia, sociolinguistics of Middle East, the Quran, Islamic philosophy

Nevada Union High School

Graduated June 2017, GPA 4.50

PATENTS & AWARDS

Fellow - Ibrahim Leadership and Dialogue Program, Queens College New York (2020)
Co-Inventor - Patent Pending US62788539, Algorithmic Relational Odds Nexus (2019)
Recipient - Lipson Essay Prize for Humanistic Values (2019) - "Our Own Phantom World"

SKILLS

Communication: public speaking, patent preparation, data analysis/presentation, data consulting, report preparation
Technological: C# & .NET, Python, Flask, SQL, JavaScript, TypeScript, Angular, Ionic, HTML, CSS & Sass, SQL, MSSQL Server, PostgreSQL, Bash, Powershell, Git, Docker, Windows Server, Ubuntu Server, ArcGIS

Web: Angular, Typescript, Javascript, Sass, Css3, Html5
Backend: Rust, Python, C# & .NET
Databases: SQL, MSSQL, PostgreSQL
DevOps: Git, Docker, Bash, Powershell, Windows Server, Ubuntu Server

EMILY NEUMEIER
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EDUCATION

2016 Ph.D. University of Pennsylvania, History of Art
Thesis: "The Architectural Transformation of the Ottoman Provinces under Tepedelenli Ali Pasha, 1788-1822"
2012 M.A. University of Pennsylvania, History of Art
2008 B.A. Boston College, History of Art, concentration in Islamic Studies
summa cum laude, Phi Beta Kappa, Gabelli Presidential Scholar

APPOINTMENTS

2018-present Assistant Professor, Art History Department, Tyler School of Art and Architecture, Temple University
2016 Research Collaborator (Wissenschaftlicher Mitarbeiter), Max Planck Research Group "Objects in the Contact Zone", Kunsthistorisches Institut, Florence, Italy

PUBLICATIONS

Peer-Reviewed Articles & Book Chapters

2022 "The Muybridge Albums in Istanbul: Photography as Diplomacy in the Ottoman Empire," *Making Modernity: Art and Architecture in the Nineteenth-Century Islamic Mediterranean*, ed. Margaret Graves and Alexandra Seggerman (Bloomington: Indiana University Press, 2022), 94–113.

2022 "Mohamed Zakariya and Contemporary Islamic Art," *Mohamed Zakariya: The Life and Times of a 21st century Calligrapher*, ed. Nancy Micklewright (Louisville, KY: Fons Vitae, 2022), 85–94.

2021 "'A Church is Never Just a Church': Hagia Sophia and the Mutability of Monuments," *Journal of the Ottoman and Turkish Studies Association* 8.1 (2021): 215-221. Co-authored with Shannon Steiner.

2021 "Portrait of Ali Pasha: Cultural Mobility on the Periphery of Empire," *Reading Objects in the Contact Zone*, ed. Eva-Maria Troelenberg, Kerstin Schankweiler, and Anna Sophia Messner (Heidelberg: University of Heidelberg, 2021), 172–178.

2020 "Trans-imperial Encounter on the Ionian Sea: A French Engineer's Account of Constructing Ottoman Fortifications," *Ports and Fortifications in the Muslim World: Coastal Military Architecture from the Arab Conquest to the Ottoman Period*, ed. Stéphane Pradines (Cairo: Institut français d'archéologie orientale, 2020), 217–236.
***Winner of the 2017 Preveza Prize

2019 "Mediating Legacies of Empire in the Post-Imperial Museum," *History and Anthropology* 30.4 (2019): 406–420.

2017 "Rivaling Elgin: Ottoman Governors and Archaeological Agency in the Morea," *Antiquarianisms: Contact, Conflict, and Comparison*, ed. Benjamin Anderson and Felipe Rojas (Oxford: Oxbow Books, 2017), 134–160.

2017 "Spoils for the New Pyrrhus: Alternative Claims to Antiquity in Ottoman Greece," *International Journal of Islamic Architecture* 6.2 (2017): 311–338.

Edited Volumes

2020 *International Journal of Islamic Architecture* 9.2 (June 2020), special issue "Field as Archive/Archive as Field," co-edited with Eray Çaylı.

Exhibition Catalogues & Other Publications

2013 "Hat Sanatında Sefine İstifleri ve Nuh'un Gemisi" [Noah's Ark and the Theme of the Ship in Islamic Calligraphy], *Nuh Kitabı*, ed. Emine Gürsoy Naskali (Istanbul: Kitabev, 2013), 221–232. Co-authored with Irvin C. Schick. [Turkish]

2011 "From Istanbul to Philadelphia: The Journey of the Painting *At the Mosque Door*," exhibition catalogue essay for *Osman Hamdi Bey and the Americans: Archaeology, Diplomacy, Art,* ed. Robert Ousterhout and Renata Holod (Istanbul: Pera Museum, 2011), 102–117. Co-authored with Heather Hughes.

Multi-author Books

2016 Karel Nováček, Miroslav Melčák, Lenka Starková, Narmin Ali Muhammad Amin, Jan Petřík, and Emily Neumeier, *Medieval Urban Landscape in Northeastern Mesopotamia* (Oxford: Archaeopress, 2016

Bibliography

Selected Archival sources:

Registry of Citizens of Greece Permanently Resident in Constantinople/Istanbul, 1879-1924. Anthemion Digital Archive of the Greek Communities of Constantinople, Online. http://anthemion.phs.uoa.gr/index.php/el/ . [sample provided in appendix 6]

Population Registers of the Greek Orthodox of Istanbul [NFS Rum Nüfusu Defterleri] (1821-1860s) (123 registers) Ottoman Prime Ministry Archives, Istanbul, Turkey. [sample provided in appendix 6]

Istanbul Kadı/Shari'a Court Records. Online. http://www.kadisicilleri.org/ .

Annuaire Oriental (ancien Indicateur oriental) du commerce, industrie, administration, magisture de l'Orient. SALT Research. Online. https://archives.saltresearch.org/handle/123456789/2878 . [sample provided in appendix 6]

Oral History Archive of Asia Minor Greeks taken in the 1960s and 1970s. Center for Asia Minor Studies, Athens. http://en.kms.org.gr/TheCentre.aspx

Goad Fire Insurance Maps of Istanbul. Bibliothèques d'Orient. Online. https://heritage.bnf.fr/bibliothequesorient/en/fire-insurance-maps

Selected Secondary sources:

Paris to Download: A Factgrid database project. Factgrid:A Database for Historians. Online. https://blog.factgrid.de/archives/2333 .

Alexandris, Alexis. 1983. *The Greek Minority of Istanbul and Greek-Turkish Relations 1918-1974*. Athens: Center for Asia Minor Studies.

Anastassiadou, Méropi. 2012. *Les Grecs d'Istanbul Au XIXe Siècle*. The Netherlands : Brill.

Artan, Tulay. 1989. "Architecture as a Theatre of Life: Profile of the Eighteenth-Century Bosphorus." PhD Diss. MIT.

Barkey, Karen. 2008. *Empire of Difference: The Ottomans in Comparative Perspective*. Cambridge: Cambridge University Press.

Behar, Cem. 2003. *A Neighborhood in Ottoman Istanbul: Fruit vendors and civil servants in Kasap Ilyas Mahalle*. Binghamton, NY: SUNY Series in the Social and Economic History of the Middle East.

Braude, Benjamin and Bernard Lewis, eds. 1982.. *Christians and Jews in the Ottoman Empire*, 2 vols. New York and London: Holmes and Meier.

Campos, Michelle. 2010. *Ottoman Brothers: Muslims, Christians and Jews in Early Twentieth-Century Palestine*. Stanford, CA: Stanford University Press.

Der Matossian, Bedross. 2014. *Shattered Dreams of Revolution: From Liberty to Violence in the Late Ottoman Empire*. Stanford, CA: Stanford University Press.

Duben, Alan and Cem Behar. 2002. *Istanbul Households: Marriage, Family and Fertility 1880-1940*. Cambridge: Cambridge Studies in Population, Economy and Society in Past Time, Series Number 15.

Ekmekçioğlu, Lerna. 2016. *Recovering Armenia: The Limits of Belonging in Post-Genocide Armenia.* Stanford, CA: Stanford University Press.

Erol, Merih. 2015. *Greek Orthodox Music in Ottoman Istanbul: Nation and Community in the Era of Reform*. Bloomington: Indiana University Press.

Fairey, Jack. 2015. *The Great Powers and Orthodox Christendom: The Crisis over the Eastern Church in the Era of the Crimean War*. London: Palgrave MacMillan Histories of the Sacred and Secular.

Feldman, Walter. 1996. *Music of the Ottoman Court: Makam, composition, and the early modern Ottoman instrumental repertoire.* Berlin: Intercultural Music Studies.

Genell, Aimee. "Ottoman Autonomous Provinces and the Problem of "Semi-Sovereignty" in International Law." Special Issue "Autonomy and Federation in the Ottoman Empire," *Journal of Balkan and Near Eastern Studies* 18, no. 6 (2016): 533-549.

Gibb, H.A.R. and Harold Bowen. 1958. *Islamic Society and the West: A Study of the Impact of Western Civilization on Moslem culture in the Near East* I: Islamic Society in the Eighteenth Century. London: Oxford University Press.

Gondicas, Dimitri and Charles Issawi. 1999. *Ottoman Greeks in the Age of Nationalism: Politics, Economy and Society in the Nineteenth Century*. Princeton, NJ: Darwin Press.

Kafesçioğlu, Çiğdem. 2009. *Constantinopolis/Istanbul: Cultural Encounter, Imperial Vision, and the Construction of the Ottoman Capital*. University Park, PA: Pennsylvania State University Press.

Kamouzis, Dimitris. 2021. *Greeks in Turkey: Elite Nationalism and Minority Politics in late Ottoman and Early Republican Istanbul*. London: Routledge.

Marcus, Abraham. 2010. *The Middle East on the Eve of Modernity: Aleppo in the 18th Century. New York: Columbia University Press.*

Mazower, Mark. 2004. *Salonica, City of Ghosts: Christians, Muslims and Jews, 1430-1950*. New York: Vintage eBooks.

Mills, Amy. 2010. *Streets of Memory: Landscape, Tolerance, and National Identity in Istanbul*. Athens, GA: University of Georgia Press.

Neumeier, Emily. "Spoils for the New Pyrrhus: Alternative Claims to Antiquity in Ottoman Greece." *International Journal of Islamic Architecture* 6 no. 2. (2017): 311-338.

Neumeier, Emily. "Mediating Legacies of Empire in the Post-Imperial Museum," *History and Anthropology* 30 no. 4. (2019): 406-420.

Ors, Ilay. 2017. *Diaspora of the City: Stories of Cosmopolitanism from Istanbul to Athens*. London: Palgrave Studies in Urban Anthropology.

Ozil, Ayse. 2017. *Orthodox Christians in the Late Ottoman Empire: A Study of Communal Relations in Anatolia*. London: SOAS/Routledge Studies on the Middle East.

Poulos, Panagiotis. "Greeks and Turks meet the Rum: Making Sense of the Sounds of 'Old Istanbul'" In *When Greeks and Turks Meet: Interdisciplinary perspectives on the relationship since 1923*, edited by Vally Lytra, 83-105. London: Routledge, 2016.

Poulos, Panagiotis. "Spaces of Intercommunal Musical Relations in Ottoman Istanbul" *YILLIK: Annual of Istanbul Studies* 1 (2019): 181-189.

Philliou, Christine. 2010. *Biography of an Empire: Governing Ottomans in an Age of Revolution.* Berkeley, CA: University of California Press.

Philliou, Christine. 2021. *Turkey: A Past Against History*. Berkeley, CA: University of California Press.

Philliou, Christine. "Communities on the verge: Unraveling the Phanariot ascendancy in Ottoman governance" *Comparative Studies in Society and History* 51 no. 1. (2009): 151-181.

Philliou, Christine. *Greeks in the Service of the Sublime Porte* [in Greek] Presented at Third Conference of the Scholarly Society, "He Kath'emas Anatole", Athens: 2002.

Provence, Michael. 2017. *The Last Ottoman Generation and the Making of the Modern Middle East*. New York: Cambridge University Press.

Runciman, Steven. 1968. *The Great Church in Captivity: A Study of the Patriarchate of Constantinople from the Eve of the Turkish Conquest to the Greek War of Independence*. New York: Cambridge University Press.

Sömel, Selçuk Akşin. 2013. *The Modernization of Public Education in the Ottoman Empire, 1839-1908: Islamization, Autocracy and Discipline*. Leiden: Brill Ottoman Empire and its Heritage.

Trivellato, Francesca. 2009. *Familiarity of Strangers: The Sephardic Diaspora, Livorno, and Cross-Cultural Trade in the Early Modern Period.* New Haven: Yale University Press.

The following attachment is not included in the view since it is not a read-only PDF file.

Upon submission, this file will be transmitted to the Grantor without any data loss.

appendices.pdf

Funding Received

Project Director Christine Phillliou
Awarded September 2022 for Chair in Modern Greek and Hellenic Studies
Funder: The Modern Greek Studies Foundation
$1,000,000 in endowment funds for the Nikos Kazantzakis Visiting Scholar Program to fund a visiting scholar with expertise in Modern Greek history, culture and language. We see this as complementary to our proposed NEH project and hope that some of the scholars will have expertise on Orthodox Christian communities indigenous to Turkey.

Awarded September 2021 for project, “Exploring the Ottoman World”
Funder: The Peder Sather Center for Advanced Research at UC Berkeley
$25,000 in research funds including partial funding for Istan-polis website

Key collaborator Firuzan Melike Sumartas
Awarded May 2021 for research on Istan-polis Project
Funder: The Scientific and Technological Research Council of Turkey (TUBITAK)
$30,000 in research funds for use over a 12-month period

The following attachment is not included in the view since it is not a read-only PDF file.

Upon submission, this file will be transmitted to the Grantor without any data loss.

agreement.pdf

EXHIBIT C

NATIONAL ENDOWMENT FOR THE HUMANITIES

September 22, 2023

Bridget Zwimpfer
Contracts and Grants Officer
Regents of the University of California, Berkeley
c/o Sponsored Projects Office
1608 Fourth Street, Suite 220
Berkeley, CA 94710-1749

Federal Award ID Number: RZ-292650-23

Dear Ms. Zwimpfer:

I am delighted to inform you that the National Endowment for the Humanities (NEH) has approved an award of $246,347.00 in support of your institution's project. The application was considered carefully during the NEH review process, which includes peer review along with deliberation by the National Council on the Humanities and the Office of the Chair.

The award documents from the NEH Office of Grant Management, which provide information on the period of performance and the terms and conditions that apply to your project, are available in eGMS Reach, NEH's electronic grant management system. Please review the award materials carefully. Address your questions either to the grants administrator or to the program officer whose names appear in the terms and conditions.

A notice of award has also been sent to the project's director, Christine M. Philliou.

Congratulations on your award. I wish you every success.

Sincerely,

Shelly Lowe
Chair

EXHIBIT D

From: Grant Notification <Grant_Notifications@nehemail.onmicrosoft.com>
Subject: Notice of Grant Termination – Effective April 2, 2025
Date: April 2, 2025 at 8:35:25 PM PDT
To: "bzwimpfer@berkeley.edu" <bzwimpfer@berkeley.edu>

Ms. Bridget Zwimpfer,

We regret to inform you that your NEH grant has been terminated. Please see the attached grant termination notice.

With Regards,
Michael McDonald
Acting Chairman, National Endowment for the Humanities

EXHIBIT E

NATIONAL ENDOWMENT FOR THE HUMANITIES
NOTICE OF GRANT TERMINATION

April 2, 2025

Ms. Bridget Zwimpfer

Regents of the University of California, Berkeley

Dear NEH Grantee,

This letter provides notice that the National Endowment for the Humanities (NEH) is terminating your federal grant (Grant Application No. RZ29265023) effective April 2, 2025, in accordance with the termination clause in your Grant Agreement.

Your grant no longer effectuates the agency's needs and priorities and conditions of the Grant Agreement and is subject to termination due to several reasonable causes, as outlined in *2CFR§200.340*. NEH has reasonable cause to terminate your grant in light of the fact that the NEH is repurposing its funding allocations in a new direction in furtherance of the President's agenda. The President's February 19, 2025 executive order mandates that the NEH eliminate all non-statutorily required activities and functions. *See Commencing the Reduction of the Federal Bureaucracy*, E.O. 14217 (Feb. 19, 2025). Your grant's immediate termination is necessary to safeguard the interests of the federal government, including its fiscal priorities. The termination of your grant represents an urgent priority for the administration, and due to exceptional circumstances, adherence to the traditional notification process is not possible. Therefore, the NEH hereby terminates your grant in its entirety effective April 1, 2025.

Please remember that your obligations under the Grant Agreement continue to apply. Additionally, an audit may be conducted by the NEH after the termination of your grant.

Please contact Grant_Notifications@nehemail.onmicrosoft.com with only urgent questions.

Sincerely,

/s/ *Michael McDonald*

Michael McDonald
Acting Chairman, National Endowment for the Humanities
400 7th Street S.W., Washington, DC 20506

EXHIBIT F

Berkeley
UNIVERSITY OF CALIFORNIA

Angela R. Ford
Executive Director
Sponsored Projects Office
1608 Fourth Street. Suite 220
Berkeley, CA 94710-1749
arford@berkeley.edu
https://spo.berkeley.edu/

April 30, 2025

Submitted via eGMS Reach

Senior Deputy Chairman
National Endowment for the Humanities
400 7th Street, SW
Washington, DC 20506

RE: Appeal of Termination of Award No. RZ-292650-23

Dear Senior Deputy Chairman:

I write on behalf of the Regents of the University of California, Berkeley ("UC"), in regards to the termination of Award No. RZ-292650-23 (the "Award"). UC greatly values its partnership and decades long strong working relationship with the National Endowment for the Humanities ("NEH") but in this instance has no choice but to appeal the termination, which is not justified and should be reversed. The amount under dispute represents funds that the University has not yet received from the government under this Award. This includes amounts not yet expended by the University and amounts properly incurred before the Award termination date but which have not yet been reimbursed in accordance with 2 C.F.R. § 200.343. The amount in dispute for this Award is $184,784.

We are grateful for our opportunities to support NEH priorities to examine the human condition, promote civics education, and understand our cultural heritage. As you know, UC researchers have led and contributed to NEH-supported work for decades. We hope to continue this longstanding partnership.

Background

On April 2, 2025, UC received a letter from Michael McDonald, Acting Chairman of NEH, announcing the termination of this Award (the "Letter"). The Letter stated:

> Your grant no longer effectuates the agency's needs and priorities and conditions of the Grant Agreement and is subject to termination due to several reasonable causes, as outlined in *2 CFR § 200.340.* NEH has reasonable cause to terminate your grant in light of the fact that the NEH is repurposing its funding allocations in a new direction in furtherance of the President's agenda. The President's February 19, 2025 executive order mandates that the NEH eliminate all non-statutorily required activities and functions. *See Commencing the Reduction of the Federal Bureaucracy,* E.O. 14217 (Feb. 19, 2025). Your grant's immediate termination is necessary to safeguard the interests of the federal government, including its fiscal priorities. . . . [D]ue to exceptional circumstances, adherence to the traditional

> notification process is not possible. Therefore, the NEH hereby terminates your grant in its entirety effective April 1, 2025.

The Letter was signed by Mr. McDonald but sent from an email account unaffiliated with NEH and believed to be associated with the Department of Government Efficiency ("DOGE").[1]

As described below, the termination of this Award is unjustified.[2]

Argument

I. Section 200.340 Does Not Permit Termination of the Award

Although the letter cites 2 C.F.R. § 200.340 as authority for termination of this Award, that provision does not permit a termination of this nature under the rationale offered. Thus, the termination is unlawful and violates the Administrative Procedure Act. 5 U.S.C. § 706(2)(A) (authorizing courts to set aside agency action that is "arbitrary, capricious, an abuse of discretion, or otherwise not in accordance with law"); *see International Dark-Sky Ass'n, Inc. v. FCC*, 106 F.4th 1206, 1220 (D.C. Cir. 2024) (An agency action based on a flawed interpretation of a statute or regulation is "contrary to law.").

We assume NEH relies specifically on 2 C.F.R. § 200.340(a)(2) (2023), providing an award may be terminated by an awarding agency if it "no longer effectuates the program goals or agency priorities." That reliance is misplaced.

First, that provision is not designed for the sort of sweeping funding terminations NEH has imposed on UC (and other universities across the country). The preamble to the final rule adopting the language at issue offers two scenarios in which termination pursuant to "agency priorities" might be appropriate: First, where "following the issuance of a Federal award, . . . additional evidence reveals that a *specific* award objective is ineffective at achieving program goals"; and second, where "additional evidence . . . cause[s] the Federal awarding agency to significantly question the feasibility of the intended objective of the award, such that it may be in the interest of the government to terminate." Guidance for Grants and Agreements, 85 Fed. Reg. 49,506, 49,507-

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[1] The Letter was sent via email from Grant_Notifications@nehemail.onmicrosoft.com. The Letter also instructs recipients to send "only urgent questions" to this email address. Email addresses of NEH personnel, on the other hand, generally end with "@neh.gov." *See* https://www.neh.gov/about/staff (linking to contact information for staff members, each of whom has an "@neh.gov" address).

[2] Although no statute or regulation requires UC to exhaust any administrative appeal process, the University is filing this appeal in accordance with Section XIII of the General Terms and Conditions for Awards to Organizations. *See* https://www.neh.gov/sites/default/files/General%20Terms%20and%20Conditions%20for%20AwAwar%20to%20Organizations_FFRMS%20removed_3.13.25.pdf (for awards issued October 1, 2024, or later); https://www.neh.gov/sites/default/files/Gen%20T%26C%20Awards%20Issued%20between%20Jan%201%2C%2022%2C%20and%20Sept%2030%2C%202024.pdf (for awards issued between January 1, 2022, and September 30, 2024).

49,508 (Aug. 13, 2020) (emphasis added). Both examples plainly contemplate an award-level assessment of alignment with evolving agency priorities.

No such analysis was done here. Nor was a single agency priority or program goal identified. The Letter speaks only in generalities, stating the Award "no longer effectuates the agency's needs and priorities and conditions of the Grant Agreement and is subject to termination due to several reasonable causes" but identifies none of the foregoing. It further states "NEH is repurposing its funding allocations in a new direction" but fails to define any such direction. This obviously boiler-plate discussion does not explain why the feasibility of *this* project's objective is now questionable, or what specific aspects of *this* project are misaligned with agency priorities. *See FCC v. Prometheus Radio Project*, 592 U.S. 414, 423 (2021) (agency action must be both "reasonable and reasonably explained"); *see also* 2 C.F.R. § 200.341 (requiring a notice of termination to "include the reasons for termination").

Perhaps realizing it failed to identify such priorities in its termination notices, NEH published a post hoc explanation of its new priorities in a press release on April 24, 2025, stating "NEH is especially interested in projects on the nation's semiquincentennial and U.S. history more generally."[3] The press release also explained NEH "cancelled awards that are at variance with agency priorities, including but not limited to those on diversity, equity, and inclusion (or DEI) and environmental justice, as well as awards that may not inspire public confidence in the use of taxpayer funds" and that "NEH-supported projects must not promote a particular political, religious, or ideological point of view and must not engage in political or social advocacy." However, such attempt at an explanation has no bearing on the inadequate and unlawful termination of this Award. The press release was not incorporated into the Letter, nor could it have been, as it was published over three weeks after NEH terminated the Award. Moreover, NEH still has not articulated how this Award is inconsistent with its newly identified priorities. Accordingly, the press release cannot retroactively save the agency's deficient termination.

Second, § 200.340(a) clearly states an award may be terminated only "[b]y *the* Federal awarding agency"—*i.e.*, the agency responsible for the award. Here, that means NEH alone. That this Letter was sent by an email account unaffiliated with NEH (to which all further inquiries are also directed) indicates the termination was not issued by NEH and any implication that NEH itself decided to terminate this Award is pretextual.

II. The General Terms and Conditions Do Not Permit Termination of the Award

The Letter plainly cites § 200.340 as the purported authority for the termination, stating the Award "no longer effectuates the agency's needs and priorities and conditions of the Grant Agreement and is subject to termination due to several reasonable causes, *as outlined in 2 CFR § 200.340*." The Letter does not cite the General Terms and Conditions as a basis for the termination.

[3] *See* https://www.neh.gov/news/update-neh-funding-priorities-and-agencys-recent-implementation-trump-administration-executive.

However, even if the Letter could be read to rely on the General Terms and Conditions for authority to terminate this Award, such reliance is also misplaced. Section XIII provides, in relevant part, that NEH may suspend or terminate an award if "an award no longer effectuates the agency's needs and priorities" or NEH "has other reasonable cause." As described above, NEH failed to conduct the award-level analysis required by the regulation underpinning this provision, nor did it articulate any agency need or priority this Award "no longer effectuates." Nor could it, as it does not appear NEH even made this termination decision.

The Letter also fails to point to any reasonable cause. The Letter contends that "NEH has reasonable cause to terminate [the Award] in light of the fact that the NEH is repurposing its funding allocations in a new direction in furtherance of the President's agenda[,]" and more specifically states: "The President's February 19, 2025 executive order mandates that the NEH eliminate all non-statutorily required activities and functions. *See Commencing the Reduction of the Federal Bureaucracy*, E.O. 14217 (Feb. 19, 2025)." But that is wrong.[4] Although the Order states that "non-statutory components and functions . . . shall be eliminated" for the Presidio Trust, Inter-American Foundation, United States African Development Foundation, and United States Institute of Peace, NEH is noticeably absent from that list. In sum, the sole, potentially articulable basis for the termination provided in the Letter—the Executive Order purportedly mandating elimination of this Award—is flatly wrong.

III. This Award Is Not Inconsistent with Agency Priorities

Even if NEH could, in theory, terminate this Award based on misalignment with unspecified agency priorities or reasonable causes, it was mistaken—and acted arbitrarily and capriciously—in drawing that conclusion here. This project is directly aligned with the fundamental purpose of NEH, which is directed by statute to "initiate and support research and programs to strengthen the research and teaching potential of the United States in the humanities," "foster the interchange of information in the humanities," and "support the publication of scholarly works in the humanities." 20 U.S.C. § 956. Consistent with that directive, this Award offers a data-rich reconstruction of the social and economic fabric of Greek Orthodox Christian communities in 19th- and early 20th-century Istanbul—just prior to the mass migrations that would reshape the Greek diaspora in the Americas. By focusing on neighborhood-level dynamics, it reveals how local identities were shaped through provincial ties, parish affiliations, and interreligious professional networks, shedding light on how these communities functioned within the complex structure of the Ottoman Empire. It also offers a comparative perspective on life within an imperial context versus that of a newly forming nation-state like Greece, deepening our understanding of identity, belonging, and coexistence in pluralistic societies.

Beyond its historical contributions, the project exemplifies the broader value of the humanities in helping us interpret human experiences across time and space. The project serves as a dynamic research laboratory, training over 20 undergraduate and 20 graduate students in historical analysis,

[4] *See* Exec. Order No. 14217, https://www.federalregister.gov/documents/2025/02/25/2025-03133/commencing-the-reduction-of-the-federal-bureaucracy.

data science and computational methods, and digital tools, while creating connections between the past and present. Importantly, it enriches Greek American heritage by tracing roots not just to Greece, but to Ottoman Istanbul—bringing this history to life through student-driven research, community engagement, and a dynamic public-facing platform at istanpolis.org.

The project also serves to raise the visibility of a minority Christian community in Istanbul, an important link between the East and West, and to understand how that community's Christian identity influenced its decision to migrate—whether within the empire, to the capital, to the Americas, or to places like Greece. In documenting Christian churches, the project makes available to the American public spaces that are now physically closed either because the community that used them has died out or been driven out. The project can preserve those spaces' existence for posterity and future generations of scholars. Accordingly, this Award is consistent with NEH's statutorily established priorities.

Moreover, the Award does not focus on DEI, gender ideology, environmental justice, or any other topic this Administration (or NEH in its recent press release) has identified as a non-priority. And while it examines and attempts to rebuild historical Greek Orthodox Christian communities, it does not "promote a particular political, religious, or ideological point of view." Likewise, developing a deeper understanding of these communities and their culture just prior to their mass migrations to the Americas enriches the broader patchwork of American history and enhances many Americans' understanding of their heritage by reconstructing communities they can no longer visit in person. Accordingly, this Award is consistent with, and indeed effectuates, NEH's newly declared priority to promote "U.S. history more generally." NEH also recognized in its press release that, while the agency may now be "especially interested in projects with a focus on American history and the nation's founding[,] . . . NEH continues to accept (and fund) applications in all areas of the humanities as defined by NEH's statute." Thus, by its own declaration, NEH is not constrained to awarding funds to projects that focus solely on America's founding and intends to continue funding projects in all areas of the humanities, which, by definition, include history "with particular attention to [studies] reflecting our diverse heritage, traditions, and history." 20 U.S.C. § 952(a). Therefore, to the extent this Award was terminated by NEH on the assumption it relates to DEI or another such topic, promotes a particular ideology, or that it does not enrich U.S. history or Americans' lives, that is deeply mistaken.

NEH never gave UC the opportunity to explain all the above before immediately terminating the award, despite that being the usual practice. *See* General Terms and Conditions (2024) § XIII ("Generally, NEH will terminate an award only after notifying the recipient of the deficiency and giving the recipient sufficient time to correct it; however, this does not preclude immediate suspension or termination when such action is required to protect the interests of the federal government."); General Terms and Conditions (2022) § XIII (functionally the same). Instead, NEH concluded the Award's "immediate termination is necessary to safeguard [unarticulated] interests of the federal government." Hence NEH failed to both "reasonably consider[] the relevant issues and reasonably explain[] the decision." *Prometheus Radio Project*, 592 U.S. at 423. For that reason alone, the termination was arbitrary and capricious and should be reversed. *Id.*

IV. Request for Relief

For the reasons stated above, UC respectfully requests that the decision to terminate the Award be reversed and that funding be reinstated; or in the alternative, to allow UC to modify the project's objectives to more closely align with NEH's new priorities.

We appreciate the consideration of this appeal and look forward to a timely and favorable response.

Sincerely,

Angela R. Ford
Executive Director, Sponsored Projects Office
Research Administration and Compliance
University of California, Berkeley
arford@berkeley.edu
510-642-8117

cc: Michael McDonald, Acting Chairman, National Endowment for the Humanities (mmcdonald@neh.gov)
Christine Philliou, Principal Investigator, Professor, Department of History
Kairi Williams, Assistant Vice Chancellor, Research Administration and Compliance

Encls.
Termination Notice
Notice of Award

From: Grant Notification <Grant_Notifications@nehemail.onmicrosoft.com>
Subject: Notice of Grant Termination – Effective April 2, 2025
Date: April 2, 2025 at 8:35:25 PM PDT
To: "bzwimpfer@berkeley.edu" <bzwimpfer@berkeley.edu>

Ms. Bridget Zwimpfer,

We regret to inform you that your NEH grant has been terminated. Please see the attached grant termination notice.

With Regards,
Michael McDonald
Acting Chairman, National Endowment for the Humanities

NATIONAL ENDOWMENT FOR THE HUMANITIES
NOTICE OF GRANT TERMINATION

April 2, 2025

Ms. Bridget Zwimpfer

Regents of the University of California, Berkeley

Dear NEH Grantee,

This letter provides notice that the National Endowment for the Humanities (NEH) is terminating your federal grant (Grant Application No. RZ29265023) effective April 2, 2025, in accordance with the termination clause in your Grant Agreement.

Your grant no longer effectuates the agency's needs and priorities and conditions of the Grant Agreement and is subject to termination due to several reasonable causes, as outlined in *2CFR§200.340*. NEH has reasonable cause to terminate your grant in light of the fact that the NEH is repurposing its funding allocations in a new direction in furtherance of the President's agenda. The President's February 19, 2025 executive order mandates that the NEH eliminate all non-statutorily required activities and functions. *See Commencing the Reduction of the Federal Bureaucracy*, E.O. 14217 (Feb. 19, 2025). Your grant's immediate termination is necessary to safeguard the interests of the federal government, including its fiscal priorities. The termination of your grant represents an urgent priority for the administration, and due to exceptional circumstances, adherence to the traditional notification process is not possible. Therefore, the NEH hereby terminates your grant in its entirety effective April 1, 2025.

Please remember that your obligations under the Grant Agreement continue to apply. Additionally, an audit may be conducted by the NEH after the termination of your grant.

Please contact Grant_Notifications@nehemail.onmicrosoft.com with only urgent questions.

Sincerely,

/s/ *Michael McDonald*

Michael McDonald
Acting Chairman, National Endowment for the Humanities
400 7th Street S.W., Washington, DC 20506

NATIONAL ENDOWMENT FOR THE HUMANITIES

September 22, 2023

Bridget Zwimpfer
Contracts and Grants Officer
Regents of the University of California, Berkeley
c/o Sponsored Projects Office
1608 Fourth Street, Suite 220
Berkeley, CA 94710-1749

Federal Award ID Number: RZ-292650-23

Dear Ms. Zwimpfer:

I am delighted to inform you that the National Endowment for the Humanities (NEH) has approved an award of $246,347.00 in support of your institution's project. The application was considered carefully during the NEH review process, which includes peer review along with deliberation by the National Council on the Humanities and the Office of the Chair.

The award documents from the NEH Office of Grant Management, which provide information on the period of performance and the terms and conditions that apply to your project, are available in eGMS Reach, NEH's electronic grant management system. Please review the award materials carefully. Address your questions either to the grants administrator or to the program officer whose names appear in the terms and conditions.

A notice of award has also been sent to the project's director, Christine M. Philliou.

Congratulations on your award. I wish you every success.

Sincerely,

Shelly Lowe
Chair

OFFICIAL NOTICE OF ACTION
National Endowment for the Humanities

Action Taken: Award **Date of Action:** 9/22/2023 **Award Date:** 9/22/2023

FEDERAL AWARD INFORMATION

Federal Award ID Number (FAIN)	RZ-292650-23
Award Recipient	University of California, Berkeley
Award Recipient UEI	GS3YEVSS12N6
Period of Performance	10/1/2023 - 9/30/2026
FAL Number	45.161 Promotion of the Humanities_Research (B)
Does the award support Research & Development?	No
Project Title	Visualizing Local Christian Communities in Muslim Cosmopolitan Istanbul in the 19th and 20th Centuries
Project Description	Preparation of a website that will reconstruct Orthodox Christian communities in late Ottoman Istanbul between 1821 and 1923. (36 months)
Program and Office	Collaborative Research, Research Programs

AWARD AMOUNTS **FEDERAL MATCHING FUNDS**

Funds Obligated by this Action	$246,347.00	Amount Offered	$0.00
Total Outright Award Amount	$246,347.00	Offer Expiration Date	
Total Federal Match	$0.00		
Total Award	$246,347.00		

RECIPIENT CONTACTS

Role	Name	Affiliation
Grant Administrator	Ms. Bridget Zwimpfer (Reach Primary Email: bzwimpfer@berkeley.edu)	Contracts and Grants Officer Regents of the University of California, Berkeley
Project Director	Prof. Christine M. Philliou (Reach Primary Email: philliou@berkeley.edu)	Professor Regents of the University of California, Berkeley

REMARKS

Information on requesting payment is located in the *Payment Requests and Financial Reporting Requirements* at http://www.neh.gov/grants/manage/financial-reporting-requirements.

The due dates for the required financial and performance reports for this grant appear on the Report Schedule document. Forms and publications referenced in this award package, including the financial and performance reporting forms and instructions, are available from our website. Go to "Manage Your Award" at www.neh.gov.

This program is authorized by 20 USC §956 *et seq*., and this award is subject to 2 CFR Part 200 Uniform Administrative Requirements, Cost Principles, and Audit Requirements for Federal Awards, and the General Terms and Conditions for Awards to Organizations (for grants and cooperative agreements issued January 1, 2022 or later), and the Specific Terms and Conditions included in eGMS Reach.

AWARDING OFFICIAL

Richard C. Brundage
Director, Office of Grant Management

NATIONAL ENDOWMENT FOR THE HUMANITIES

RECIPIENT: Regents of the University of California, Berkeley
FAIN: RZ-292650-23
PROJECT TITLE: Visualizing Local Christian Communities in Muslim Cosmopolitan Istanbul in the 19th and 20th Centuries

BASIS OF AWARD

This award is made in support of the activities described in NEH application RZ-292650-23.

ENDOWMENT ADMINISTRATION OF THE AWARD

This award has been funded by the Division of Research Programs.

Questions relating to project activities, the scope of the project, or changes in key project personnel should be addressed via eGMS Reach to:

Judith Adkins
National Endowment for the Humanities
Division of Research Programs
400 Seventh Street, SW
Washington, DC 20506
Telephone: (202) 606-
Fax: (202) 606-8204
E-mail: JAdkins@neh.gov

Questions about the regulations that apply to the award or requests for budget changes or extensions of the period of performance should be addressed via eGMS Reach to:

Al-Nasir Fontenot
National Endowment for the Humanities
Office of Grant Management
400 Seventh Street, SW
Washington, DC 20506
Telephone: 202-606-8604
Fax: (202) 606-8633
E-mail: AFontenot@neh.gov

SPECIFIC TERMS AND CONDITIONS

The following terms and conditions apply to this award:

1. Organizations must maintain active System for Award Management (SAM)

registration with current information at all times during which they have an active federal award or an application or plan under consideration by a federal agency. Recipients must therefore review and update their information at least annually after the initial registration, and more frequently if required by changes in information. Entities can update or renew their organization's SAM registration here.

2. The revised budget submitted on September 21, 2023, is approved with the understanding that the following proposed project expenditures which amount $3,000.00 were deleted from the budget: Calculations for foreign travel costs were miscalculated in the budget justification and reflects $7,100.00 per year and not the $8,100.00 that was requested. After the direct cost reduction, the indirect costs were reduced accordingly. Total award reduction amount is $3,495.00. All other estimated costs are within reason, but as a reminder, only actual costs may be charged to the NEH award. Any variations from the approved budget will be subject to the limitations set forth in Article VII ("Project Changes: Prior Approval Requirements") of the General Terms and Conditions for Awards.

3. The due dates for the required financial and performance reports for this award are located in eGMS Reach, the NEH's online grant management system. The link for eGMS Reach is https://securegrants.neh.gov/eGMS-Reach/Login.aspx. The "Report Schedule" document is located in the Reports tab. All reports must be submitted electronically via eGMS Reach.

   All project directors and institutional grants administrators (IGAs) are assigned eGMS Reach accounts. Reach uses Login.gov for sign in. Access Reach at https://securegrants.neh.gov/eGMS-Reach/Login.aspx and follow the on-screen instructions to create or use a Login.gov account.

   Note: eGMS Reach sends official notifications to the email address associated with your account. Protections against spoofing and phishing are provided by Domain-based Message Authentication, Reporting, and Conformance (DMARC). If you forward messages to other addresses, this may cause eGMS messages to be flagged as illegitimate and rejected. Therefore, we recommend that you do not enable auto-forwarding on accounts which receive eGMS notifications. If you do so, you may miss important official communications sent to your email address for which you are still responsible.

4. Information on requesting payment is located in the Payment Requests and Financial Reporting Requirements at http://www.neh.gov/grants/manage/financial-reporting-requirements.

   Final financial and performance reports will be due 120 days after the period of performance ending date. The OMB Standard Form 425, Federal Financial Report (FFR) is required for submission of the final financial report. This form (which must be completed as an online form in eGMS Reach) and the

instructions are available at eGMS Reach at https://securegrants.neh.gov/eGMS-Reach/Login.aspx.

If this award includes subawards, a subrecipient must submit to the pass-through entity all financial and performance reports no later than 90 calendar days after the period of performance end date.

5. Information and instructions for submission of the interim (if applicable) and final performance reports are contained in the Performance Reporting Requirements, available on the NEH website at https://www.neh.gov/grants/manage/performance-reporting-requirements.

6. All materials publicizing or resulting from NEH-funded activities must contain an acknowledgment of NEH support. Consult the *Acknowledgment and Publicity Requirements for NEH Awards* and *Publicizing Your Project* pages on the NEH website for guidance on acknowledging NEH support and promotion.

7. This program is authorized by 20 USC §956, *et seq*., and this award is subject to 2 CFR Part 200 Uniform Administrative Requirements, Cost Principles, and Audit Requirements for Federal Awards, and the General Terms and Conditions for Awards to Organizations (for grants and cooperative agreements issued January 1, 2022 or later).

8. See 2 CFR §§200.308 and 407 for post-award revisions of budget and program plans that require written prior approval from NEH's Office of Grant Management. Note: NEH has waived prior approval requirements for items noted in 2 CFR §200.308 (d)(1) 90-day pre-award costs and (2) up to a 12-month extension to the period of performance; however recipients must provide written notification to NEH if such actions are taken in order for NEH to update related award records and reporting schedules, as appropriate. Recipients authorizing an extension of more than six months must include with the notification to the NEH a detailed work plan describing the activities that will be undertaken during the extension period. All requests for prior approval and notifications of post award changes must be submitted electronically through eGMS Reach Messaging to the NEH Office of Grant Management contact person named above.

9. As required by the Federal Funding Accountability and Transparency Act of 2006 (FFATA), (Pub. L. 109–282), as amended by section 6202 of Public Law 110–252, recipients must report information for each subaward of $30,000 or more in Federal funds and executive total compensation as outlined in Appendix A to 2 CFR Part 170. The FFATA reporting requirements apply for the duration of the project period. Subawards to individuals are exempt from these requirements. Refer to Article IX Section B ("FFATA") in the General Terms and

Conditions for Awards at: https://www.neh.gov/general-terms-and-conditions-awards-organizations-grants-and-cooperative-agreements-issued-january-2022.

10. **For NEH awards that exceed $100,000, funds will not be released until the Grants.gov Lobbying form (and the SF-LLL Disclosure, if applicable) has been submitted**. For more information, refer to section C. "Lobbying activities" in the General Terms and Conditions for Awards to Organizations. Please complete and submit the required lobbying form(s) as an attachment to an eGMS Reach message. These forms can be found in the Assurances and Certifications section of the NEH website at https://www.neh.gov/grants/manage/assurances-and-certifications.

11. Any foreign travel must be undertaken on U.S. flag carriers, wherever such service is available. Refer to Article VI Section G, Part 1 ("Foreign Travel") of the General Terms and Conditions for Awards for further details.

12. Recipients are prohibited from doing business with any organization or person (as a subrecipient, contractor, key employee, consultant, fellow or seminar/workshop participant) if they have been debarred or suspended by any federal department or agency.

    The OMB Guidelines to Agencies on Governmentwide Debarment and Suspension (Nonprocurement) contained in 2 CFR Parts 180 and 3369 apply to this award. The recipient must comply, and must require subrecipients to comply, with Subpart C of these regulations.

    Recipients are required to ensure subrecipient compliance by including a term or condition in the lower-tier transaction that requires the subrecipient's compliance with Subpart C of these regulations. Recipients are also responsible for further requiring the inclusion of a similar term or condition in any subsequent lower-tier covered transaction.

    In the event of suspension or debarment, the information is made publicly available through the Exclusions area within the Performance Information functional area of SAM.gov. Select this link to download and view the Quick Start Guide for searching exclusions in SAM.gov: Quick Start Guide for Exclusions Search & View.

13. NEH-funded projects reach broad public audiences. Projects that receive NEH funds cannot include material that is obscene, libelous, offensive, or defamatory (including hate speech, personal attacks, or material constituting harassment). Recipients are responsible for monitoring all project content, including user-generated content, comments, blog posts, links and other social media.

14. As a reminder, overlapping project costs between two or more applications for federal funding and/or approved federal award budgets is not permitted (2 CFR §200.403(f)).

15. NEH may terminate agreements in whole or in part to the greatest extent authorized by law, if an award no longer effectuates the program goals or agency priorities as noted in 2 CFR Part 200.340.

16. The approved award budget includes travel costs. Travel costs can include but are not limited to any costs towards airfare, ground transportation, mileage, lodging, and per diems for project personnel and participants. Per diems must be limited to travel time and days of attendance or activities performed under the award. Travel for recipient employees and participants must be consistently applied in accordance with 2 CFR §200.475 and the non-federal entity's internal travel policy. All travel costs must be documented and clearly and directly benefit the award to which they are charged. Travel costs not originally included in the approved budget require NEH prior approval.

    NEH will not reimburse costs for cancelled travel arrangements or travel that extends beyond the official travel purpose. Per 2 CFR §200.303, the recipient entity must have established and maintain effective internal controls. Any travel arrangements made on a non-refundable basis are at the risk of the recipient, if the services must be cancelled for any reason.

17. This award includes $34,890.00 in indirect costs. Per the negotiated indirect cost rate agreement dated 06/25/2020, a 16.5% indirect cost rate is permitted on Modified Total Direct Cost base.

    The indirect cost amount is reflective of the budget submitted at the time of award. Any variation from the approved budget will be subject to the limitations set forth in Article VII ("Project Changes: Prior Approval Requirements") of the General Terms and Conditions for Awards.

AWARD REPORTING REQUIREMENTS

National Endowment for the Humanities

Award Number: RZ-292650

Award Recipient: Regents of the University of California, Berkeley

The following is a listing of the due dates of the reports required for this award. A copy of this listing should be forwarded to those individuals responsible for the submission of the required reports.

Report	Special Instructions	Due Date	Period to be Covered
Annual Financial	No special instructions	12/31/2024	10/1/2023 - 9/30/2024
Interim Performance Progress Report (PPR)	No special instructions	12/31/2024	10/1/2023 - 9/30/2024
Interim Performance Progress Report (PPR)	No special instructions	12/31/2025	10/1/2024 - 9/30/2025
Annual Financial	No special instructions	12/31/2025	10/1/2024 - 9/30/2025
Final Financial	No special instructions	1/31/2027	10/1/2023 - 9/30/2026
Final Performance Progress Report (PPR)	No special instructions	1/31/2027	10/1/2023 - 9/30/2026

All reports must be submitted using **eGMS Reach**, the online award management system located at https://reach.neh.gov/.

Document date: 9/14/2023

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Attorneys for Plaintiffs and the Proposed Class
[Additional counsel listed on signature page]

UNITED STATES DISTRICT COURT

NORTHERN DISTRICT OF CALIFORNIA

NEETA THAKUR, KEN ALEX, NELL GREEN NYLEN, ROBERT HIRST, CHRISTINE PHILLIOU, and JEDDA FOREMAN, on behalf of themselves and all others similarly situated,

Plaintiffs,

v.

DONALD J. TRUMP, in his official capacity as President of the United States; DEPARTMENT OF GOVERNMENT EFFICIENCY ("DOGE"); AMY GLEASON, in her official capacity as Acting Administrator of the Department of Government Efficiency; NATIONAL SCIENCE FOUNDATION;

[*caption cont'd next page*]

Case No. 3:25-cv-04737-RL

DECLARATION OF KEN ALEX

The Honorable Rita F. Lin

BRIAN STONE, in his official capacity as Acting Director of the National Science Foundation;
NATIONAL ENDOWMENT FOR THE HUMANITIES;
MICHAEL MCDONALD, in his official capacity as Acting Chairman of the National Endowment for the Humanities;
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY;
LEE ZELDIN, in his official capacity as Administrator of the U.S. Environmental Protection Agency;
UNITED STATES DEPARTMENT OF AGRICULTURE;
BROOKE ROLLINS, in her official capacity as Secretary of the U.S. Department of Agriculture;
AMERICORPS (a.k.a. the CORPORATION FOR NATIONAL AND COMMUNITY SERVICE);
JENNIFER BASTRESS TAHMASEBI, in her official capacity as Interim Agency Head of AmeriCorps;
UNITED STATES DEPARTMENT OF DEFENSE;
PETE HEGSETH, in his official capacity as Secretary of the U.S. Department of Defense;
UNITED STATES DEPARTMENT OF EDUCATION;
LINDA MCMAHON, in her official capacity as Secretary of the U.S. Department of Education;
UNITED STATES DEPARTMENT OF ENERGY;
CHRIS WRIGHT, in his official capacity as Secretary of Energy;
UNITED STATES DEPARTMENT OF HEALTH AND HUMAN SERVICES;
ROBERT F. KENNEDY, JR., in his official capacity as Secretary of the U.S. Department of Health and Human Services;
UNITED STATES CENTERS FOR DISEASE CONTROL;
MATTHEW BUZZELLI, in his official capacity as Acting Director of the Centers for Disease Control;
UNITED STATES FOOD AND DRUG ADMINISTRATION;
MARTIN A. MAKARY, in his official capacity as Commissioner of the Food and Drug Administration;
UNITED STATES NATIONAL INSTITUTES OF HEALTH;
JAYANTA BHATTACHARYA, in his official capacity as Director of the National Institutes of

Health;
INSTITUTE OF MUSEUM AND LIBRARY SERVICES;
KEITH SONDERLING, in his official capacity as Acting Director of the Institute of Museum and Library Services;
UNITED STATES DEPARTMENT OF THE INTERIOR;
DOUG BURGUM, in his official capacity as Secretary of the Interior;
UNITED STATES DEPARTMENT OF STATE;
MARCO RUBIO, in his official capacity as Secretary of the U.S. Department of State;
DEPARTMENT OF TRANSPORTATION;
SEAN DUFFY, in his official capacity as Secretary for the U.S. Department of Transportation,

Defendants.

DECLARATION OF KEN ALEX

I, Ken Alex, declare as follows:

1. I have personal knowledge of the facts contained in this declaration and, if called as a witness, could and would testify competently to those facts.

2. Since 2019, I have served as Director of Project Climate at the Center for Law, Energy & the Environment (CLEE) at UC Berkeley School of Law. I founded Project Climate as a think tank designed to move promising environmental research into the policy realm quickly, and helping climate interventions scale, given the urgency of mitigating climate change.

3. I received a JD from Harvard Law School in 1983 and a BA in political theory from UC Santa Cruz in 1979.

4. Prior to joining CLEE, I spent eight years as a Senior Policy Advisor to Governor Jerry Brown; as the Director of the Governor's Office of Planning and Research; and as the Chair of the Strategic Growth Council, focusing on climate, environment, and land use issues. Before joining the Governor's Office, I was the Senior Assistant Attorney General heading the environment section of the California Attorney General's Office, and the co-head of the Office's global warming unit. From 2000 to 2006, I led the California Attorney General's energy task force, investigating price and supply issues related to California's energy crisis. My (somewhat dated) CV is attached as Exhibit A.

5. My roles as climate policy expert and gubernatorial advisor on the topic were the subject of a 2020 profile in CalMatters. *See* Julie Cart, *Meet Ken Alex, Gov. Brown's Climate Concierge* (updated June 23, 2020), https://calmatters.org/environment/2018/10 /ken-alex-jerry-brown-climate-change-california/. One important opportunity that Governor Brown gave me before the Paris Agreement on Climate Change in 2015 was to help start an entity called the "Under2 Coalition." This Coalition now has over 200 subnational governments around the world working to promote more aggressive climate action. I see it as an essential complement to the international efforts sponsored by the United Nations, which are at country level; subnational governments are often a force for more aggressive action than is happening at the national level.

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(510) 642-5398

6. For the past decade, I have been particularly concerned about methane as a greenhouse gas and a big climate policy issue. Underscoring the connection between academia and policy, much of our understanding of the effects of methane on planetary temperatures is the result of work done by a professor at UC San Diego, Ram Ramanathan, who is one of the world experts on short-lived climate pollutants. He brought to my and the Governor's attention the importance of short-lived but potent climate pollutants. Dr. Ramanathan's research has shown that although methane only remains in the atmosphere for 10 to 15 years—as opposed to carbon dioxide (CO2), which can last 100 years or more— methane is about an 80-times greater greenhouse gas promoter than CO2 over a 20-year period because methane is so effective at trapping heat.

7. In recent work on climate, methane has turned out to be very policy-sensible focus, for a number of reasons. First, If we stop emitting the shorter-lived climate pollutants, not only will we have reduced emissions, but they will be out of the atmosphere in fairly short order, giving us more time to act on CO2. In addition, methane accounts for at least 25 percent of the greenhouse gas forcing function, meaning the amount that it contributes to heating the earth and creating the greenhouse gas effect. Further, methane emissions are somewhat easier to remedy, control, and limit than CO2, because the emissions come from many fewer sources. Methane emissions result mostly from fossil fuel (coal/oil/gas) operations; from certain agricultural operations (mostly cattle and rice production); and from off-gassing from waste sites, such as landfills.

8. The 2021 Conference of the Parties to the United Nations Framework Convention on Climate Change ("COP 26") produced the Global Methane Pledge, which identifies an international goal of cutting methane emissions 30 percent below 2020 emissions levels by 2030. This voluntary agreement has now been signed by over 110 countries to reduce greenhouse gas emissions.

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9. Further, although China did not sign onto the Global Methane Agreement, it entered into a separate agreement with the United States that signaled both countries' commitment to reducing methane emissions, and stated that they would share research and information on methane control strategies. (*See International Atomic Energy Agency, U.S.-China Joint Glasgow Declaration on Enhancing Climate Action in the 2020s* (last updated Feb. 21, 2022), https://www.iea.org/policies/14944-us-china-joint-glasgow-declaration-on-enhancing-climate-action-in-the-2020s.)

10. Last year, working with the State of California, I initiated the Subnational Methane Action Coalition, a group of about 25 jurisdictions (and growing) around the world focused on reducing methane emissions more quickly (*see* https://www.smacmethane.org/).

EPA Grant Application

11. In 2022, EPA's Office of Research and Development sought applications proposing research on air emissions from municipal solid waste (MWS) landfills. MSW landfills are a significant source of methane emissions. The grant solicitation was part of EPA's Science to Achieve Results (STAR) program, and conducted in collaboration with the Air, Climate, and Energy (ACE) research program.

12. EPA's request for applications solicited proposals that addressed these Agency-identified research priorities:

- How can cost effective stationary, mobile, aerial, and remote sensing technologies be combined to more easily and accurately quantify landfill methane emissions, hazardous air pollutants (HAPs), and other air pollutant emissions from municipal solid waste (MSW) landfills?

- How can cost effective stationary, mobile, aerial, and remote sensing measurements be used to increase ease of use and evaluate mitigation strategies and technologies to identify best landfill management practices?

13. In response to the solicitation, a UC Berkeley professional engineer with specialized expertise in landfill design and analysis enlisted me as a co-Principal Investigator as part of a multi-disciplinary science and public policy team. Our team developed a detailed proposal for applying cutting edge technologies, including satellites and AI, to improve the detection of methane and HAP releases from landfills through improved scientific monitoring methods, and to improve the quality of policy responses by pinpointing sources of high methane emissions that could be targeted for control measures. Implementation of control methods for methane—a climate-forcing pollutant—would have the additional important effect of reducing local emissions of the HAPs that are co-pollutants at emissions hot spots, benefitting the health of fenceline residents.

14. We submitted our Grant Proposal to EPA on December 21, 2022. It described a three-year project that would (a) develop and demonstrate (via multiple integrated sensors operating at different scales) a method for monitoring landfill methane emissions more accurately and economically than previously; (b) explore how continuous air monitoring of MSWs can help assess the efficacy of methane-reduction interventions; and (c) promote creation of robust offset protocols that would financially incentivize methane reductions, while also (d) reducing both methane and hazardous air pollutant (HAP) emissions in communities near landfills.

15. The Grant Application proposed a cumulative budget of $999,999 (later rounded up to $1,000,000), which included personnel and equipment to: deploy autonomous flux chambers to take point measurements of methane and other gases in landfill soil; deploy robots and drones to measure these gases at various special scales and temporal intervals; train AI models to estimate methane concentrations in areas without direct measurements; speciate and quantify landfill gases in the lab; integrate satellite and aircraft observations with data collected at and near ground level to identify areas with high methane emissions from point sources; design methane mitigation strategies; and incentivize the adoption of mitigation through carbon offset or other climate change mitigation funding programs. The last listed item is a high leverage policy intervention, because to date, projects to reduce landfill gas emissions have generated more credits in the U.S. voluntary carbon offset market than any other type of projects.

16. A true and correct copy of our Grant Application responsive to solicitation EPA-G2023-STAR-B1, project title *Next-Generation Landfill Monitoring: A Multi-Scale Approach to Measuring Emissions for Evaluating and Financing Interventions*, is attached as Exhibit B.

Award of Grant Funding

17. On October 19, 2023, EPA notified UC Berkeley that it was awarding the grant.

18. A true and correct copy of our research team's Notice of Award and Grant Agreement are attached hereto as Exhibits C and D respectively.

19. On December 16, 2024, EPA notified UC Berkeley that it was awarding the second and final installment of grant funding.

20. A true and correct copy of our 2024 Assistance Amendment is attached as Exhibit E.

21. A printout of EPA's web page *Understanding and Control of Municipal Solid Waste Landfill Air Emissions Grants* (https://www.epa.gov/research-grants/understanding-and-control-municipal-solid-waste-landfill-air-emissions-grants) from May 12, 2025, publicizing our grant as one among five awarded, is attached as Exhibit F.

EPA's Grant Termination

22. On April 29, 2025, EPA sent to the UC Regents a document styled as an "Assistance Amendment." A true and correct copy of the Assistance Amendment is attached as Exhibit G.

23. The Amendment instructed our research team to "stop work; terminate the [grant] agreement; reduce performance period duration; [and] curtail scope of work," while waiving certain reporting requirements. *Id*. at 1. It stated that "(EPA) hereby awards $0.00" towards any unfunded, as-yet-unincurred costs of the previously awarded $1,000,000. *Ibid.*

24. The Assistance Amendment stated: "The Agency is asserting its right under 2 C.F.R. 200.340 and the Termination General Term [stet] and Condition [stet] of this agreement to unilaterally terminate this award." *Id*. at 4.

25. The Amendment was accompanied by memorandum from EPA titled "Termination of EPA Assistance Agreement RD 84062301 under 2 CFR 200.340." A true and correct copy of this memo is attached as Exhibit H.

26. The memo stated that EPA terminated our grant for the following reasons:

> [T]he award no longer effectuates the program goals or agency priorities. The objectives of the award are no longer consistent with EPA funding priorities.
>
> The EPA Administrator has determined that, per the Agency's obligations to the constitutional and statutory law of the United States, this priority includes ensuring that the Agency's grants do not conflict with the Agency's policy of prioritizing merit, fairness, and excellence in performing our statutory functions. In additional to complying with the law, it is vital that the Agency assess whether all grant payments are free from fraud, abuse, waste, and duplication, as well as to assess whether current grants are in the best interests of the United States.
>
> The grant specified above provides funding for programs that promote initiatives that conflict with the Agency's policy of prioritizing merit, fairness, and excellence in performing our statutory functions; that are not free from fraud, abuse, waste, or duplication; or that otherwise fail to serve the best interests of the United States. The grant is inconsistent with, and no longer effectuates, Agency priorities.

Id. at 1.

Harm from EPA's Grant Termination

27. I and my project team have suffered immediate harm as a result of the cancellation of the grant. Specifically:

a) I have been unable to proceed with the basic work to evaluate policy options, with a particular focus on how we can use the detailed methane and HAPs emissions findings to improve landfill regulations, impact decision-making at landfill sites, promote subnational action at landfills, and improve emissions offset protocols. Because California and the United States are leaders in this field, halting the policy work also impacts what is possible internationally.

b) Our research team has been unable to continue and complete novel work related to evaluating HAPs and their relationship to methane emissions from landfills, evaluation of atmospheric and weather impacts on emissions, and the relationship of satellite emissions data to terrestrial data, which is important as we build a satellite-based system for monitoring, reporting, and verification. Most painfully, to my understanding and belief, some of researchers and graduate students will lose hours and compensation, and there is some concern that one or more may need to be let go.

c) Additionally, even if we were eventually to find replacement funding for this project (a difficult proposition given the sum at stake), the delay and uncertainty would preclude full recovery of the project. First, we have multiple partners, including those evaluating HAPs and those evaluating variables related to interpretation of atmospheric variables, who will have scheduling and project conflicts making it quite likely that the project as originally conceived cannot be completed. Second, graduate students with particular expertise and experience will leave for other project and employment, and replacing that expertise will be difficult or impossible. Third, the timing of reduction of methane emissions is critical, as reflected in the Global Methane Pledge reduction goal for 2030. Landfill emissions are a key element of meeting the reduction goals, and the work of this grant in refining our understanding of emissions, tying terrestrial and satellite data, establishing meaningful and robust offset criteria, and accelerating regulatory reform for landfill emissions will be delayed if not put off indefinitely. Finally, our ability to work with jurisdictions around the world will be impacted by the delay in data, results, analysis, and offset protocol determination, all of which is relevant to policy and implementation of landfill emissions mitigation action.

d) These harms are ongoing.

e) In addition, my inability to complete work on the design of policy instruments to reduce landfill emissions of methane and HAPs, which are respectively key contributors to climate change and environmental health impairment, will result in the loss of value to the public.

Appeal of Grant Termination

28. The EPA memo regarding grant termination provided that UC Berkeley could submit a "Dispute" to a named Disputes Decision Official at EPA within 30 days from the date EPA transmitted the termination notice.

29. Our Lead PI (Dimitrios Zekkos) has indicated to our Sponsored Projects Office (SPO) that our team would like to appeal this denial and has provided relevant information to SPO. SPO has responded that outside counsel will use that information to draft an appeal letter.

30. The Award of Grant Funding remains unavailable to our project pending the outcome of the appeal.

Role of Class Representative

31. I am ready to assume the responsibilities of serving as a class representative. I understand that I must stay informed regarding developments in the lawsuit, communicate regularly with my attorneys, and act in the best interests of the class. I have no conflicts that would prevent me from assuming this responsibility.

32. I have been in communication with other UC researchers, who would be members of the class, who have suffered the same general type of harm as I describe above, from the abrupt termination of their previously approved research grants. This harm is widespread and I believe it will only increase in scope and impact if classwide relief is not granted.

I declare under penalty of perjury under the laws of the State of California and the United States that the foregoing is true and correct.

Executed this 28 day of May, 2025.

Signed by:
Ken Alex
F2A8AAB556BB4BA...

Ken Alex

EXHIBIT A

KEN ALEX

510.590-7763 (c)
510.658-4219 (h)

EDUCATION

Harvard Law School
J.D. 1983, cum laude

University of California at Santa Cruz
B.A. 1979, political theory
Highest Honors in major
General College Honors
Honors on Oral Comprehensive Exam

University of Sussex, England
Junior year, 4.0 gpa

EMPLOYMENT

Policy

2019- Director, Project Climate
https://www.law.berkeley.edu/research/clee/research/climate/projectclimate/
University of California, Berkeley

2011-2018 Senior Policy Advisor to Governor
Director, Governor's Office of Planning and Research
Chair, Strategic Growth Council
California Governor Jerry Brown
Multiple citations, including 2020 Order of Merit, highest award of German State of Baden Wurttemberg

Legal

2008-2011 Senior Assistant Attorney General
California Attorney General, Environment Section
Co-head, Global Warming unit

1990-2008 Supervising Deputy Attorney General
California Attorney General, Environment Section
1991 Attorney General's Award for Outstanding Achievement
1997 U.S.DOJ Certificate of Commendation
2001 Attorney General's Award for Excellence
2007 ABA Award: Distinguished Achievement in Env. Law and Policy
2008 Ecology Law Quarterly Leadership Award
Office Management Committee

2001-05 Acting Senior Assistant (2001-02, 2004-05), Sup. Deputy Attorney General
California Attorney General, Energy Task Force
Investigation and prosecution in relation to CA energy crisis
2003 Attorney General's Team Award
2004 Attorney General's Award for Sustained Superior Accomplishment
2004 California Lawyer Magazine Attorney of the Year Award

1985-1990	Deputy Attorney General **California Attorney General, Environment Section**
1983-1985	Court Law Clerk **United States Court of Appeals for the Ninth Circuit** Clerk to Judge Pregerson (loan), May-June 1984 Clerk to Judge Nelson (loan), July-August 1985 Division Chief, September 1984--September 1985
1982-1983	Legal Research **Professors Dershowitz, Edley, Estrich**, Cambridge, MA Appeal of Claus von Bulow

Teaching

Spring 1998, Fall 1999, 2000 Summer 2007	Adjunct Professor **Golden Gate University Law School, San Francisco, CA** "California Environmental and Natural Resources Law" and "Global Warming and the Courts"
Spring 1994 Spring 1996	Visiting Professor Adjunct Professor **Hastings College of the Law, San Francisco, CA** Classes: Environmental Statutes; Environmental Practice. Also in charge of Environmental Externship/Clinical Program
Fall 1987, 1989, 1990	Visiting Instructor (SWOPSI) **Stanford University, Stanford, CA** "Toxic Waste, Social and Political Responses," "Environmental Degredation and Social Change"

PUBLICATIONS ***The Brothers in Law***, a weekly syndicated law column (1984-87); Chapter in Rechtschaffen and Antolini, "Creative Common Law Strategies for Protecting the Environment," ELI Press (2007); "A Period of Consequences: Global Warming as a Public Nuisance," 43A Stanford J. Internl L. 77 (2007); 26A Stanford Env. L. J. 77 (2007); "Merging Paleobiology With Conservation Biology to Guide the Future of Terrestrial Ecosystems," Barnosky et al., Science 355, 594 (2017) (co-author); "Well Under 2 Degrees Celsius: Fast Action Policies to Protect People and the Planet from Extreme Climate Change," Ramanathan, et al. (2017) (co-author)

SPEAKING numerous speeches re environmental and litigation issues at law schools, seminars, and conferences around the world; multiple UN and related events

OTHER Climate and Wildfire Institute Board President; Carbon Business Council Board Member; Earth Island Institute Board Member; Project Silicon Valley Board Member; John Muir Institute, UC Davis; Executive Committee, Environment Section, State Bar of California; Advisory Board, Environmental Law Advisory Board, Golden Gate University Law School; "West/Northwest" Journal Advisory Board, Hastings College of the Law; Chair, Western States Hazardous Waste Project; Advisory Board, Energy Policy Initiatives Center (University of San Diego); Primary Architect: Under2 MOU and Under2 Coalition (www.under2coalition.org)

SELECTED MAJOR LEGAL CASES

Global Warming. Developed AG global warming strategy; filed novel action in conjunction with seven other states against the five largest owners of coal-fired power plants and the largest emitters of CO2 in the country seeking injunctive relief for public nuisance resulting from global warming (AEP v. Connecticut). Filed separate action for damages against big six automakers for damages resulting from emissions based on federal common law (CA v. GM); settled multiple novel CEQA cases for substantial ghg mitigation (ConocoPhillips, San Bernardino, others).

Energy Crisis. Led the AG investigation into the causes of California's energy crisis; supervised unit handling over 70 filed actions in all levels of state and federal court, FERC, and the SEC; negotiated a number of landmark settlements, including with El Paso Energy for $1.7 billion and Williams Energy Trading Co., Duke Energy, Dynegy, and others for over $2 billion; challenged FERC's market based rate structure and PG&E's regulatory exemptions in *Lockyer v. FERC*, 383 F.3d 1006 (9th Cir, 2004), among many other matters.

Iron Mountain Mine. This $1 billion mediated settlement created a structure for a massive cleanup system and process over 3000 years at a site near Redding that contains the most acidic material (pH -1.4) ever found. The complex agreement involves insurance financing, massive on-site remediation, and projects for natural resource damage restoration.

Avila Alliance v. Unocal. Negotiated a landmark agreement in a case involving three environmental groups, the County of San Luis Obispo, two state agencies, and Unocal for the excavation of a massive oil plume under the beach, Front Street, and a portion of the town. Cost for the year-long excavation and remediation exceed $100 million. In addition, Unocal agreed to pay $18 million for projects and funding for natural resource damages and related damage to the town.

In Re Cape Mohican. An improperly opened value resulted in the release of oil into San Francisco Bay from the *Cape Mohican*, a ship owned by the United States and being serviced at San Francisco Dry Dock. Harsh winter weather resulted in the spread of oil throughout the Bay and onto the National Shoreline and State Parks systems. Year-long negotiations resulted in a multi-million dollar settlement for natural resource damages for habitat restoration and replacement and reimbursement of all costs.

California v. PG&E. Following an anonymous tip, completed a two year investigation and negotiated a $14 million settlement, the largest under the Clean Water Act for a single facility. The case involved intentional omission of sampling data concerning the impact of the Diablo Canyon nuclear power plant cooling towers on local marine environment.

California v. Southern Pacific. Negotiated $40 million agreement for natural resource damages resulting from metam sodium spill into the Upper Sacramento River, one of the largest settlements of its kind.

California v. United States Dept. of Agriculture (Sequoia National Forest). Negotiated a 170 page agreement in conjunction with 27 parties through an 18 month mediation process for revision of the 50 year Sequoia National Forest Land Management Plan, controlling timber harvest levels and techniques, protecting Giant Sequoia Groves, and governing all management practices in the Forest.

People v. Filbin. Settled case involving the "world's largest tire pile," by requiring massive reduction of the 40 million tires in the pile, the creation of fire breaks, and additional fire safety equipment.

People v. EBMUD. Litigation halted construction of reservoir in wilderness area pending full environmental analysis.

Citizens for Goleta Valley v. Board. Argued issue of alternative site analysis under California Environmental Quality Act on behalf of amicus curiae before the California Supreme Court.

Cogeneration Power Plants. Negotiated over a dozen settlements involving cogeneration power plants, by requiring full environmental documentation and air emission offsets.

People v. Texaco. Discovery of thousands of rusted, leaking drums of hazardous waste led to the largest penalty-settlement of a hazardous waste case in the United States--$8.95 million.

Ken Alex

SELECTED MAJOR ACTIONS, GOVERNOR'S OFFICE

Under2 Coalition. Created and developed the Under2 MOU and Under2 Coalition (www.under2coalition.org), now the world's largest organization of sub-national (states, provinces, regions) governments, with over 200 signatories representing 40% of world GDP and over 1.3 billion people. Signatories agree to reduce greenhouse gas emissions by 80% below 1990 levels or to less than 2 tons per capita by 2030. The Coalition focuses on increasing the capacity of sub-national jurisdictions to reduce emissions and to provide the political leadership and scale needed to combat climate change.

AmeriCorp: CivicSpark. Created three AmeriCorp programs that send recent college and graduate school graduates into local communities to work on (1) climate issues; (2) water issues; (3) planning and broadband access. Each program was designed in collaboration with the Local Government Commission, which now runs them, sending about 100 Corp members to communities each year. The program is being expanded nationally.

Flame Retardant in Furniture. California set flame retardant standards in the 1970s, before self-extinguishing cigarettes and greater knowledge about the health impacts of the retardants themselves. Multiple legislative efforts to reduce retardants in furniture failed. I directed the review and update of the underlying regulations, which resulted in a wholesale change and flame retardant-free furniture in California.

Solar Siting, Least Conflict. After observing an eight-year, highly contentious process for land use and renewable planning in the Mojave desert, created a four month process to identify areas of "least conflict" in the San Joaquin Valley for possible solar projects, resulting in identification of hundreds of thousands of acres of possible sites, which has informed transmission decisions and focused resources. Now using a similar process in different counties.

Vehicle Miles Traveled. Under the California Environmental Quality Act, agencies must evaluate the impact of the proposed project on "level of service"—traffic delay. Projects in urban areas almost always result in traffic delay, which must be mitigated, usually through wider streets and more traffic lights. Projects in green field areas rarely result in traffic delay and require no mitigation, providing a hidden but significant benefit and incentive to sprawl promoting projects. Proposed and obtained passage of legislation changing the standard to require agencies to evaluate the impact of the project on vehicle miles traveled. Projects on urban outskirts tend to generate more miles and need more mitigation. The new VMT standard changes the incentives and benefits.

Salton Sea. A 20-year agreement providing Colorado River water to the Sea was set to end in 2017, with potentially catastrophic impacts for the sea, for air quality, and for down-wind residents. Led a task force to resolve the issues, establish a smaller but sustainable Sea, address air emission areas resulting from lake bed exposure, and develop funding sources. The task force resulted in a multi-party negotiation and supplement that will govern the Sea for the next ten years.

Data. Led multiple efforts to change how the State uses and presents data, including open data initiatives, water data and transparency, conservation mapping, scenario planning tools, urban mapping tools, CEQANet on line access for all environmental review documents, and CA@50 Indicators project.

Owens Lake. A long standing set of disputes between the Los Angeles Department of Water and Power and the Great Basin Air District over air emissions from the exposed lake bed resulted from the historic action by LADWP to drain the Lake and resulted in numerous law suits and repeated attempts at settlement. Acted as mediator for the final set of issues, and obtained a settlement that appears to have finally resolved the matter.

Other Projects of Note.

- Complete revision of General Plan Guidelines for local jurisdictions
- Revision of Guidelines for California Environmental Quality Act
- Streamlined Review for large scale projects under AB 900 (Environmental Leadership Projects)
- Guidelines for Indian Tribe Consultation
- Biochar research
- Rooftop Solar Handbook
- Regional Advance Mitigation Program (AB 2087)
- Autonomous vehicle policy review
- Multiple mediations for large scale solar projects

EXHIBIT B

PROJECT NARRATIVE

FON: EPA-G2023-STAR-B1, Understanding and Control of Municipal Solid Waste Landfill Air Emissions (Research Area 2)
Project Title: Next-Generation Landfill Monitoring: A Multi-Scale Approach to Measuring Emissions for Evaluating and Financing Interventions

Table of Contents

ABSTRACT

FON: EPA-G2023-STAR-B1, Understanding and Control of Municipal Solid Waste Landfill Air Emissions (Research Area 2)
Project Title: Next-Generation Landfill Monitoring: A Multi-Scale Approach to Measuring Emissions for Evaluating and Financing Interventions
PIs: Lead PI: Dr. Dimitrios Zekkos; Co-PIs: Ken Alex, Riley Duren
Institution: The University of California, Berkeley
Project Period & Location: 9/1/23 - 8/31/26; Landfills in California and Michigan
Project Cost: $1,000,000 total

Objectives: The objective of this proposal is to demonstrate that an integrated multi-scale and multi-sensing approach to monitoring will provide critical insights into the spatial and temporal emissions from MSW landfills, inform mitigation strategies, and enable financial incentives for landfill interventions. The scientific hypothesis is that the multi-scale approach—i.e., the deployment of continuously operating, self-powered, wireless methane flux chambers, paired with terrestrial robots as well as unmanned aerial vehicles, and satellite observations—provides a viable, low-cost, and scalable means of monitoring methane and co-pollutants at landfills. The study will enable data-driven assessments of mitigation strategies and support data-driven landfill emission models. The economic hypothesis is that the improved landfill emissions monitoring can form the basis of a market-based offset protocol capable of reducing emissions by lowering the cost of emission mitigation practices.

Experimental Approach: We will deploy low-cost continuous monitoring systems at landfills using flux chambers that paired with multi-sensor equipped unmanned aerial vehicles (UAVs) and terrestrial robots will provide unique insights on how methane and co-pollutant emissions are affected by weather, variable site conditions and landfill practices. This approach will be scaled up to provide an independent validation of satellite- and airborne-based emissions estimates by Carbon Mapper.

Expected Results: The proposed project represents a leap forward in properly assessing risk from landfill emissions by creating a methodology for emission monitoring, an unprecedented dataset through multiple sensors and technologies, and a financial framework for driving innovation and quantification in mitigation strategies. This project will result in:

1. A *tested methodology* for emissions measurements from wireless sensors, UAVs, and robotic platforms and satellite data as a means to continuously measure methane as well as hazardous air pollutant emissions.
2. A *multi-sensing, multi-temporal dataset* that will quantify the profound impact of weather/climate, landfill conditions and practices, as well as mitigation strategies on emissions that can also be used to inform future data-driven methane models.
3. A financing system for funding and crediting effective mitigation measures, including through an expanded carbon offset protocol.

Supplemental Keywords: energy, energy capture, waste reduction, waste minimization, environmental justice, renewable feedstocks, sustainability, public policy, air, atmosphere, global climate, health effects, VOCs, oxidants, organics, dissolved solids, clean technologies, modeling, monitoring, measurement methods, remote sensing, satellite

RESEARCH PLAN

Motivation and Objectives

This project will develop a scalable methodology through which Municipal Solid Waste (MSW) landfill gasses can be monitored and emissions interventions can be measured and financially rewarded. The **first objective** of this study is to test the hypothesis that continuous air monitoring of MSW landfills is feasible and cost-effective through an integrated multi-scale approach (e.g., coordinated observations with multiple sensors deployed on flux chambers, Unmanned Aerial Vehicles (UAVs), aircraft, and satellites). The **second objective** is to explore how this approach can establish the efficacy of interventions and create financial incentives to reduce emissions by serving as the basis for robust landfill emissions reduction quantification protocols. A successful multi-sensor approach will allow landfills to more effectively monitor emissions at lower cost for regulatory compliance and to quantify the emissions impact of interventions enabling private sector funding and more sustainable practices.

Continuous data collection at selected locations at a landfill using inexpensive self-powered, autonomous flux chambers will provide direct measurements (point measurements) of methane fluxes, other non-methane gases, and environmental conditions. The point measurements will be scaled to the entire landfill through recurrent deployments of aerial and terrestrial robots equipped with multiple sensors. Together, these instruments will provide a multi-temporal emissions map of the entire landfill with high spatial resolution (cm-level). In conjunction with Carbon Mapper, the project will also employ and validate aircraft- and satellite-based techniques for remote monitoring of operational and closed landfills.

These emissions quantification methods will form the basis of an integrated landfill emissions reduction quantification protocol. The protocol will attract private funding to help landfill operators reduce methane emissions, such as through the generation of high-quality offset credits from a wider set of landfill methane reduction interventions than current programs allow.

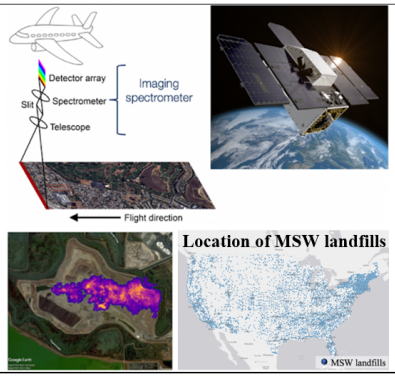
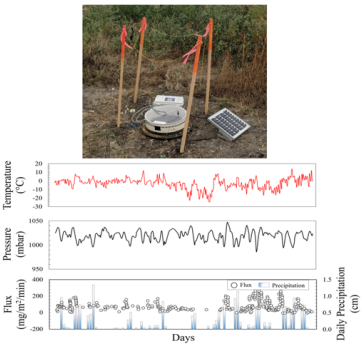
Method	Satellites and Aircraft	Drones and Robot	Autonomous Flux Chambers
			
Coverage	City - Country	Landfill Scale	Point Measurement
Data resolution	3 ~ 30 m	> 1 cm	Local
Data frequency	1 ~ 7 days*	hrs	sec
Sensors	Infrared imaging spectroscopy	Lidar optical, Infrared, Methane (CH_4), H_2S, VOCs	Temperature, Pressure, Precipitation, CH_4, CO, H_2S, VOCs

Fig. 1. Proposed multi-scale, multi-sensor monitoring of methane (and non-methane) emissions from landfills using satellites, aircraft, robots, and autonomous flux chambers

Success in the objectives of this proposal will yield:

- A **practical engineering methodology** for landfill emissions monitoring that can be employed broadly to understand landfill emissions, support data-driven gas mitigation strategies, promote environmental stewardship, finance interventions, and maximize benefits to communities.
- A unique **multi-sensor and multi-scale (wireless sensors, robots, and satellites) dataset** at specific landfills that will advance the science of emissions from landfills and provide insights into the spatial and temporal emissions variation.
- **A protocol** that could be used to generate high-quality carbon credits currently limited by the lack of available data.
- **Improved landfill emissions models** that use methane concentration maps, employ machine learning to derive flux, and account for changing environmental factors, in contrast to current practices.
- Integrated **VOC and H_2S measurements and methane:HAP ratios** from field samples and secondary datasets that can provide insights into non-methane emissions from landfills.

Background

Waste placed in landfills quickly becomes anaerobic. The resulting gas primarily includes methane (40-60%) and carbon dioxide and may contain other co-pollutants, such as hazardous air pollutants (HAPs), volatile organic compounds (VOCs), and hydrogen sulfides (H_2S). Although gas collection systems aim to flare or capture biogas, gas systems may not be in place for up to 5 years following waste placement and, in general, may fail to function properly (Amini and Reinhart, 2011; Anshassi et al., 2022; Barlaz *et al.* 2009; Huitric and Kong, 2006; Oonk, 2012; Townsend *et al*., 2005). Gas collection becomes more challenging in poorer communities extenuating environmental justice issues and may not be viable on a long-term basis after landfill closure. (Hanson *et al*., 2020).

Current landfill gas monitoring operations do not provide a comprehensive assessment of methane or non-methane air pollutant fluxes to the atmosphere, and instead only focus on near-surface methane concentrations and/or gas volumes in capture systems (and often assume the latter are fully functioning). Moreover, the approaches used for methane concentration measurements are outdated, can be unreliable, are solely used for compliance, ignore advances in technology, lack sufficient frequency, and are often conducted at improper spatial and temporal scales. Regulatory guidance requires measurement of methane concentrations at 25 or 100 ft intervals that can fail to capture localized methane emission "hotspots" that contribute the majority of methane leaks (CalEPA, 2016), while measurements at other critical areas (*e.g.* landfill slopes, active areas) are not typically conducted. Despite the evidence that landfill emissions are time-varying due to fluctuations in weather, waste degradation processes and cover soils, no official guidance is provided on the exact timing of measurements (Allen *et al*., 2019; Burgués and Marco, 2020; Hanson *et al.*, 2020). Approaches to quantitatively assess the volume of gasses emitted with better temporal and spatial awareness are needed to fully assess emissions.

Recent advances in IoT, wireless sensing, robotics, and remote sensing technology provide an unprecedented opportunity to monitor and understand landfill emissions that also consider the significant temporal and spatial variations. Wireless sensors placed at the landfill surface and within the waste mass have provided new insights involving gas generation, liquid flow, landfill temperature as well as methane emissions (Alarcon *et al.*, 1987; Bergamaschi *et al*., 2009; Gentry and Walsh, 1984; Kim *et al.*, 2011; Noda *et al.*, 2005; Shin *et al.*, 2001; Sonkar *et al*., 2022; Suchanek *et al*., 2022; Yang *et al*., 2018). Advances in robotics, especially UAVs, are

revolutionizing civil infrastructure (Zekkos *et al*. 2018, Greenwood *et al*. 2019). In landfills, progress has been slower, but UAVs have already enabled the collection of measurements that were either impossible or prohibitively expensive in the past. For example, UAVs equipped with cameras have been used for site inspections and operation monitoring, as well as for the development of three-dimensional models using overlapping photos that are stitched together to create 3D models (Champagne *et al*. 2020; Emran *et al*. 2017). Multi-temporal data generated by repeated deployments provides an ability to calculate changes in 3D models (known as "DEM differencing") that can be used for measuring waste placement activities and monitoring settlements (Champagne *et al*. 2020). Settlement monitoring is particularly beneficial as landfill settlements are primarily associated with waste biodegradation and methane generation (Fei and Zekkos, 2018). UAVs equipped with Lidar can measure terrain geometry even when the surface is vegetated.

UAVs equipped with gas sensors were used to monitor methane gas and cover detection areas quickly and cost-effectively (Emran *et al*. 2017). Advances in the miniaturization of chemical instrumentation and low-cost small UAVs are catalyzing exponential growth in the use of such platforms for environmental chemical sensing applications (Burgués and Marco, 2020). Terrestrial robots (*i.e*., wheeled or tracked robots) have been deployed in landfills in order to monitor GHGs, especially methane gas (Bennetts *et al*., 2013; Bateman *et al*., 2016; Feitz *et al*., 2018). Such robots have the advantage of conducting measurements at controlled and tight distances from the ground surface (Anderson *et al*., 2014) using methane sensors such as tunable diode laser (TDL) to monitor methane gas at MSW landfills. These studies reported significant improvement in data quality and generated 3D methane concentration maps over current practices.

Recent advances in methane remote-sensing from aircraft and satellites offer observations that can uniquely complement surface and near-surface monitoring systems. Specifically, a new class of imaging spectrometers designed by NASA's Jet Propulsion Laboratory measure ground-reflected solar radiation from the visible to shortwave infrared spectral regions (380 to 2,510 nm) with 5 nm sampling (Hamlin *et al.,* 2011). These push-broom instruments have a wide field of view and operate on high-performance aircrafts and satellites, allowing for efficient mapping of large regions and the ability to detect and quantify methane emissions (Thompson *et al*., 2015; Thorpe *et al*., 2016). We have previously demonstrated the ability to rapidly survey methane point sources with this technology on aircraft – covering up to 5000 km^2 per day at spatial resolutions of 3 – 8 meters with typical detection limits of 10 $kgCH_4/hr$ (Cusworth *et al*., 2022; Duren *et al*., 2019). Since 2016, these studies have been conducted in 21 US states and consistently find that a small fraction of facilities, including landfills, are disproportionately responsible for 20-60% of regional methane emissions. Additionally, we used the high spatial resolution methane plume images produced by aircraft studies in California to attribute point source emissions to specific sections of landfills and organic waste diversion facilities to help inform root-cause assessments by operators (Cusworth *et al*., 2020). Our remote sensing methods have been tested against independent airborne observations using in-situ methods in California (Duren *et al*., 2019) and more recently in collaboration with EPA's research division in Ohio, Michigan, Alabama, and Georgia. Going forward, Carbon Mapper plans to launch two satellites in fall 2023 that will extend these capabilities globally, towards routine operational monitoring of landfills at a 30 m resolution, a 50-100 $kgCH_4/hr$ detection limit, and sample intervals ranging from days to bi-monthly.

Methane emissions at landfills can result from several processes. Most locations across a landfill's spatial footprint will have some low emission that escapes to the atmosphere, referred to as "diffuse area sources." Other emissions are much larger in magnitude and are often the result

of some operational practice (*e.g.*, construction) or malfunction (*e.g.*, leaks in gas capture systems). We refer to these as "point sources." Together diffuse and point sources make up the "net emissions" of a landfill. Methane remote sensing from aircraft and satellites is primarily sensitive to point source emissions which can range from negligible to dominant fractions of the net emissions. The aircraft and satellite observations have the unique advantage of providing nearly instantaneous snapshots of landfill point source emissions that reduce the confounding impact of variable winds. By repeatedly imaging the entire landfill with sample intervals of minutes to days, aircraft and satellites can determine the location of point sources on the landfills' surface and characterize temporal variability. Continuous surface flux chambers and periodic near-surface observations by robots and drones complement satellite observations by quantifying diffuse area emissions and further resolving temporal variability in net landfill emissions. It is through integration of these methods that robust estimates of net landfill methane emissions can be generated as well as guidance for root-cause assessments and mitigation action.

Research Approach, Research Partners and Study Sites

Our proposed research approach, shown in Fig. 2, aims to address a range of challenges from field data collection to data analysis for emissions characterization and leverage these approaches for improved mitigation and financing. The proposing team is led by the University of California at Berkeley (with expertise in landfill engineering, robots and sensing (Zekkos-PI), and public policy (Ken Alex-co-PI, Haya-Senior Collaborator) and engages experts on satellite sensing through Carbon Mapper (Riley Duren-CoPI). In addition, GTI Energy (Amanda Harmon) will use the resulting emissions datasets to test existing emission models and determine the impact of changing environmental conditions on landfill gas release and PSE Healthy Energy (Seth Shonkoff) will collect laboratory samples for landfill gas to compare against the field measurements. The proposal is also supported by the Office of the President of the University of California (see letter of support) which is investing in renewable natural gas primarily from landfills to achieve its sustainability goals, as well as the Alameda Waste Management District (see letter of support).

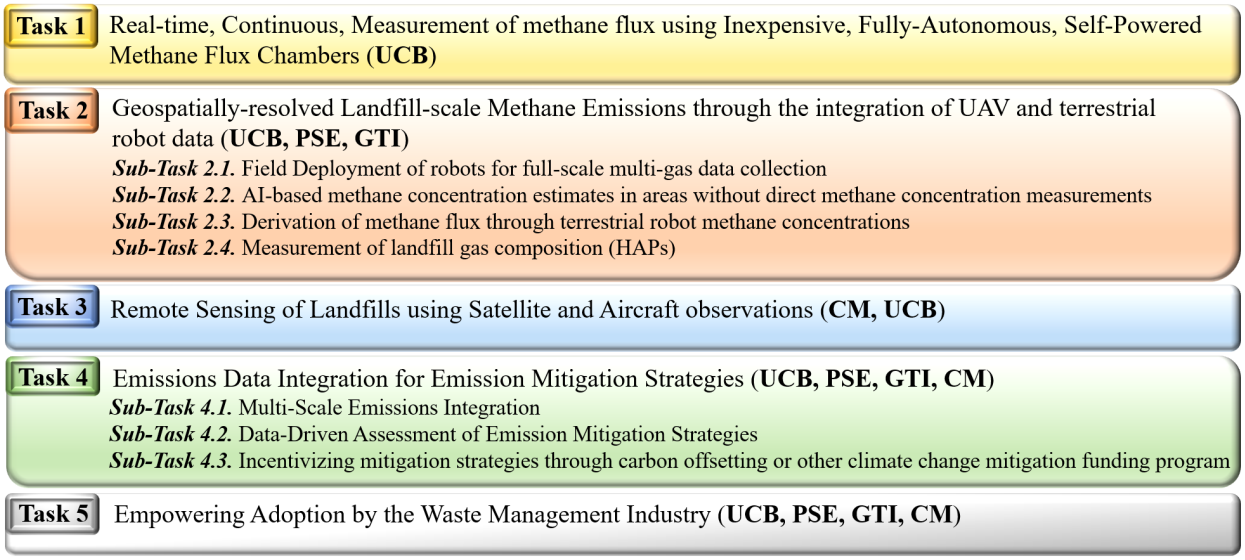


Fig. 2. Proposed Research Tasks and research partners
(UCB: UC Berkeley, CM: Carbon Mapper, PSE: PSE Healthy Energy, GTI: GTI Energy)

We propose a comprehensive monitoring program to improve understanding of the temporal and spatial variation of gas emissions that will enable intelligent emission mitigation strategies and improved landfill management practices. The proposed monitoring work will integrate wireless sensors, and robots (aerial and terrestrial) with remote sensing using satellites and aircrafts. We will create an extensive dataset of emissions at targeted facilities, where partnerships have been developed and data is available to complement our existing field instrumentation program. We have already coordinated access to the active Monterey Peninsula landfill in California (see letter by Mr. Guy Petraborg), which has a range of cover soils (daily, intermediate, final) and explores mitigation activities and gas emission monitoring, the closed UC Davis landfill (see letter by Mr. Martin Kim) that has two units, one with a clay cap and one with an engineered composite cover, and the City of Midland, Michigan, landfill (see letter by Mr. Scott O' Laughlin) which represents a landfill at a much wetter environment, has cells with liquid recirculation (and energy recovery) and cells without, and has previously collaborated with team members (*e.g.*, Bateman *et al*., 2016, Champagne *et al*., 2020). We remain open to additional partnerships with landfills that may provide additional opportunities, but the identified landfills provide an excellent selection of landfills where we can have ample access to operation data (including waste age and type), recirculation practices, and gas measurements to complement our own data. Our own measurements are intended to be conducted throughout the landfill including on slopes and in areas with active waste placement activities where data is nearly absent.

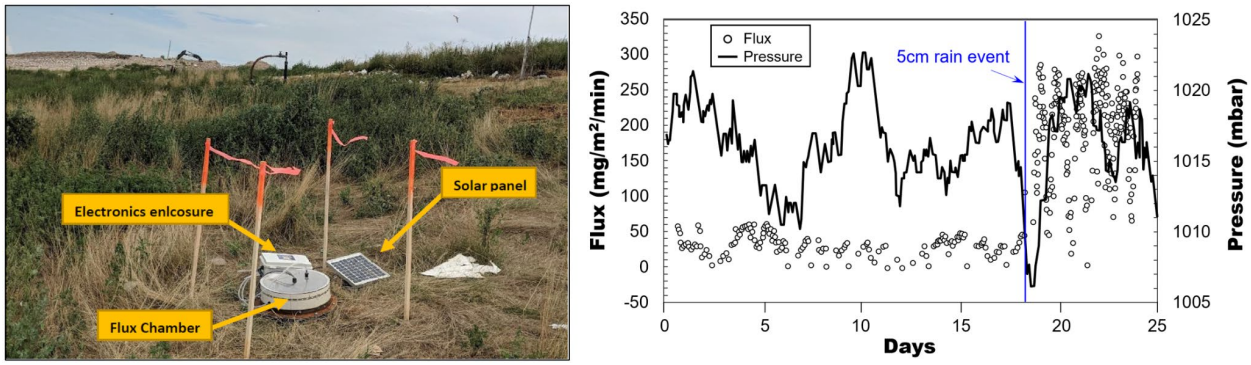


Fig. 3. View of fully-autonomous, self-powered flux chamber (left) and example of generated data showing increase in methane flux (points) following atmospheric pressure drop and 5 cm precipitation event (after Draughon et al., 2019).

Task 1: Real-time, Continuous, Measurement of Methane Flux using Inexpensive, Fully-Autonomous, Self-Powered Methane Flux Chambers (UCB)

We will deploy 6-7 fully-autonomous, self-powered flux chambers at each studied landfill to collect continuous methane flux data. This will provide insights on how methane flux varies across different locations, cover soils, and weather conditions. The self-powered flux chamber is controlled by a low-power microcontroller sensing platform and is equipped with methane, CO_2, temperature, and relative humidity sensors. As described in Draughon *et al.*, 2019), the chamber measures the build-up of gas to determine flux, evacuates autonomously, transmits the data, and repeats the process. In this study, additional sensors will be incorporated to measure emissions such as VOCs and H_2S and the moisture content of the ground beneath the chamber using a Time Domain Reflectometry (TDR) sensor. Moisture content variations are important because they affect gas conductivity of cover soils. The flux chamber data represent a "point measurement" and

will capture the significant methane flux variations that occur due to weather variations that cannot be captured by intermittent surveys or occasional site visits by robots or satellites alone. For example, as shown in Fig. 3, a change in flux by an order of magnitude is observed due to a precipitation event. The flux data collected will be used to calibrate methane concentration data collected by UAVs in the next task and scale up to derive landfill-scale flux estimates.

Task 2: Geospatially-resolved Landfill-scale Methane Emissions Through the Integration of UAV and Terrestrial Robot Data (UCB, GTI Veritas, PSE Energy)

Sub-Task 2.1. Field Deployment of robots for full-scale multi-gas data collection (UCB & GTI)
Robots (aerial and terrestrial) equipped with multiple sensors will be deployed to generate high-resolution geospatial maps of methane and co-pollutant concentrations and flux for the entire landfill. Robots and UAVs can collect multi-sensor data more standardized and efficiently than humans. UAVs can also collect data at a safe distance without interfering with landfill operations on the ground. Two different approaches will be implemented with the goal to generate a high-resolution landfill-scale geospatial map of methane flux, and the results will be compared.

Approach (A): UAVs will directly measure methane concentrations along a lawnmower-type path by towing a tunable diode laser (TDL) at 3'' above the ground and at adequate distance to ensure that the UAV flight does not impact the measurements. TDL measurements provide a localized measurement of concentrations at the tip of the sensor, but by moving the sensor, geospatially varied measurements can be conducted. The methane measurements will be co-located with a 3-dimensional geometric, optical and infrared model of the entire landfill based on data collected by the on-board UAV camera sensors. As explained in Sub-Task 2.2., an AI model will be used to correlate concentration measurements along the UAV path to the 3D optical/infrared attributes and derive estimates of methane concentrations at the entire landfill including areas where methane concentrations were not measured (e.g., between the traversed path of the UAV and other areas in the landfill). Finally, the concentration measurements of the facility will be related to some (3-4) of the flux chambers to derive a flux model for the entire facility, and the results will be compared against additional flux chambers (2-3) that were not used in the derivation of the relationship. This procedure is illustrated in Fig. 4.

Approach (B): A terrestrial robot will be used to generate methane concentration data along its lawnmower-type path using TDL sensors at three (and low) heights above ground to reduce the effect of air mixing. Methane flux data will be derived from the multi-height methane concentrations, as described in Sub-Task 2.3 and shown in Fig. 5 and scaled up to derive flux estimates for the entire landfill through interpolation between measurements, or by also using optical and infrared characteristics of the ground surface. We will also experiment with equipping the terrestrial robot with non-methane gas sensors (such as electrochemical sensors, semi-conductor or photo-ionization sensors to measure H_2S and VOCs). An anemometer will be used to measure wind speed and direction during field measurements.

For both approaches, we will also use the continuous flux methane data in an attempt to create a time-continuous facility-wide methane emissions profile which is denoted here as 4D (3-dimensions and duration/time). To explore that model results, as part of our research, we will deploy our UAVs and robots frequently, in some cases even multiple times in one day.

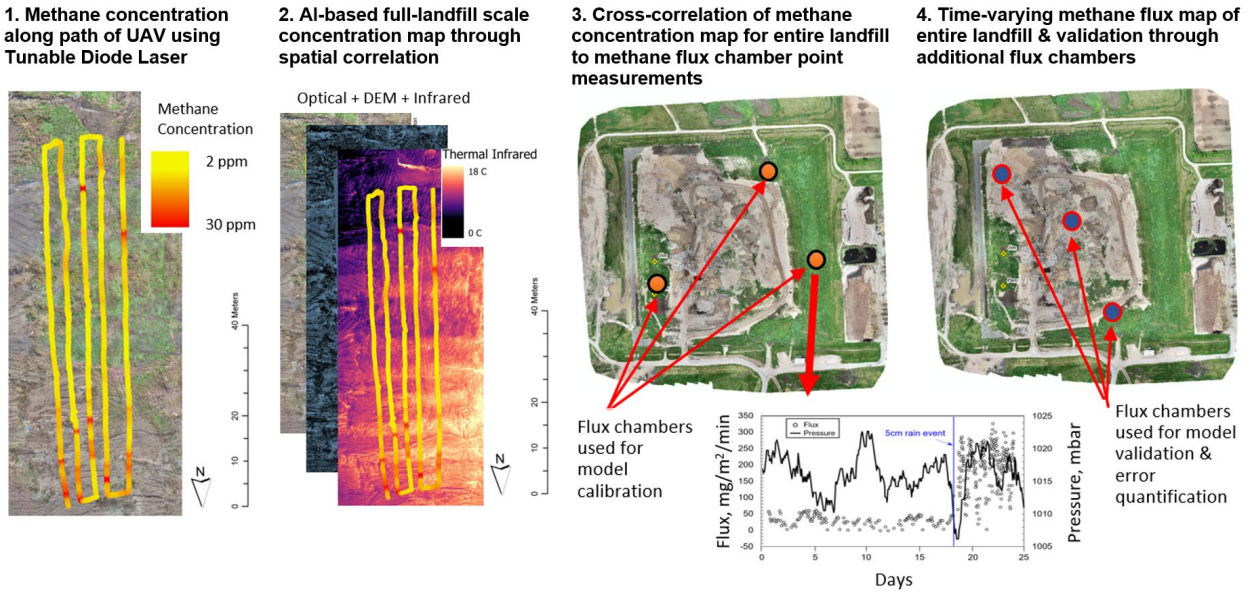


Fig. 4: Schematic showing Approach (A) for deriving landfill-scale methane flux from UAV and flux chamber data.

Sub-Task 2.2. AI-based methane concentration estimates in areas without direct methane concentration measurements (UCB)

UAVs and robots have the capacity to traverse the entire landfill. However, this may be challenging or time-consuming for large landfills, active waste disposal areas or other inaccessible areas. Thus, in this task, we propose to develop, and deploy an Artificial Intelligence (AI) model, and specifically a machine learning algorithm (such as support vector machines and random forest) that can derive high-resolution methane concentration estimates from the fusion of lidar, optical and infrared landfill surface data, as well as operation data related to the gas system and landfill operations. We will quantify the accuracy of the model by training the AI model using a portion (5%-20%) of the concentration data collected by the TDL and quantifying the accuracy and variance of AI model predictions by checking it against the remaining (80-95%) of the measurements collected by the UAVs.

The AI model will use primarily landfill surface features, such as the geometric, optical and infrared attributes. The optical attributes, such as the RGB (red-green-blue components) of the imagery can be used to identify vegetated versus bare ground, soil types, the presence of cracks and other geometric attributes, and also through 3D surface differencing calculate settlement. Infrared data will also be used to characterize the thermal signature of the ground, and repeated infrared surveys in one day will provide estimates of thermal inertia, which is a function of the type of material (soil type, vegetation) and its moisture content (Cai *et al*., 2007, Zwissler *et al*., 2014, Zekkos *et al*., 2022). These attributes are expected to have a significant effect on derived methane concentrations. Other landfill operation factors (*e.g*., type of waste, recirculation conditions, weather conditions, gas well operations) will also be important and will be considered during model training.

Sub-Task 2.3: Derivation of methane flux through terrestrial robot methane concentrations (UCB)

Terrestrial robots can also collect concentration data that can be directly compared to the

UAV concentration measurements. More importantly, in this task we aim to derive methane flux data from concentration measurements at different heights above ground along the path of the robot. A Boston Dynamic's terrestrial quadruped robot will be used as it has the ability to traverse practically all landfill topographies. Methane flux measurements along the path of the robot are preferable compared to concentration data only that must be correlated to stationary flux chambers to derive geospatial flux estimates. We note that, although this is beyond the immediate scope of this proposal, we envision a future where fully-autonomous terrestrial robots will be using intelligence (e.g., methane sniffing algorithms and controls) to identify leakage sources.

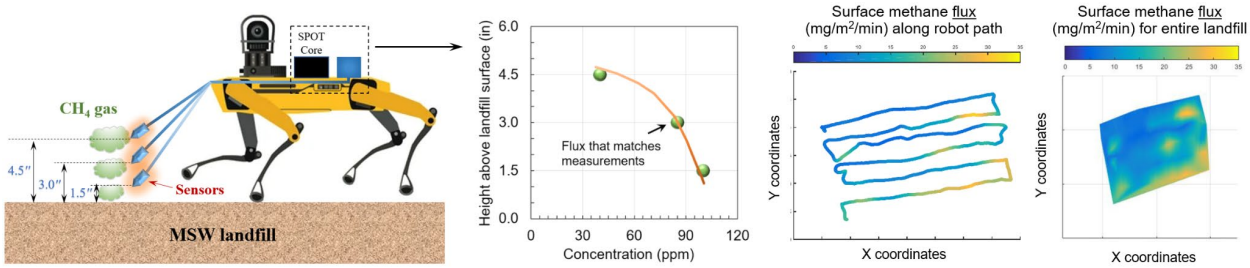


Fig. 5: Schematic showing Approach B – Derivation of methane flux from measurement of methane concentrations at three different levels above ground using terrestrial robot.

The terrestrial robot will be equipped with three methane sensors at three different levels above ground, tentatively selected as 1.5'', 3'', and 4.5'' (as opposed to only 3'' required by Method 21/SEM), although the optimum measurement heights will be explored and may be varied depending on the results. We will calculate the methane flux that matches the methane concentrations at three different levels very close to the ground and at high spatial resolutions (as shown in Fig. 5) along the robots path. We will then interpolate to derive landfill-wide methane flux or correlate these measurements to the ground conditions (type of soil, moisture, ground cracking using the high resolution optical, and infrared data) and derive using the AI model trained for flux this time, a facility-scale methane flux. We recognize the challenges of deriving methane flux from concentration data (or mixing ratios) from aerial operations, but we aim to demonstrate that this methodology will not encounter these issues due to the high resolution measurements relatively close to the ground. In deriving this methodology, we will also consider the influence of wind and the accuracy of the methane flux results and the detection limit of the sensors used.

Sub-task 2.4 Measurement of landfill gas composition (HAPs) (PSE & UCB)

We will also aim to assess landfill gas composition beyond methane, and specifically, VOCs, H_2S, with the goal to evaluate the hazardous air pollutant (HAP) and sulfur species fraction of landfill gas. Primary data collection will involve (a) VOC and H_2S concentration measurements using our terrestrial robot surveys and (b) the collection of gas samples concurrently with the robotic surveys. Samples will be collected directly from gas wells as well as from properly modified flux chambers to assess if the gas quality is similar in terms of gas fractions. Samples will be collected using passivated 1L SUMMA or Silonite-lined Entech canisters with Teflon tubing, similar to natural gas sampling methodologies employed by Michanowicz *et al*., (2022) and Lebel *et al*., (2022). Tedlar bags may also be used for sample collection depending on field conditions and available sample point access. At least one duplicate sample will be collected per site visit. Samples will be submitted to laboratories with Environmental Laboratory Accreditation

Program (ELAP) certification for analysis using U.S. EPA Method TO-15 for speciated VOCs (*e.g.*, 1,1,1-trichloroethane, 2-butanone, benzene, vinyl chloride). Samples will also be analyzed using Method ASTM D-5504 for sulfur compounds (including H_2S) and Method ASTM D-1946 for methane, ethane, elemental nitrogen, and oxygen. Direct sampling will enable the quantification of methane concentrations and ensure that pure landfill gas is collected with minimal ambient air intrusion.

The collected landfill gas composition data will be integrated into the quarterly LFG sampling & laboratory testing TRS (ASTM D-5504) data collected by the landfill and the flux chamber data, and consider the landfill site, source waste, season, meteorological conditions, and sample collection type (gas well v. flux chamber). We will also review other secondary sources of landfill gas composition including publicly available permit data, government agency or agency-commissioned reports, and peer-reviewed journal publications. Measured methane-to-VOC and sulfur species fractions from sampling will be compared to fractions measured from the robotic surveys and fractions available from secondary data sources. These fractions will be used to estimate non-methane emissions using methane emissions rates. These findings will support efforts to better understand and avert health risks to fence line communities.

Task 3: Remote Sensing of Landfills Using Satellite and Aircraft Observations (Carbon Mapper & UCB)

Observing atmospheric methane (CH4) from orbital and suborbital remote-sensing platforms has greatly improved in the last decade. Particularly, airborne imaging spectroscopy studies have shown that high-emission CH4 point sources ("super-emitters") can be reliably detected and quantified with these remote sensing platforms (Cusworth *et al.,* 2022; Duren *et al.,* 2019; Thompson *et al.,* 2016). However, prioritizing which of these detected emission sources is prime for mitigation and rapidly communicating the data to the appropriate stakeholder remain major challenges. Reducing this "hands-off" challenge barrier is critical for the adoption of remote sensing data products into stakeholder frameworks.

Carbon Mapper and JPL scientists have conducted methane point source surveys across the U.S. and Canada between 2016 and 2022 with the Next Generation Airborne Visible/Infrared Imaging Spectrometer (AVIRIS-NG) and Global Airborne Observatory (GAO). These airborne observations have fine spatial resolution (3-8 m depending on flight altitude), which enables precise attribution of a super-emitter to a specific geolocation. Those surveys include coverage of over 400 active and inactive landfills and waste diversion facilities in California (Duren *et al.,* 2019) and over 200 active landfills in 20 other US states. In previous work, we shared data with selected landfill operators which in at least one case directly informed operator remediation action and dramatic methane emission reductions (Cusworth *et al.*, 2020).

In this task, Carbon Mapper will conduct coordinated satellite and airborne remote-sensing observations at the proposed landfill pilot project sites where continuous flux chamber sensor data as well as periodic UAV and terrestrial robot data are being collected. Specifically, Carbon Mapper will provide methane remote-sensing observations as in-kind contributions as part of its recently awarded $8 million Global Waste Sector Methane Baseline initiative targeting 10,000+ landfills and waste dumps globally. This includes AVIRIS-NG and GAO flight operations across the U.S. and internationally through 2024 with <=5 meter spatial resolution and 10 $kgCH_4/hr$ detection

limit. This effort also includes Carbon Mapper methane analysis of observations from the recently launched NASA EMIT (Earth Surface Mineral Dust Source Investigation) instrument onboard the International Space Station. EMIT's coarser spatial (60-m) and spectral resolution will result in detection limits around 500 kgCH_4/hr (limited to only the highest emission landfills), but the near-global coverage enables expanded quantification of landfills - particularly in arid regions which are the focus of that mission through 2023. Finally, we will use our first two Carbon Mapper satellites (scheduled to launch in fall 2023) to landfills and dumpsites around the world with 30-meter spatial resolution and 50-100 kgCH_4/hr detection limit. In particular, we will prioritize Carbon Mapper satellite tasking of the landfill pilot projects in this study (*e.g.*, weekly to biweekly sampling). We will deliver geolocated methane plume images and instantaneous emission estimates and post all data on a public data portal (data.carbonmapper.org) as Carbon Mapper has with the nearly 8000 CH_4 plumes published to date

Task 4. Emission Data Integration for Emission Mitigation Strategies

Sub-Task 4.1. Multi-Scale Emissions Integration (UCB, Carbon Mapper and GTI

The multi-scale approaches to emissions measurements described in previous tasks will inform methane and other gas emissions estimates, which have important implications for data-driven environmental stewardship, climate change and sustainability. Thus, although in previous tasks each methodology will be assessed independently, in this task, we will make comparisons between the methodologies, the type of data collected, and the associated uncertainty in results. We will aim for a common data assimilation framework, consider the different scales and resolution, for extended durations of data acquisition with the goal to reconcile the remote sensing emission estimates with estimates derived from contemporaneous UAV and terrestrial robot observations. At the end, although in this study an extensive monitoring program is proposed, we will provide recommendations on which techniques are best suited for specific applications/objectives.

Sub-Task 4.2. Data-Driven Assessment of Emission Mitigation Strategies (UCB)

An explicit objective of the proposed monitoring is to determine the most effective mitigation strategies, including for mitigation of pollutants, that impact nearby communities. This will be achieved by relating our emission measurements to landfill management practices and, especially, mitigation activities. We will ensure that our monitoring results in actionable data to evaluate mitigation strategies. For example, we will measure before, during, and after the application of cover soils, at landfill areas where different waste separation and diversion is taking place. We will focus our observations on gas collection systems and compare our atmospheric observations with reported gas collection system data from operators. Landfill owners have committed to share their gas capture system data to support our analysis efforts. We will use our multi-scale observations to generate maps of methane hotspots across the landfill surface that can be shared with facility operators. This will allow us to better assess the influence of these strategies on emissions, as well as the type of sensing methodologies (flux point measurements with UAV data, terrestrial robot data, satellite data) that can provide credible guidance on implementation and assessment of these strategies. In considering such approaches we will leverage GTI's expertise on supporting equitable data sharing and future protocols that strengthen leak detection at landfills with an emphasis on methods that most benefit disadvantaged communities.

Sub-Task 4.3. Incentivizing mitigation strategies through carbon offsetting or other climate change mitigation funding programs (UCB)

This task is intended to unlock funding so that interventions can be deployed by operators who could not otherwise afford them. Based on the results from previous tasks, we will improve and expand financial incentives to carry out mitigation measures, using the expertise of the Berkeley Carbon Trading Project at the Goldman School of Public Policy. In the United States, landfill gas emissions reduction projects have generated the most credits on the voluntary carbon offset market (So *et al.*, 2022). However, current landfill gas offset protocols only credit landfill gas capture and destruction, constraining the protocols' ability to cost-effectively and sustainably control landfill methane emissions and reach a wide range of landfills. For example, expanding landfill gas offset protocols to include other interventions, such as biocovers has been limited by uncertainties in quantifying emissions reduced, particularly around baseline emissions.

We will develop a robust methodology for quantifying the emissions benefits from a range of interventions in order to form the basis of a new emissions reduction quantification methodology that can be used to generate carbon offsets or otherwise quantify the impact of financial support for these projects. By developing new monitoring and financing tools, we aim to improve the uptake of emissions interventions across a range of landfills.

We propose a two-part research approach:

(a) Baseline and project emissions: We will translate the emissions monitoring techniques and modeling developed in Tasks 1 to 3 into detailed methods for estimating emission reductions from a range of interventions. Refined assessment of project baselines (emissions that would likely have occurred without the intervention) has been a critical uncertainty in emissions reduction quantification to date, from project types currently able to generate offset credits (gas capture and destruction and composting) and promising emissions mitigation activities not currently eligible for carbon offsetting, such as biocovers. In particular, the multi-temporal and geospatially resolved data that we will collect from landfills will help fill key gaps in the literature on oxidation rates from landfill covers and the impacts of leachate recirculation on methane production (Chanton *et al.*, 2009; De la Cruz *et al.*, 2015; Aghdam *et al.*, 2018; Liu *et al.*, 2018; Berenjkar *et al.*, 2022). The multi-temporal data collected at the study landfills will be used to refine and improve models for quantifying emission reductions from various interventions.

(b) Additionality and sustainability: Carbon offsets have been widely criticized for overestimating, and over-crediting, program benefits by generating credit from activities that would have happened regardless of the offset incentives (projects that are *non-additional*) (Badgley *et al.*, 2021; Cames *et al.*, 2016; Haya, 2010). We will study the additionality of the current pool of US-based landfill gas capture offset projects to inform the development of an emissions quantification protocol that effectively targets mitigation that would not otherwise have happened and to accurately assess emissions impact at a programmatic level, recognizing the inherent uncertainty in determining additionality. Landfill gas offset projects have also been criticized for creating "perverse incentives" to prioritize interventions that maximize credit generation instead of broader community sustainability priorities (Cames *et al.*, 2016). Such perverse incentives will be reduced with our comprehensive protocol that credits many landfill gas interventions. This research involves mixed methods including econometrics, financial analysis of individual landfills, interviews, and trend analysis.

Task 5: Empowering Adoption by the Waste Management Industry (All with UCB Lead)

We propose activities intended to ensure that the results of this work reach and impact the solid waste industry. We will also establish a project website that will be hosted by UC Berkeley and will include all data, algorithms, methodologies, findings, reports, and publications produced from this work.

Open-Access Data, Technology, Scripts, and Protocols: The type of data across all scales generated in this study is diverse and of large size. To address this challenge, we first plan to make available through our website all the data we generate, allowing interested parties to access and employ it for additional research. We will also provide additional synthesized data and interpretations based on Sub-tasks 4.1 and 4.2 that will provide clear guidance on the ultimate methane (and other gas) outputs that will be delivered and how they can be used by the landfill industry. To facilitate data analysis by others, we will also release in open-access the data analysis scripts that we use. Finally, we will develop protocols for field measurements, as well as more robust offset protocols that will enable and encourage greater use of interventions to reduce emissions.

Scientific Publications, Education, and Training Activities: Although science is advancing and emissions monitoring technologies are declining in cost, the waste industry has struggled to employ them. This is due to a number of reasons including the lack of technical expertise, the unavailability of actionable data and the limited incentives for methane mitigation initiatives. This proposal is addressing all these points. The second and third reason are addressed in Sub-Task 4.2 and Sub-Task 4.3 respectively. To address the first one, we first plan to create outputs (*e.g.*, reports, presentations, and short courses) that explain the "what" and "how" of our sensor technology (*e.g.*, flux chambers, drones, robots) so that we can make it easier for everyone to adopt. We will also generate publications of methodologies and scientific findings in scientific journals, technical conferences, and other means intended to engage the industry. The proposing team has a strong record of publishing publications in scientific journals and conferences that will advance methane emission monitoring and interpretations. To promote industry translation of our findings, we will organize webinars and an online short course where interested engineers will be able to attend and learn about the methods, data, and results of the work that was done.

Innovation

The proposed work promotes innovation in the waste management industry and specifically on emissions by advancing sensing autonomy. Advancing autonomy does not involve only incorporating technology (i.e., wireless sensors, robots, drones and satellites), but developing the data analysis, methodology and protocols, as well as organizing the educational activities that can help the industry incorporate these approaches into their portfolio. The innovative application of a tiered, multi-scale observing system will provide more accurate and cost-effective quantification and mitigation guidance for methane and co-pollutants with implications on local public health and environmental justice.

Sustainability

This proposal was designed to address each of the EPA's three pillars of sustainability. It advances a vision where low-cost landfill sensors and technology create financial incentives to improve

waste management practices, protect fenceline communities and the climate. Specifically:

1. Environmental Pillar: We will address **stressors** and **air quality** by observing the emission of methane and its co-pollutants while establishing the basis for their reduction.
2. Social Pillar: We will work to advance **environmental justice** and **human health** by examining the constituents of hazardous air pollutants, which impact fenceline populations that are disproportionately lower-income and communities of color. By working to improve Carbon Mapper's observational capabilities, we will contribute to an effort to ensure that high-quality emissions data soon becomes available to governments and communities that might not otherwise afford it.
3. Economic Pillar: We will create new **incentives** by developing an offset protocol to reward landfill emission interventions. Meanwhile, we will lower **costs** by refining inexpensive landfill monitoring techniques for use elsewhere.

Expected Results, Benefits, Outputs, and Outcomes

This proposal is consistent with EPA's strategy (#1) on science-based decision making, as well as EPA's goals to tackle climate change, ensure clean and healthy air for all and especially under-privileged communities located in the vicinity of landfills, as articulated in EPA's 2022-2026 strategic plan. It will advance landfill methane and other gas emissions measurement and monitoring from its current state that is largely static, limited, data deficient, and often implemented reactively after much methane has already been released. It will pave new technological, scientific and financial avenues for the waste industry. Ultimately, our vision, which extends beyond the scope of this proposal, is that the methodologies proposed herein are part of "next generation smart landfills" that are operated as energy plants and treat the waste as a resource to be harvested and not a hazard to be contained, contributing to the US energy portfolio, and promoting prosperity to communities near them.

Outputs of this research:

1. Frameworks and methods for measuring methane and co-pollutants for entire landfills that can be adopted by the waste management industry. Our comparative analysis of the extensive deployment will point out the appropriate method and the procedures (frequency, timing) that should be used to monitor emissions (means: website, papers, presentations, & short course).
2. Publicly available, comprehensive emission data for methane and co-pollutants from landfills as technology demonstration to the industry (means: website).
3. A data-driven financial methodology for quantifying the emissions benefits from a range of mitigations and landfill management methodologies (such as gas system operation, biocovers, diversion of organic material, different cap configurations) in order to form the basis of a new emissions reduction quantification methodology that can be used to generate carbon offsets or otherwise quantify the impact of financial support for these projects (means: website, papers, presentations, and short course).
4. Evaluation of potential for fully or partially remote determination of emissions (means: website, papers, presentations, and short course).

Outcomes:

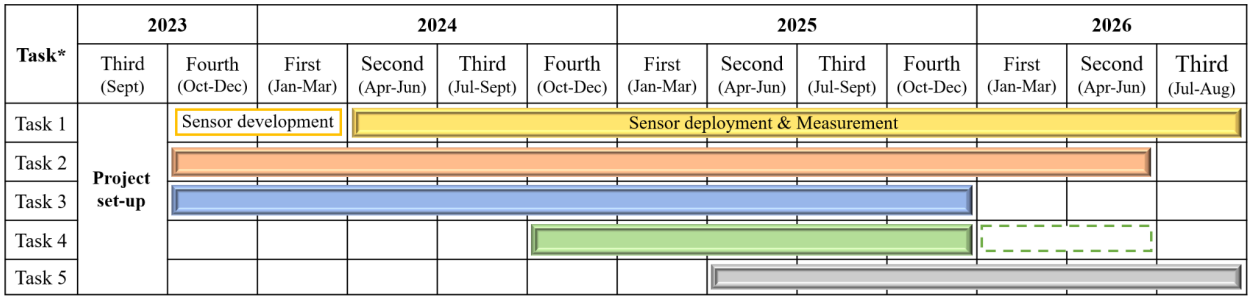
1. *Improved approaches for monitoring and quantifying emissions of methane and other gasses*

from landfills: We will develop a multi-scale landfill monitoring approach that considers methane and other gas emissions observations through integrating data across ground-based, UAV, and satellite platforms; The method is able to identify localized leaks as well as provide a landfill-scale measure of total methane flux from the landfill

2. *Increased data to inform the development of landfill emissions models and emissions inventories:* We will provide a time-continuous, high geospatial resolution data that will lead to more accurate and detailed assessment of methane emissions from landfills and serve as demonstration projects for the industry;
3. *Reduction of methane and HAPs emissions through mitigation strategies (e.g., diversion and composting programs) and waste management practices:* We will develop a crediting protocol by which the impact of site-specific landfill interventions can be assessed, measured, and financially rewarded.
4. *Improved ability to quantify methane and co-pollutants for current and expected future direction of technological progress:* We will compare, synthesize and contrast the gas data collected through the various approaches that will point towards needed improvements and methods to detect methane and co-pollutants from landfills;
5. *Better understanding of factors that affect landfill emissions that will inform strategies to reduce emissions:* By developing a standard, scalable, low-cost emissions monitoring system, that is continuous but also spatially resolved we aim to identify the key factors contributing to emissions.
6. *Mitigation of HAPs and methane emissions from landfills in and near neighboring communities:* We will reduce emissions through a greater understanding of size, scope, location, and other variables related to emissions and produce an off-the-shelf methodology for evaluating mitigation techniques at landfills sector-wide;

Project Management

Project Schedule and Management: The proposing team at UCB will have weekly in-person research meetings and engage in additional online meetings with the sub-award partners. We expect to engage with sub-award recipients on a bi-weekly or monthly basis to coordinate field activities and data analysis. The project schedule is shown in the following table. An estimated half a year is needed for methane flux deployment (Task 1) and will continue throughout the period of the grant. Field deployments of UAVs and robots will start immediately (Task 2). The team will coordinate activities with satellite and aircraft sensing (Task 3). Once data is collected and analyzed, Task 4 data integration and finances will initiate. Publications and educational material are expected in the second half of the grant 3-yr duration.



* Each task can be found in Figure 2 and the detailed descriptions are delineated in "Research Approach and Activities"

: Dotted boxes mean supplementary tasks if necessary

Facilities: The Geosystems Sensing and Analytics Laboratory (GeoSAL) which is part of UC Berkeley's Center for Smart Infrastructure, and is led by the PI, owns and operates a fleet of nine UAVs as well as Boston Dynamic's SPOT terrestrial robot that will be used for the proposed work. The UAVs are equipped with a variety of sensors including Lidar, as well as optical and infrared cameras that are mounted on the UAVs depending on the scope of the project. Carbon Mapper has access to NASA JPL's next generation Airborne/Visible Infrared Imaging Spectrometer and Arizona State University's Global Airborne Observatory for airborne surveys (funded through Carbon Mapper's airborne science program). Carbon Mapper is also funding the launch of two methane sensing satellites in fall 2023 through its partners at Planet Labs PBC and JPL.

Personnel Expertise/Experience: The proposing team is uniquely positioned to execute this work.

Dimitrios Zekkos (PI) has 20+ years of experience in landfill design, analysis, and construction quality assurance (CQA), first as a landfill design professional engineer (P.E.) in a consulting company, and subsequently as a researcher. As a researcher, he has collected field data using sensors, and UAVs at landfill sites. He has published 60+ journal and conference papers specifically on the assessment of properties of municipal solid waste (MSW), stability of landfills, closure and post-closure development and MSW degradation, as well as post-disaster UAV-enabled mapping, as well as robot-enabled measurements. The PI is also a FAA Section 107 licensed UAV pilot.

Ken Alex (Co-PI) is the Director of Project Climate at UC Berkeley Law School. Ken was a senior policy advisor to Governor Jerry Brown in California on climate and environmental issues, the director of the Governor's Office of Planning and Research, and the chair of the Strategic Growth Council. Before joining the Brown Administration, Ken was the head of the California Attorney General's Office Environment section.

Riley Duren (Co-PI) is CEO of the non-profit Carbon Mapper in Pasadena, Research Scientist at the University of Arizona, and Engineering Fellow at NASA's Jet Propulsion Laboratory. He has led methane monitoring research projects using surface, airborne and satellite observations in California over the past decade. His team has conducted remote sensing surveys of over 500 landfills across California and 20 other US states and was recently funded to initiate a new Global Waste Sector Baseline assessment of over 10,000 landfills and dump sites around the world using satellites and aircraft in the support of the Global Methane Pledge's Waste Pathway.

Barbara Haya is the Director of the Berkeley Carbon Trading Project at the UC Berkeley Goldman School of Public Policy. Barbara has studied carbon offset quality and engaged with offset program design and policy for over twenty years. Barbara holds a PhD from UC Berkeley's Energy and Resources Group.

Seth Shonkoff is the executive director of the energy science and policy research institute PSE Healthy Energy, an associate researcher in the Environmental Health Sciences Division of the School of Public Health at UC Berkeley, and an affiliate in the Energy Technologies Area at Lawrence Berkeley National Lab. An environmental and public health scientist by training, he has more than 20 years of experience in water, air, climate, and population health research at the energy interface and has published more than 50 peer-reviewed journal articles and reports.

Amanda Harmon, Senior Manager, Programs GTI Energy, is a trained microbiologist focusing on renewable natural gas from biogenic sources and emissions from the natural gas industry. Amanda is Director of Veritas-GTI Energy's Methane Emission Measurement and Verification Initiative, Risk/Integrity/Environmental program manager for Operations Technology Development, and Renewable Fuels co-chair for Low Carbon Resource Initiative.

QUALITY ASSURANCE STATEMENT

Our research team is composed of 4 research partners (UC Berkeley, Carbon Mapper, PSE Healthy Energy, and GTI Energy), contributing to different parts of the proposal and working together towards the project objectives. Our project has a significant data acquisition component and involves data collection by flux chambers deployed at each studied landfill, UAVs & quadruped-terrestrial robots, and satellites & airborne remote technologies.

The overall responsibility of quality assurance for the entire project lies with the PI, Prof. Dimitrios Zekkos, who has extensive experience with data acquisition activities and data synthesis and analyses and has been working on landfills as a researcher and consultant for 20 yrs. In the subsequent narrative, the various types of data and procedures as well as the specific responsible person for that data is identified.

Flux chambers (Responsible Person: Zekkos): In Task 1, sensors will be mounted to flux chambers. 6~7 fully autonomous, self-powered flux chambers will be deployed depending on the size of the landfill. Methane (CH_4), CO_2, NMOCs, VOCs, H_2S, temperature, relative humidity, moisture content on the ground, and the variation of methane flux in relation to changes in soil type, etc. will be measured by the flux chambers using the procedures published in Draughon et al. 2019.

UAV Remotely Sensed Data Collection and Analysis (Responsible Person: Zekkos). In Task 2, the UAV remotely sensed data that will be collected as part of this study are Lidar, optical and infrared. In addition, a Tunable Diode Laser will be used for methane concentration measurements. UAV platform will be equipped with high quality payloads to achieve centimeter-level resolution spatial sub-products in conjunction with centimeter-level positioning data (Real Time Kinematic (RTK) or Post Processing Kinematic (PPK)) captured in images metadata.

UAV Remote Sensors: Optical camera's sensor size will be no less than 1", with a full-frame sensor selection for optimal low-noise imagery acquisition in various lighting conditions. Optical camera payload will also feature a global mechanical shutter for eliminating ghosting effect (rolling shutter effect) caused by drone's frontal motion. Fixed-focus lens selection is also mandatory for the Structure-from-Motion photogrammetry and computer vision technique. Thermal camera sensors will have 640x512 pix. sensor size will be used to achieve the highest possible resolution results (a few centimeters) in the low elevation flights proposed herein (<100 m flight elevation). Thermal camera will be radiometric type to allow surface temperature measurement in every single image pixel with post-processing adjustment capabilities of basic parameters, such as emissivity, distance from the object, reflected temperature, humidity, etc. The drone-mounted Lidar unit will feature a laser scanner with a scan rate of 240.000 pts/sec, supporting 3 returns for a maximum of 720.000 pts/sec and 70º field of view.

UAV Data Acquisition: Optical imagery will be acquired along cross-gridded flight patterns for well established elevation models with mitigated systematic surface distortions such as the dome effect in flat areas. Primarily oblique camera angles of 70º will be selected for still image capturing. Flight patterns will feature a frontal overlap of 80% and a side overlap of at least 70% for ensuring increased number of connections across and between distant images. Radiometric thermal imagery will be acquired to generate thermal orthophotos. This requires quick acquisition plans. Single grid missions will be performed with high frontal and side overlaps (>80%) at proposed flight elevations of less than 50 meters above terrain for efficiently measuring approx. 50 cm surface dimension elements (see FLIR UAS Technical Note). The emissivity and reflectivity of the terrain surface will be considered. Lidar acquisition plan consists of overlapping scanning strips. To the degree possible, acquisition plans will be kept identical between consequent

flight surveys to facilitate 3D surface comparison analyses. Several well established ground control points on stable ground will also be acquired and measured during every survey, serving as base points for RTK measurements and as elevation check points during post processing. UAV should stay within a <1 km distance from the GNSS base station or keep a stable cellular connection in case of Networked Transport of RTCM via Internet Protocol (NTRIP) connection for receiving real time corrections.

Data Analysis and Error Assessment: Optical and thermal imagery processing for landfill 3d reconstruction with Structure-from-Motion (SfM) photogrammetric and computer vision technique is described in quality reports which list camera calibration results with optimized internal parameters, final external parameters (camera positions and rotations), camera positions uncertainties, quality measures and uncertainties on tie points, photo coverage, reprojection error per tie point, and control points errors. Camera position uncertainties should be within the range of up to 2 cm, with fixed values from RTK or PPK processing. Number of observations (camera views) per tie point should be targeted to minimum three while a value of 0.5 for tie points reprojection error is considered optimal. For Lidar post-processing quality control, error reports are generated for georeference process, boresight correction and trajectory adjustment. 3D point cloud accuracy is finally checked by an elevation difference report between the point cloud and ground control points, which can be used to check the elevation accuracy of the point cloud and use the calculated correction values to improve the elevation accuracy of the point cloud data.

In addition, in Task 2, UAVs and Boston Dynamics' terrestrial robot equipped with gas sensors will be deployed at the landfill site. For methane data collection a tunable diode laser is going to be used that has been verified to collect high accuracy methane concentration data. For non-methane gases (*i.e.*, H_2O and VOCs) collection, Gas Sensitive Electrochemical (GSE) and Photo Ionization Detector (PID) sensors are going to be used to collect data. The accuracy of sensors will range from 0.01 ppm to 0.1 ppm depending on the concentration range. The data collected by the robots and the UAVs will be georeferenced with an RTK GPS unit.

Landfill Gas Composition Data Collection and Analysis (Responsible Person: Shonkoff): Twenty landfill gas samples for laboratory testing will be collected from gas wells and/or flux chambers at 1 to 2 landfill sites in California. Passivated 1 L SUMMA or Silonite-lined Entech canisters prepared by a commercial environmental testing lab with Teflon tubing to form a direct in-line connection with a gas sampling well valved outlet and/or a valved outlet on the flux chamber. From each sampling point, we will apply Teflon-lined tubing to tightly enclose the orifice outlet, minimizing potential for ambient air entrainment. After flushing the hosing, the canister will be connected and filled until the vacuum on the canister is between -5 and 0 in Hg. Gas samples will be analyzed by a laboratory with Environmental Laboratory Accreditation Program (ELAP) certification. Samples will be analyzed using U.S. EPA Method TO-15, which calls for sample separation and analysis by gas chromatography and mass spectroscopy. Samples will be analyzed by the lab within 30 days of collection—the maximum hold time specified by the TO-15 method during which concentrations are considered stable. Each sample will also be analyzed using Method ASTM D-5504 for sulfur compounds (including H_2S) and Method ASTM D-1946 for methane, ethane, elemental nitrogen, and oxygen. Chain of custody forms will be maintained for all samples. Several quality control measurements will be collected and steps will be taken throughout this study, in addition to blanks and other quality checks performed directly by the laboratories. For example, at least one duplicate sample will be collected during each field visit from each sampling point type (e.g., gas well or flux chamber). Additionally, methane, nitrogen and oxygen measurements will be used for quality control to ensure pure gas sample

collection and to verify minimal ambient air intrusion during sampling. Gas composition analyses will rely on methods similar to those employed by Michanowicz et al. (2022) and Lebel et al. (2022).

Satellite Data Collection and Analysis (Responsible Person: Duren): In Task 3, satellite and aircraft imaging spectrometers will repeatedly map the pilot landfills (and a much larger population of global landfills) to detect and quantify methane point source emissions. The satellite/aircraft overflights will be coordinated with drone and surface observations to achieve maximum simultaneity. Satellite/aircraft overflights will typically occur within ± 2 hours of local noon for maximum solar illumination and radiometric performance (during which time the atmosphere is also generally well mixed, with minimum pooling at landfills) and in most cases, a single observation can capture the entire landfill and surrounding areas. Observations will be repeated as quickly as possible based on cloud cover and tasking priorities. For aircraft, many overflights in a given day are possible with revisit intervals as short as 10 minutes. For satellites, revisit intervals for the pilot landfills will initially range from several days to several weeks but can be routinely scheduled to continue for multiple years. As described in Cusworth *et al.* (2020) and Duren *et al.* (2019), our survey strategies are designed to provide enough samples to ensure that a statistically significant estimate can be made of source variability/persistence over the life of the experiment. All raw data from the aircraft and satellite imaging spectrometers undergo spectral and radiometric calibration using a combination of ground test data and ongoing calibration measurements during operations (typically for each flight line for the aircraft and every orbit for the satellites) with methods as described by Chapman *et al.* (2019). Carbon Mapper's data analysis workflow includes the following elements (described in Duren *et al.,* 2019): 1) process calibrated radiance files for each flightline to generate screening flags for clouds, flaring and other potential artifacts, 2) run methane retrieval algorithms on each flight line, 3) manual and automated plume detection to identify and segment potential methane plume candidates, 4) quick-look plume image generation with estimated coordinates for plume origin, 5) automated Integrated Methane Enhancement (IME; methane mass in each plume) and plume length estimation), 6) emission rate and uncertainty quantification (combining output of step 5 and surface wind speed data from NOAA reanalysis products), g) source persistence (frequency) and average source emission rate calculation after multiple observations, 7) attribution of source to emission sector, equipment type and/or process, 8) delivery of refined plume images and plume/source lists with relevant meta-data for comparison with methane emission rates and spatio-temporal distribution of sources derived from other measurement methods and public release through the Carbon Mapper data portal. Error estimates (presented as ± 1 standard deviation) are reported with all key quantities including IME, wind speed, and emission rate (described in Duren *et al.,* 2019). Each of the above steps involves manual review in the Carbon Mapper QC Portal by human analysts using a standard protocol for flagging suspect images or calculations. That QC protocol rejects unsatisfactory images and/or quantitative products based on a variety of factors informed by empirical field experience and analysis including but not limited to: spectral and image artifacts due to clouds, flares, and anomalous surface features; methane plume shape/aspect ratio; and anomalous wind conditions. Only data products that pass QC review are released. In terms of validation of Carbon Mapper methane data products, we have conducted validation experiments (Duren *et al.*, 2019) and continue to apply the following methods to provide independent evaluation.

The project also involves the collection of secondary data primarily from our landfill partners, who have committed to provide it to us and work with us to synthesize the data and understand the source, procedures followed and quality of the data.

EPA HUMAN SUBJECTS RESEARCH STATEMENT

This research does not involve human subjects.

SCIENTIFIC DATA MANAGEMENT PLAN

I. Types of Scientific Data and Metadata expected to be generated or collected

This project will generate a variety of research data and end products intended to promote environmental stewardship and data-driven decision making. Data that will be collected include:

1. Multi-sensor data collected by flux chambers; There will be two sub-datasets of field data: (a) raw field data; and (b) processed sensor data;
2. Geospatial optical, infrared, and lidar data collected by the UAVs and satellites.
3. Methane and other gas concentration data collected by the UAVs and the terrestrial robots.
4. Data from gas samples
5. Scientific publications as well as other online resources aimed at educating professionals.

II. Location where the data will be publicly available

The data will be available through our project's website, which is expected to be a Drupal website hosted by UC Berkeley. Although the website will serve as the "front face" of the project, dataset(s) resulting from this research will be shared via the generalist repository Dryad, which provides metadata, persistent identifiers (i.e., DOIs), and long-term access. Dryad is the institutional data repository supported by the University of California and all data is shared under a CC0 waiver, which makes the dataset(s) publicly available. Data will be made available as soon as possible or at the time of associated publication. Associated code/scripts to the deposited datasets will be shared via Zenodo through use of Dryad. Dryad datasets are backed up to Merritt, the UC's CoreTrustSeal-certified digital repository, for long-term storage and accessibility. Procedures in place to ensure dataset preservation include storage of data files in multiple geographic locations, regular audits for fixity and authenticity, and succession plans in the event of repository closure.

III. Standards to be used for data and Metadata format and content.

The research project's website will be based on a MySQL database that will mirror, in structure, the proposal tasks. Overall responsibility for updating, uniformity, and consistency will be the responsibility of the PI (Zekkos) with the support of a student. Co-PIs and senior collaborators will be responsible for updating each section of the website related to their Thrust.

The data format will vary depending on the type of data. All raw field data will be available as ASCII files. Processed data will be available as Excel or Matlab files. UAV optical still images raw data will be available in DNG (raw format), TIFF, or JPEG formats, and infrared still images raw data will be available in Radiometric JPEG or 14-bit TIFF formats. Video data will be MOV or MP4 formats. Processed rasters (orthophotos, surface models) extracted from optical or thermal data will be available in GEOTIFF, JPEG2000, or ECW formats with georeference information embedded or in external text world files. Lidar data will be available in XYZ ASCII format or in LAS and E57 binary formats. Satellite optical imagery will be available in GEOTIFF format. Published works will be available in pdf files (for those publications that copyright permission is released; otherwise pre-publication copies will become available). Presentations from the symposia and other educational materials will become available in powerpoint.

IV. Policies for Access and Sharing data and policies and Provisions for Re-use, Re-distribution, and the Production of Derivatives:

During the duration of the project and after its completion, the data, models, algorithms, and curriculum materials will be available to all of the team members and the international collaborators. The team will also aim to publicly release the data as early as possible but no later than 90 days after the publication of timely scholarly journal articles that fully utilize the data. The data generated will be available for re-use from the research project's website. An acknowledgment of the source of the data, as well as the funding agency (Environmental Protection Agency), will be required.

V. Plans for digital data storage, archiving, and long-term preservation

All data/findings generated from this research project will become available through a dedicated website during and after the project. The University's server that will host the data is backed up regularly to an off-site university data storage facility to ensure no data is lost if hardware failure were to occur.

VI. Description of how data accessibility and preservation will enable validation of published results.

Papers that use data generated as part of this study, will reference the source data and provide a link to them, so that interested individuals will be able to access them and use them for validation. Meta-data on the use of the data will be provided to guide the user.

VII. Roles and responsibilities for ensuring SDMP implementation and management

The PI, Prof. Dimitrios Zekkos, will be the individual responsible for ensuring the data management plan is executed as described herein. Co-PIs and collaborators commit to having their data shared, unless they are copyrighted by others, or otherwise restricted. The implementation will be conducted by the post-doc and PhD student who will ensure all the data is posted during the duration of the project as well as upon completion of their engagement in the project.

VIII. Resources and capabilities requested in the research application to meet the stated goals for accessibility and preservation

All the resources needed for scientific data management are incorporated into the practices of research at UC Berkeley and are supported by the indirect costs paid at UC Berkeley.

EARLY CAREER VERIFICATION

This proposal does not include an early career element.

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UC Berkeley BUDGET JUSTIFICATION

PERSONNEL: $295,903

Professor Dimitrios Zekkos (PI), at the University of California at Berkeley, will be the Principal Investigator (PI) of this project and will provide overall direction and oversight of the project. He will be responsible for tracking budget and deliverables, conducting outreach and evaluating research progress. The amount budgeted is .50 month per year at an annual salary of $162,968.

Ken Alex (Co-PI): Ken Alex is the Director of Project Climate at CLEE. In this capacity, he will provide oversight and input regarding project approach, research management, and other methodological and operational questions. He will be committing his time as needed to the project.

Research Fellow or Director TBD: A CLEE research fellow or program director will provide the full-time staffing support and project management for the work in this proposal. The fellow or director, in conjunction with Dimitrios Zekkos and Ken Alex, will determine parameters of project scope, research, and methodology, and organize outreach events, draft policy reports, attend in-person events, facilitate workshops, and otherwise focus on overall implementation. They will be committing 5.76 calendar months to the project, at an annual salary of $90,000.

Barbara Haya (Senior Collaborator), 12.5% FTE in year 1 (nine months) and 10% FTE in year 3 (twelve months) is budgeted at an annual salary of $94,952. Barbara Haya will lead the study of the outcomes of current landfill gas capture offset protocols in year 1. She will help guide the development of a new offset methodology in year 3.

Post-doc: One post-doc for the first year is budgeted at 82% at an annual salary of $65,000. The post-doc will work on preparing the permanent flux chamber sensors and deploy them. He will also assist the graduate student in the field work and work to integrate the two methodologies. The postdoc is budgeted at 6.0 calendar months per year.

Salary for **one graduate student** is provided at 49.5% during the academic year and 100% during the summer for each year. The graduate student researcher salary is the standard wage for a current GSR UC Berkeley. The graduate students will conduct research as part of the scope of work described. GSR's will contribute to aspects of experimental design, data analysis and synthesis of results with emphasis on UAVs and terrestrial robots, as well as the integration between flux chambers, robots and satellites. Annual Salary is $59,088. A **second graduate student** is budgeted to work with Barbara Haya (with as needed assistance by Dimitrios Zekkos and Ken Alex) in year 1, at 50% during the academic and summer months. The graduate student researcher will perform quantitative and qualitative research on the outcomes of current landfill gas offset protocols in the United States. Annual Salary is $59,088.

Escalation of 4% is based on cost of living increases, which are given on average 2% each year (COLA), and merit increase on average at least 5% every other year, which on average makes 4% a year an accurate estimate of increase. Merit requests can be submitted every 2 years and our proposals are an estimate where we assume the possible liability in the future. Salaries are based on 10/1/22 actual salary rates.

Position Title	Annual Salary	% of Time Assigned to Project	Base Fringe % Rate	Year 1 Salary	Year 1 Fringe Costs	Year 2 Salary	Year 2 Fringe Costs	Year 3 Salary	Year 3 Fringe Costs	Total Salary	Total Fringe
Principal Investigator	$162,968	50%	16.4%	$ 9,054	$1,485	$ 9,416	$1,544	$ 9,793	$1,606	$ 28,262	$ 4,635
Research Fellow/Director	$ 90,000	16%	35.9%	$14,400	$5,170	$14,976	$5,376	$15,575	$5,591	$ 44,951	$ 16,137
Senior Collaborator	$ 94,952	Y1 13%, Y3 10%	35.9%	$ 8,902	$3,196	$ -	$ -	$10,270	$3,687	$ 19,172	$ 6,883
Postdoc Scholar Employee	$ 65,004	82%	16.4%	$53,303	$8,742	$ -	$ -	$ -	$ -	$ 53,303	$ 8,742
Graduate Student Researcher 1	$ 59,088	50% acad, 100% summer	2.4%	$38,309	$ 919	$39,843	$ 956	$41,436	$ 994	$119,588	$ 2,870
Graduate Student Researcher 2	$ 59,088	50% acad + Summer	2.4%	$30,628	$ 735	$ -	$ -	$ -	$ -	$ 30,628	$ 735

FRINGE BENEFITS: $145,073

The University of California, Berkeley, Composite Benefit Rates (CBR) have been reviewed and federally approved by the Department of Health and Human Services (DHHS) for use by all fund sources for FY21. Rates beyond June 30, 2021 are estimates and are provided for planning purposes only. Future CBR rates are subject to review and approval by DHHS on an annual or bi-annual basis. The DHHS-approved fringe benefit rates are available online at: http://spo.berkeley.edu/Policy/benefits/benefits.html.

Graduate Student Tuition Remission:

The University of California provides full remission of tuition, fees, and graduate student health insurance to all graduate students who are employed on-campus 45% time or greater during the academic year. For FY22-23, the rate for in-of-state remission is $10,841.00 per semester, which is escalated annually in the budget at a rate of 4% each year. In year 1, one non-resident student is budgeted that includes a nonresident tuition amount of $7853 per semester. Additional information regarding the fee remission program and fees can be found at: http://grad.berkeley.edu/financial/fee-remissions/ and https://registrar.berkeley.edu/tuition-fees-residency/tuition-fees/fee-schedule.

TRAVEL - $15,512 is budgeted for several field deployments at the study landfills as well as attendance of one conference per year, in year 2 and 3. The exact number of trips will evolve depending on the scope of work, but overall, involves several trips (9 in year 1, 7 in year 2 and 6 in year 3)to the target landfills at a budget of $550 per trip. Purpose of trips will be to deploy sensors, repair them and deploy robots. Deployments to California by car are likely to be a bit cheaper and deployments in Michigan by plane are likely to be higher. In addition, $1,937 is budgeted for travel expenses to a conference in yr2 and yr3. If these funds are not adequate, they will be supplemented by additional resources.

We will not use EPA funds for foreign travel without approval by EPA. Based on prior experience.

Year1:

TRAVEL	**Domestic Travel for technical meetings for technical deployment**						
		Trips:	9	Days:	1	Subtotal	
			Traveler:		1.0	4,761	
						0	
	Gas or airfare	$200	Taxi:		$50	**4,761**	
	Meals	$79	Conf. Reg. PI		$0		
	Hotel	$200	Conf. Reg. Student		$0		

Year2:

TRAVEL	**Domestic Travel for technical meetings:**						
		Trips:	1	Days:	3	Subtotal	
			PI Travelers:		1.0	1,937	
						0	
	Airfare	$600	Taxi:		$0	**1,937**	
	Meals	$79	Conf. Reg. PI		$500		
	Hotel	$200					
TRAVEL	**Domestic Travel for technical meetings for technical deployment**						
		Trips:	7	Days:	1	Subtotal	
			Traveler:		1.0	3,703	
					0.0	0	
	Gas or airfare	$200	Taxi:		$50	**3,703**	
	Meals	$79	Conf. Reg. PI		$0		
	Hotel	$200	Conf. Reg. Student		$0		

Year 3:

TRAVEL	**Domestic Travel for technical meetings:**						
		Trips:		1	Days:	3	Subtotal
				PI Travelers:		1.0	1,937
				Student Travelers:		0.0	0
	Airfare	$600		Taxi:		$0	**1,937**
	Meals	$79		Conf. Reg. PI		$500	
	Hotel	$200					
TRAVEL	**Domestic Travel for technical meetings for technical deployment**						
		Trips:		6	Days:	1	Subtotal
				Traveler:		1.0	3,174
						0.0	0
	Gas or airfare	$200		Taxi:		$50	**3,174**
	Meals	$79		Conf. Reg. PI		$0	
	Hotel	$200		Conf. Reg. Student		$0	

EQUIPMENT - None

SUPPLIES – A total of $30,371 is budgeted. Supplies include miscellaneous expendable research supplies necessary for completion of the project. This includes software and hardware for the field data acquisition and analysis, such as sensors, electronics, computing, and robot supplies such as robot components, batteries and sensors. Based on prior experience

WORKSHOP - $1,124 will cover a workshop among landfill gas and offsets practitioners and researcher in Year 3 to receive feedback on proposed offset methodology. Funds will cover lunch and travel for non-local participants. Based on prior experience.

OTHER: SUBAWARDS -- The following non-profit institutions are included as subawards:

Carbon Mapper (Dr. Riley Duren, Co-PI) - $111,979: Will coordinate sensing using satellite-based approach and work with UCB team on sensing technologies comparison and integration.

PSE Healthy Energy (Seth Shonkoff, Senior Collaborator) - $68,000: Will perform HAP testing from gas samples to supplement field sensing

GTI Energy (Amanda Harmon , Senior Collaborator)- $55,000: Will work with UCB to create formal and equitable protocols for methane emissions especially for disadvantaged communities and the influence on methane model prediction results.

INDIRECT COSTS: $277,037. Indirect costs are based on University negotiated rates with the cognizant federal authority and are applied at a rate of 60.5% for the entire project period using the modified total direct cost (MTDC) formula as per the approved rate agreement dated (6/25/20 of current Agreement). Modified total direct costs exclude equipment, capital expenditures, charges for patient care, student tuition remission, participant support costs, rental costs of off-site facilities, scholarships, and fellowships as well as the portion of each subgrant and subcontract in excess of $25,000. For more information, please see: https://spo.berkeley.edu/policy/fa.html. The rates after (6/30/22) are provisional and subject to change based upon our updated federally negotiated indirect cost rate agreement.

Biographical Sketch

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PROFESSIONAL PREPARATION

University of Patras	Civil Engineering	5-yr Diploma, 2001
University of California, Berkeley	Civil and Environmental Engineering	MSc, 2002
University of California, Berkeley	Civil and Environmental Engineering	PhD, 2005

APPOINTMENTS

7/22 - current	Professor, Department of Civil and Environmental Engineering, University of California at Berkeley, CA
1/20 – 6/22	Associate Professor, Department of Civil and Environmental Engineering, University of California at Berkeley, CA
06/14 – 12/19	Associate Professor, Department of Civil and Environmental Engineering, The University of Michigan, Ann Arbor, MI
09/17 – 12/19	Associate Professor, Department of Earth and Environmental Science, The University of Michigan, Ann Arbor, MI
09/08 – 06/14	Assistant Professor, Department of Civil and Environmental Engineering, The University of Michigan, Ann Arbor, MI
11/05 - 7/08	Engineer, Geosyntec Consultants, Oakland, CA.
07/02 - 10/05	Research Assistant, Department of Civil and Environmental Engineering, University of California, Berkeley, CA
08/01 – 05/02	Teaching Assistant, Department of Civil and Environmental Engineering, University of California, Berkeley, CA

FIVE MOST CLOSELY RELEVANT PRODUCTS

1. Datta, S., and Zekkos, D. (2021). The Influence of Waste Composition on Landfill Gas Generation Model Parameters, Environmental Geotechnics https://doi.org/10.1680/jenge.20.00058
2. Zekkos, D., Datta, S., Fei, X. (2021). Coupled process modeling for energy generation from municipal solid waste degradation: Laboratory-scale and field-scale simulations, 3rd International Symposium on Coupled Phenomena in Environmental Geotechnics, 20-21 October 2021, Kyoto, Japan (keynote lecture).
3. Champagne, C. L., Zekkos, D., Lynch, J. P., and O'Loughlin, S. (2020) "Waste Settlement Measurements using Unmanned Aerial Vehicles at a Municipal Solid Waste Landfill in

Michigan, Geo-Congress 2020 : Geo-Systems, Sustainability, Geoenvironmental Engineering, and Unsaturated Soil Mechanics.
4. Draughon, G. T., Lynch, J. P., Zekkos, D., & O'Laughlin, S. (2019). Development of an autonomous flux chamber for continuous methane measurements at MSW landfills. Sardinia 2019.
5. Bateman, J., Zekkos, D., Olson, E., Messenger, S., Kershaw, C., Fei, X., and Lynch, J. (2016) Preliminary Observations from Robot-Enabled Surface Methane Concentration Monitoring at a MSW Landfill. Geo-Chicago 2016: pp. 740-749. doi: 10.1061/9780784480168.072

FIVE OTHER SIGNIFICANT PRODUCTS

1. Datta, S., Zekkos, D., Fei, X., McDougall, J. (2018). Waste-composition-dependent 'HBM'model parameters based on degradation experiments, Environmental Geotechnics, *Environmental Geotechnics*, 1-10.
2. Fei, X., Zekkos, D. (2018), "Coupled experimental assessment of physico-biochemical characteristics of municipal solid waste undergoing enhanced biodegradation" *Geotechnique*, DOI: 10.1680/jgeot.16.p.253
3. Fei, X., Zekkos, D. (2017), "Comparison of Direct Shear and Simple Shear Response of MSW", Environmental Geotechnics Journal, September 2017, DOI: 10.1680/jenge.16.00036
4. Bray, J. D., Zekkos, D., Kavazanjian, E., Jr., Athanasopoulos, G. A., and Riemer, M. F. (2009). "Shear Strength of Municipal Solid Waste." *Journal of Geotechnical and Geoenvironmental Engineering*, ASCE, Va., 135 (6), 709-722. → Awarded 2010 Middlebrooks Award by the American Society of Civil Engineers
5. Zekkos, D., Kabalan, M., and Flanagan, M. (2013). "Lessons Learned From Case Histories of Dynamic Compaction of Municipal Solid Waste Sites." *ASCE Journal of Geotechnical and Geoenvironmental Engineering*, Va., 139(5), 738-752. → Awarded the 2014 Collingwood Prize by the American Society of Civil Engineers

FIVE SYNERGISTIC ACTIVITIES

1. Board Member, International Society for Soil Mechanics and Geotechnical Engineering (ISSMGE), 2022-current.
2. Editor-in-Chief, ISSMGE International Journal of Geoengineering Case Histories (2017-current)
3. Co-Director, Center for Smart Infrastructure, UC Berkeley, 2021- present.
4. Chair, ASCE Geo-Institute Geoenvironmental Engineering Technical Committee (2015-2021)
5. Conference Chair, 9th International Congress on Environmental Geotechnics, 25-28 June 2023, Chania, Greece https://iceg2023.org/

KEN ALEX

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EDUCATION

Harvard Law School
J.D. 1983, cum laude

University of California at Santa Cruz
B.A. 1979, political theory
Highest Honors in major
General College Honors
Honors on Oral Comprehensive Exam

University of Sussex, England
Junior year, 4.0 gpa

EMPLOYMENT

Policy

2019- Director, Project Climate
https://www.law.berkeley.edu/research/clee/research/climate/projectclimate/
University of California, Berkeley

2011-2018 Senior Policy Advisor to Governor
Director, Governor's Office of Planning and Research
Chair, Strategic Growth Council
California Governor Jerry Brown
Multiple citations, including 2020 Order of Merit, highest award of German State of Baden Wurttemberg

Legal

2008-2011 Senior Assistant Attorney General
California Attorney General, Environment Section
Co-head, Global Warming unit

1990-2008 Supervising Deputy Attorney General

California Attorney General, Environment Section
1991 Attorney General's Award for Outstanding Achievement
1997 U.S.DOJ Certificate of Commendation
2001 Attorney General's Award for Excellence

2007 ABA Award: Distinguished Achievement in Env. Law and Policy
2008 Ecology Law Quarterly Leadership Award

Office Management Committee

2001-05 Acting Senior Assistant (2001-02, 2004-05), Sup. Deputy Attorney General

California Attorney General, Energy Task Force
Investigation and prosecution in relation to CA energy crisis
2003 Attorney General's Team Award

2004 Attorney General's Award for Sustained Superior Accomplishment

2004 California Lawyer Magazine Attorney of the Year Award

1985-1990 Deputy Attorney General
California Attorney General, Environment Section

1983-1985 Court Law Clerk
United States Court of Appeals for the Ninth Circuit
Clerk to Judge Pregerson (loan), May-June 1984
Clerk to Judge Nelson (loan), July-August 1985
Division Chief, September 1984--September 1985

1982-1983 Legal Research
Professors Dershowitz, Edley, Estrich, Cambridge, MA
Appeal of Claus von Bulow

Teaching

Spring 1998, Fall 1999, 2000 Summer 2007 — Adjunct Professor
Golden Gate University Law School, San Francisco, CA
"California Environmental and Natural Resources Law" and "Global Warming and the Courts"

Spring 1994 — Visiting Professor
Spring 1996 — Adjunct Professor
Hastings College of the Law, San Francisco, CA
Classes: Environmental Statutes; Environmental Practice. Also in charge of Environmental Externship/Clinical Program

Fall 1987, 1989, 1990 — Visiting Instructor (SWOPSI)
Stanford University, Stanford, CA
"Toxic Waste, Social and Political Responses,"
"Environmental Degredation and Social Change"

PUBLICATIONS ***The Brothers in Law***, a weekly syndicated law column (1984-87); Chapter in Rechtschaffen and Antolini, "Creative Common Law Strategies for Protecting the Environment," ELI Press (2007); "A Period of Consequences: Global Warming as a Public Nuisance," 43A Stanford J. Internl L. 77 (2007); 26A Stanford Env. L. J. 77 (2007); "Merging Paleobiology With Conservation Biology to Guide the Future of Terrestrial Ecosystems," Barnosky et al., Science 355, 594 (2017) (co-author); "Well Under 2 Degrees Celsius: Fast Action Policies to Protect People and the Planet from Extreme Climate Change," Ramanathan, et al. (2017) (co-author)

SPEAKING numerous speeches re environmental and litigation issues at law schools, seminars, and conferences around the world; multiple UN and related events

OTHER Climate and Wildfire Institute Board President; Carbon Business Council Board Member; Earth Island Institute Board Member; Project Silicon Valley Board Member; John Muir Institute, UC Davis; Executive Committee, Environment Section, State Bar of California; Advisory Board, Environmental Law Advisory Board, Golden Gate University Law School; "West/Northwest" Journal Advisory Board, Hastings College of the Law; Chair, Western States Hazardous Waste Project; Advisory Board, Energy Policy Initiatives Center (University of San Diego); Primary Architect: Under2 MOU and Under2 Coalition (www.under2coalition.org)

Riley M. Duren
Chief Executive Officer, Carbon Mapper;
Research Scientist, University of Arizona;
Engineering Fellow, NASA Jet Propulsion Laboratory
rduren@arizona.edu

RELEVANT EXPERIENCE

Principal investigator for 10+ carbon cycle, methane and decision-support projects. My teams combine atmospheric measurements from satellites, aircraft and surface-based systems, tracer transport modeling, machine learning, and big data methods to detect, quantify and attribute greenhouse gas emission sources. Systems engineering, design, management, and operations for 10 space missions and NASA's earth science enterprise. CEO for the non-profit organization Carbon Mapper with public good mission to deliver actionable methane and CO2 emissions data globally.

Professional Experience

CARBON MAPPER, Pasadena, California
- 2020-present, Founder and Chief Executive Officer

UNIVERSITY OF ARIZONA, Tucson, Arizona
- 2019-present, Research Scientist

JET PROPULSION LABORATORY, CALIFORNIA INSTITUTE OF TECHNOLOGY, Pasadena, California
- 2017 – present, Engineering Fellow
- 2008 – 2019, Chief Systems Engineer, Earth Science & Technology Directorate
- 2002 – 2009, Chief Engineer & Project System Engineer, Kepler mission
- 2000 – 2002, Instrument System Engineer, Starlight mission
- 1996 – 2000, Metrology System Engineer, Shuttle Radar Topography Mission (SRTM)

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION, Kennedy Space Center, Florida
- 1988 – 1995, Payload Integration, Test and Operations Engineer (five space shuttle missions)

EDUCATION

- Auburn University, Bachelor of Science, Electrical Engineering, 1991

SELECTED COMMITTEE SERVICE

- National Academy of Science: Committee on Earth Science and Applications from Space (2022-present)
- National Academy of Science: Committee on Developing a Research Agenda for Carbon Dioxide Removal and Sequestration (2017-2018)
- United States Carbon Cycle Science Program: 2nd State Of the Carbon Cycle Report – Writing Team, Decision Support and Urban Chapters (2016-2018)

SELECTED PUBLICATIONS

1. **Duren, R.,** D. Gordon, 2022, Tackling unlit and inefficient gas flaring, *Science*.
2. Evan D. Sherwin[1,*], Jeffrey S. Rutherford[1], Zhan Zhang[1], Yuanlei Chen[1], Erin B. Wetherley[2], Petr V. Yakovlev[2], Elena S.F. Berman[2], Brian B. Jones[2], Daniel H. Cusworth[3], Andrew K. Thorpe[5], Alana K. Ayasse[3], **Riley M. Duren**[3,4,5], Adam R. Brandt, 2022, Quantifying oil and natural gas system emissions from six regions using over one million aerial site measurements, submitted, 2022.
3. Cusworth, D.H. A.K. Thorpe, A.K. Ayasse, D. Stepp, J. Heckler, G. P. Asner, C. E. Miller, J.W. Chapman, M. L. Eastwood, R.O. Green, B. Hmiel, D. Lyon, and **R M. Duren,** 2022. Strong methane point sources contribute a disproportionate fraction of total emissions across multiple basins in the U.S., *Proc. Nat. Aca. Sci*., https://doi.org/10.1073/pnas.2202338119
4. Jacob, D. J., Varon, D. J., Cusworth, D. H., Dennison, P. E., Frankenberg, C., Gautam, R., Guanter, L., Kelley, J., McKeever, J., Ott, L. E., Poulter, B., Qu, Z., Thorpe, A. K., Worden, J. R., and **Duren, R. M.,** 2022:

Quantifying methane emissions from the global scale down to point sources using satellite observations of atmospheric methane. *Atmos. Chem. Phys.* https://doi.org/10.5194/acp-2022-246 .

5. Hmiel, Benjamin, David Lyon, Jack Warren, Jevan Yu, Daniel Cusworth, **R. Duren**, Steven Hamburg, Empirical Quantification of Methane Emission Intensity from Oil and Gas Producers in the Permian Basin, *Env. Res. Lett.,* in revision, *Env. Res. Let.,* 2022.
6. Lauvaux, T., C. Giron, M. Mazzolini, A. d'Aspremont, **R. Duren**, D. Cusworth, D. Shindell, P. Ciais, 2022. Global assessment of oil and gas methane ultra-emitters, *Science*, https://www.science.org/doi/10.1126/science.abj4351
7. A. K. Ayasse, A.K. Thorpe, D. H. Cusworth, E. A. Kort, A. G. Negron, J. Heckler, G.P. Asner, **R. M. Duren**, 2022. Methane remote sensing and emission quantification of offshore shallow water oil and gas platforms in the Gulf of Mexico, https://iopscience.iop.org/article/10.1088/1748-9326/ac8566/meta
8. J. R. Worden, D. Cusworth, Z. Qu, Y. Yin,Y. Zhang, A. Bloom, S.Ma, B. Byrne, T. Scarpelli, J. D. Maasakkers, D. Crisp, **R. Duren**, and D.J. Jacob, 2021. The 2019 Methane Budget and Uncertainties At 1 Degree Resolution and Each Country, Through Bayesian Integration Of GOSAT Total Column Methane Data and a priori Inventory Estimates, *Atmo. Chem. Phys.*
9. D H. Cusworth, **R.M. Duren,** A. K. Thorpe, W. Olson-Duvall, J. Heckler, J.W. Chapman, M. L. Eastwood, M. C. Helmlinger, R. O. Green, G. P. Asner, P. E. Dennison, and C. E. Miller, 2021. Intermittent methane emissions in the Permian basin. *Environ. Sci. Technol. Lett. 8, 7, 567–573.*
10. Irakulis, I., L.Guanter, Yin-Nian Liu, D.J. Varon, J. D. Maasakkers, Y.Zhang, A. K. Thorpe, **R. M. Duren**, C. Frankenberg, D. Lyon, D. H. Cusworth, Yongguang Zhang, K. Segl, J. Gorrono, E. Sanchez-Garcıa, M. P. Sulprizio, K. Cao, H. Zhu, J. Liang, X. Li, I. Aben, D. J. Jacob, 2021. Satellite-based Survey of Extreme Methane Emissions in the Permian Basin, *Science Advances*.
11. Cusworth, D. H., **Duren, R. M**., Yadav, V., Thorpe, A. K., Verhulst, K., Sander, S., et al,. 2020. Synthesis of methane observations across scales: Strategies for deploying a multitiered observing network. *Geophys. Res. Let.*, *47*, e2020GL087869. https://doi.org/10.1029/2020GL087869.
12. Guha, A., S. Newman, D. Fairley, T. M. Dinh, L. Duca, S.C. Conley, M. L. Smith, A. K. Thorpe, **R. M. Duren,** D.H. Cusworth, K. T. Foster, M.L. Fischer, S. Jeong, N. Yesiller, J.L. Hanson, and P. T. Martien, Assessment of Regional Methane Emission Inventories through Airborne Quantification in the San Francisco Bay Area, *Environ. Sci. & Tech.* **2020** *54* (15), 9254-9264 , DOI: 10.1021/acs.est.0c01212
13. Cusworth, D.H., **Duren, R.M.,** Thorpe, A.K., Tseng, E., Thompson, D.R., Guha, A., Newman, S., Foster, K., Miller, C.E., 2020. Using remote sensing to detect, validate, and quantify methane emissions from California solid waste operations. *Env. Res. Let.* **15**
14. **Duren, R.,** A. Thorpe, K.T. Foster, T. Rafiq, F. M. Hopkins, V. Yadav, B.Bue, D.R. Thompson, S. Conley, N. Colombi, C. Frankenberg, I.McCubbin, M.Eastwood, M.Falk, J. Herner, B. E. Croes, R. Green, C. Miller, 2019. California's Methane Super-emitters, *Nature* **575,** 180–184, doi:10.1038/s41586-019-1720-3.
15. Yadav, V., **R. Duren**, K.Mueller, K.R. Verhulst , T. Nehrkorn, J. Kim, R.F. Weiss, R. Keeling, S.Sander, M. L. Fischer, S.Newman, M. Falk, T. Kuwayama, F. Hopkins, T.Rafiq, J. Whetstone, C. Miller, 2019. Spatio-temporally resolved methane fluxes from the Los Angeles Megacity, *J. Geophy. Res. – A*
16. Cui., Y.Y, A. Vijayan, M. Falk, Y. Hsu, D. Yin, Z. Zhao, J. Avise, K. Verhulst, L. T. Iraci, M.S. Johnson, Y. Chen, K. Stroud, J.Herner, B. Croes, **R.Duren**, 2019. A multi-platform inversion estimation of statewide and regional methane emissions in California during 2014-2016, *Env. Sci. Tech*.
17. Jongaramrungruang, S., Frankenberg, C., Matheou, G., Thorpe, A., Thompson, D. R., Kuai, L., and **Duren, R.,** 2019. Towards accurate methane point-source quantification from high-resolution 2D plume imagery, *Atmos. Meas. Tech.,* doi: 10.5194/amt-2019-173,.https://www.atmos-meas-tech-discuss.net/amt-2019-173/
18. Carranza, V., Rafiq, T., Frausto-Vicencio, I., Hopkins, F. M., Verhulst, K. R., Rao, P., **Duren, R. M.,** Miller, C. E., 2018. Vista-LA: Mapping methane-emitting infrastructure in the Los Angeles megacity. *Earth System Science Data*. 10(1), 653-676. DOI: 10.5194/essd-10-653-2018

Biographical Sketch
Barbara Haya, PhD

Director, Berkeley Carbon Trading Project
Research Fellow, Environmental Center
Goldman School of Public Policy
University of California, Berkeley
bhaya@berkeley.edu
https://gspp.berkeley.edu/faculty-and-impact/faculty/barbara-haya
https://gspp.berkeley.edu/faculty-and-impact/centers/cepp/projects/berkeley-carbon-trading-project

PROFESSIONAL PREPARATION

University of California, Berkeley	Energy & Resources	PhD 2010
University of California, Berkeley	Energy & Resources	MS 2002
Villanova University	Philosophy	BA 1991

APPOINTMENTS & MAJOR PROJECTS

2015 - present Director, Berkeley Carbon Trading Project Research Fellow, Goldman School of Public Policy Environmental Center University of California, Berkeley

2018 - 2022 Project Lead, Developing University of California's Carbon Offset Procurement Strategy California Institute for Energy and Environment, University of California, Berkeley

2013 - 2015 Research Fellow, Law Clinic, Stanford Law School, Stanford, CA

2011 - 2013 Consultant, Union of Concerned Scientists, Berkeley, CA
Spring 2010 Graduate Student Researcher, China Energy Group
Lawrence Berkeley National Lab – China Energy Group, Berkeley, CA

PUBLICATIONS

Claudia Herbert, **Barbara K. Haya**, Scott L. Stephens, & Van Butsic (2022) Managing nature-based solutions in fire-prone ecosystems: Competing management objectives in California forests evaluated at a landscape scale. *Frontiers in Forests and Global Change*, *5*, 957189. https://doi.org/10.3389/ffgc.2022.957189

Grayson Badgley, Jeremy Freeman, Joseph J. Hamman, **Barbara Haya**, Anna T. Trugman, William R.L. Anderegg, Danny Cullenward (2022) Systematic over-crediting in California's forest carbon offsets program. *Global Change Biology,* DOI: 10.1111/gcb.15943

Barbara Haya, Danny Cullenward, Aaron L. Strong, Emily Grubert, Robert Heilmayr, Deborah Sivas, Michael Wara (2020) Managing Uncertainty in Carbon Offsets: Insights from California's Standardized Approach. *Climate Policy,* DOI: 10.1080/14693062.2020.1781035

Barbara Haya (2019) The California Air Resources Board's US Forest offset protocol underestimates leakage. Goldman School of Public Policy Working Paper, University of California, Berkeley

Barbara Haya, Aaron Strong, Emily Grubert, Danny Cullenward (2016*)* Carbon Offsets in California: Science in the Policy Development Process. In *New Trends in Communicating Risk and Resiliency: A Multi-Disciplinary Approach to Global Environmental Change,* eds. J. Eichelberger, K. Taylor & Y. Kontar. Springer

Barbara Haya & Payal Parekh (2011) Hydropower in the CDM: Examining Additionality and Criteria for Sustainability. Energy & Resources Group Working Paper ERG11-01, University of California, Berkeley

Barbara Haya (2010) *Carbon Offsetting: An Efficient Way to Reduce Emissions or to Avoid Reducing Emissions? An Investigation and Analysis of Offsetting Design and Practice in India and China* [(Doctoral dissertation) Energy & Resources Group, University of California]. https://escholarship.org/content/qt7jk7v95t/qt7jk7v95t.pdf

Barbara Haya (2009) Measuring Emissions Against an Alternative Future: Fundamental Flaws in the Structure of the Kyoto Protocol's Clean Development Mechanism. Energy & Resources Group Working Paper ERG09-01, University of California, Berkeley

Barbara Haya, Malini Ranganathan, Sujit Kirpekar (2009) Barriers to sugar mill cogeneration in India: insights into the structure of post-2012 climate financing instruments. *Climate and Development* 1:66-81. DOI:10.3763/cdev.2009.0002

Lara M. Kueppers, Paul Baer, John Harte, **Barbara Haya**, Laura E. Koteen, and Molly E. Smith (2003) A decision matrix approach to evaluating the impacts of land-use activities undertaken to mitigate climate change. *Climatic Change*, 63:247-257. DOI: 10.1023/B:CLIM.0000018590.49917.50

Paul Baer, John Harte, **Barbara Haya**, Antonia V. Herzog, John Holdren, Nathan E. Hultman, Daniel M. Kammen, Richard B. Norgaard, Leigh Raymond (2000) Equity and Greenhouse Gas Responsibility. *Science*, DOI: 10.1126/science.289.5488.2287

PUBLICATIONS CURRENTLY UNDER REVIEW

Barbara Haya, Samuel Evans, Letty Brown, Jacob Bukoski, Van Butsic, Bodie Cabiyo, Rory Jacobson, Amber Kerr, Matthew Potts, Daniel L. Sanchez (under review) Scientific Review of Carbon Quantification by Improved Forest Management Offset Protocols. Submitted to Frontiers in Forests and Global Change.

Jared Stapp, Christoph Nolte, Matthew Potts, Matthias Baumann, **Barbara Haya**, Van Butsic (under review) Early indications of effectiveness in California's forest offset program. Submitted to Nature Communications.

PROFESSIONAL SERVICE

- Member of the Board of Directors, Carbon Market Watch, an NGO monitoring outcomes and development of carbon trading programs under UN agreements and around the world.
- Served as a member of the Taskforce on Scaling Voluntary Carbon Markets' Credit-level Integrity Working Group
- Observed seven Conferences of the Parties to the UN Framework Convention on Climate Change (the annual international climate change negotiations).
- Reviewed manuscripts for Science, Climatic Change, Climate Policy, Energy Policy, and Carbon Management.

Seth B.C. Shonkoff, PhD, MPH
Executive Director, PSE Healthy Energy
Associate Researcher, School of Public Health, University of California, Berkeley
Affiliate, Energy Technologies Area, Lawrence Berkeley National Lab
sshonkoff@psehealthyenergy.org / sshonkoff@berkeley.edu

RELEVANT EXPERIENCE

An environmental and public health scientist by training, Dr. Shonkoff has more than 20 years of experience in water, air, climate, and population health research at the energy interface and has published more than 50 peer-reviewed journal articles and reports. Dr. Shonkoff is a widely recognized expert on the human health and climate dimensions of oil and gas systems. He has testified before congress and other decision-making bodies and has led and co-authored multiple high-profile scientific assessments. His work includes the Human Health chapter of The Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (AR5) and legislated evaluations of oil and gas development, hydraulic fracturing, produced water management and reuse and underground gas storage facilities in the State of California. Dr. Shonkoff sits on a number of science-policy expert panels.

PROFESSIONAL EXPERIENCE

PSE HEALTHY ENERGY, Oakland, California
- 2012-present, Executive Director

SCHOOL OF PUBLIC HEALTH, UNIVERSITY OF CALIFORNIA, BERKELEY, Berkeley, CA
- 2022-present, Associate Researcher

ENERGY TECHNOLOGIES AREA, LAWRENCE BERKLEY NATIONAL LAB, Berkeley, California
- 2014-present

DEPARTMENT OF ENVIRONMENTAL SCIENCE, POLICY AND MANAGEMENT, UNIVERSITY OF CALIFORNIA, BERKELEY, Berkeley, California
- 2012 – 2022, Visiting Scholar

EDUCATION

- PhD, Environmental Science, Policy and Management, University of California, Berkeley, 2012
- MPH, Epidemiology, University of California, Berkeley, 2008
- BA, Environmental Science, Skidmore College, Saratoga Springs, NY, 2003

SELECTED COMMITTEE SERVICE

- **Member,** AAAS EPI Center Orphaned and Abandoned Well Working Group, American Association for the Advancement of Science, Washington, DC. September 2021 – Present
- **Co-Chair,** Public Health Advisory Panel, California Geologic Energy Management Division, California Department of Conservation, Sacramento, CA. November 2020 – Present
- **Public Health Expert,** Baldwin Hills Oilfield Health Assessment and Environmental Justice Study, Los Angeles County Department of Public Health October 2019 – January 2020

SELECTED PUBLICATIONS

1. Lebel ED, Michanowicz DR, Hill LAL, Bilsback KR, Goldman J, Domen JK, Jaeger JM, Ruiz A, **Shonkoff SBC**. (2022). Chemical Composition Of Unburned Natural Gas in Distribution Systems in California: Considerations For Human Health. *Environmental Science and Technology.*
2. Gonzalez DJX, Morton C, Hill LA, Michanowicz D, Rossi R, **Shonkoff SBC**, Casey JA, Morello-Frosch R. (*Under Review*). Temporal Trends Of Racial And Socioeconomic Disparities in Population Exposures to Upstream Oil and Gas Production in California.

3. Michanowicz D, Leventhal O, Domen JK, Lebel E, Williams, SR, Buoncore JJ, Bernstein AS, **Shonkoff SBC**. (*Under Review*). Natural gas odorants: A scoping review of potential health effects.
4. DiGiulio D, Rossi R, **Shonkoff SBC**. (*Under Review*). Chemical Characterization of Gas Emitted From Orphaned and Abandoned Wells In Pennsylvania: Implications For Air Quality and Public Health.
5. DiGiulio DC, Rossi RJ, Jaeger JM, **Shonkoff SBC**, Ryan JN. (2021). Vulnerability of Groundwater Resources Underlying Unlined Produced Water Ponds In The Tulare Basin of The San Joaquin Valley, California. *Environmental Science and Technology*. Available at: https://pubs.acs.org/doi/10.1021/acs.est.1c02056
6. Garcia-Gonzales D, **Shonkoff SBC**, Hays J, Jerrett M. (2019). Hazardous Air Pollutants Associated with Upstream Oil and Natural Gas Development: A Critical Synthesis of Current Peer-Reviewed Literature. ***Annual Reviews of Public Health***. 40:283-304. Available at: https://www.annualreviews.org/doi/full/10.1146/annurev-publhealth-040218-043715
7. Czolowski E, Santoro RL, Srebotnjak T, **Shonkoff SBC**. (2017). Towards Consistent Methodology to Quantify Populations in Proximity to Oil and Gas Development: A National Spatial Analysis and Review. ***Environmental Health Perspectives***. https://ehp.niehs.nih.gov/EHP1535
8. Stringfellow WT, Camarillo MK, Domen JK, **Shonkoff SBC**. (2017). Comparison of Chemical-Use Between Hydraulic Fracturing, Acidizing, and Routine Oil and Gas Development. ***PLoS ONE***. 12(4): e0175344. Available at: https://doi.org/10.1371/journal.pone.0175344
9. Ingraffea A, Wells M, Santoro R, **Shonkoff SBC**. (2014). Assessment and Risk Analysis of Casing and Cement Impairment in Oil and Gas Wells in Pennsylvania: 2000-2012. ***Proceedings of the National Academy of Science.*** *111 (30): 10955-10960.* http://www.pnas.org/content/111/30/10955.abstract
10. **Shonkoff SB**, Hays, J, Finkel, MF. (2014). The Public Health Dimensions of Shale Gas Development. ***Environmental Health Perspectives***. 122 (8): 787-795. http://dx.doi.org/10.1289/ehp.1307866
11. Michanowicz DR, Lebel ED, Domen JK, Hill LAL, Jaeger JM, Schiff JE, Krieger EM, Banan Z, Goldman JSW, Nordgaard CL, **Shonkoff SBC**. Methane and Health-Damaging Air Pollutants From the Oil and Gas Sector: Bridging 10 Years of Scientific Understanding. ***PSE Healthy Energy.*** October 2021. https://www.psehealthyenergy.org/our-work/publications/archive/methane-and-health-damaging-air-pollutants-from-the-oil-and-gas-sector-bridging-10-years-of-scientific-understanding/
12. **Shonkoff SBC**, Hill LA. (2020). Analysis of air quality data near well stimulation treatments in California: implications for human health. A Report Prepared for the ***California Air Resources Board.*** July 2020.
13. **Shonkoff SBC**, Hill LL, Czolowski ED, Prasad K, Hammond SK, McKone TE. (2017). Human health hazards, risks, and impacts associated with underground natural gas storage in California. In: Long-Term Viability of Underground Gas Storage in California. *In: Long-Term Viability of Underground Natural Gas Storage in California.* ***California Council on Science and Technology***, Sacramento, CA. http://ccst.us/publications/2018/Chapter%201/Chapter%201%20v2%20Section%201-4.pdf
14. **Shonkoff SBC**, Maddalena RL, Hays J, Stringfellow W, Wettstein ZS, Harrison, R, Sandelin W, McKone, TE. (2015). Potential Impacts of Well Stimulation on Human Health in California. *In: An Independent Scientific Assessment of Well Stimulation in California*. ***California Council on Science and Technology***, Sacramento, CA. http://ccst.us/publications/2015/vol-II-chapter-6.pdf
15. Smith KR, *et al.* (**Shonkoff SB** contributing author). (2013). Chapter 11. Human Health: Impacts, Adaptation, and Co-Benefits, Intergovernmental Panel on Climate Change (IPCC), Assessment Report 5 (AR5). https://ipcc-wg2.gov/AR5/images/uploads/WGIIAR5-Chap11_FINAL.pdf

Name: Amanda N. Harmon
Title: **Senior** Manager, Programs- Net Zero Systems
Phone Number: 847-768-0513
E-mail Address: aharmon@gti.energy

1700 S. Mt. Prospect Rd.
Des Plaines, IL 60018

Summary of Experience:

Ms. Harmon is currently a Senior Manager, Programs in the Zero Emissions System team at GTI Energy where she manages the research projects to study emissions from the natural gas industry, evaluate methane detection/quantification technologies and renewable fuels. She currently serves as the Director of Veritas a GTI Energy Measurement and Verification Initiative, Co-Chair of Renewable Fuels within Low Carbon Resource Initiative, and program manages the Risk, Integrity, and Environmental Working Group for Operations Technology Development (OTD). Ms. Harmon actively participates in the Environmental Matters Committee within American Gas Association and the Sustainability (Methane Emissions Study Group) for the International Gas Union. Ms. Harmon is project managing (and has completed) large ($1M+) DOE and DOT funded projects investigating decarbonization technologies including methane emissions reduction and renewable fuels. She has extensive field campaigns/laboratory experience and co-authored/publically presented numerous research findings conducted at GTI.

Education and Training:

University	Degree	Specialty	Year
Miami University	B.A.	Microbiology	2007

Research and Professional Experience:

08/2020 – Present: Gas Technology Institute, Des Plaines, IL – Senior Manager, Programs- Net Zero Systems

Description: Manages the research projects to evaluate new technologies and emissions related studies for the natural gas industry.

Responsibilities: Responsibilities include managing a portfolio of projects that enhance the natural gas industry's understanding of methane emissions. Expertly manages a project's scope, schedule, and budget for industry, government, and NGO funded projects. Manages the renewable energy, emissions science, and environmental group with GTI Energy's Delivery Sector,

09/2009 – 08/2020: Gas Technology Institute, Des Plaines, IL – Senior Scientist, Energy Supply & Conversion

Description: Serve as a subject matter expert and principal investigator focusing on microbiologically influenced corrosion for the natural gas industry and renewable natural gas quality. Managed GTI's Environmental Laboratory.

Five Current Projects Under Management:

- Validation of Remote Sensing and Leak Detection Technologies Under Realistic and Differing Conditions. Project 850. Final Report to DOT PHMSA. https://primis.phmsa.dot.gov/matrix/PrjHome.rdm?prj=850. Status: Project Completed 2022.
- Evaluating Existing and Emerging Technologies in Methane Leak Detection and Quantification. Pipeline Research Council International #PL-1-08. Status: Project Close Out 2022.
- PSI Quantitative Gas Imager (QGI) Validation. Operations Technology Development #7.21.i. Status: Project Close Out 2022.

- Drone Based Methane Detection: Phase II. Operations Technology Development #7.18.d.2. Status: Project Completed 2022.
- Gas Mapping LiDAR for Distribution Leak Measurement. Operations Technology Development #7.20.g. Status: In Progress-On track.

Synergistic Activities:

- Sustainability Committee member of International Gas Union, Environmental Matters Committee member of the American Gas Association, Technical Committee Member-Project Astra, Low Carbon Resource Initiative Co-Chair (Renewable Fuels), Steering Committee for GTI Energy's Women's Professional Network

United States
ENVIRONMENTAL PROTECTION AGENCY
Washington, DC 20460

OMB Control No. 2030-0020
Approval expires 06/30/2024

Current and Pending Support

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: Dimitrios Zekkos	Other agencies (including NSF) to which this proposal has been/will be submitted. None

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Enabling landslide disaster risk reduction nd response throughout the disaster life cycle with a multi-scale toolbox

Source of Support: NASA National Aeronautics and Space Administration
Total Award Amount: 289,465.00 Total Award Period Covered: 05/01/2020 to 04/30/2023
Location of Project: Berkeley, CA
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr: 1.00

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Track 1- Center Catalyst: Center for Land Surface Hazards (CLaSH)

Source of Support: NSF - National Science Foundation
Total Award Amount: 15,600.00 Total Award Period Covered: 09/01/2022 to 08/31/2024
Location of Project: Berkeley, CA
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr: 0.25

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Collaborative Research: Coupling erosion, weathering, and hydrologic function in an active orogenic system

Source of Support: NSF - National Science Foundation
Total Award Amount: 451,243.00 Total Award Period Covered: 09/15/2020 to 08/31/2024
Location of Project: Berkeley, CA
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr: 0.50

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Co-seismic landslide susceptibility of clastic sedimentary rocks: Collaboration research between the University of Michigan and the University of California, Berkeley

Source of Support: USDI Geological Survey
Total Award Amount: 34,090.00 Total Award Period Covered: 01/01/2021 to 12/31/2022
Location of Project: Berkeley, CA
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr: 0.25

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal:

Source of Support:
Total Award Amount: Total Award Period Covered: to
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

United States
ENVIRONMENTAL PROTECTION AGENCY
Washington, DC 20460

OMB Control No. 2030-0020
Approval expires 06/30/2024

Current and Pending Support

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: Ken Alex

Other agencies (including NSF) to which this proposal has been/will be submitted.
n/a

Support: ☐ Current ☑ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Methane emissions reduction by sub-national governments

Source of Support: UN Climate and Clean Air Coalition
Total Award Amount: 150,000.00 Total Award Period Covered: 06/01/2 to 05/31/2(
Location of Project: UC Berkeley
Person-Months Per Year Committed to the Project. Cal: 0.25 Acad: Sumr:

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Methane fellow

Source of Support: Sidney E. Frank Foundation
Total Award Amount: 150,000.00 Total Award Period Covered: 03/01/20 to 08/31/20
Location of Project: UC Berkeley
Person-Months Per Year Committed to the Project. Cal: 1.00 Acad: Sumr:

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: methane fellow

Source of Support: Institute for Governance and Sustainable Development
Total Award Amount: 100,000.00 Total Award Period Covered: 03/01/20 to 02/28/2(
Location of Project: UC Berkeley
Person-Months Per Year Committed to the Project. Cal: 1.00 Acad: Sumr:

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Research Fellow

Source of Support: Laural Foundation
Total Award Amount: 750,000.00 Total Award Period Covered: 09/01/20 to 08/31/2025
Location of Project: UC Berkeley
Person-Months Per Year Committed to the Project. Cal: 1.00 Acad: Sumr:

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Research Fellow

Source of Support: Climate and Wildfire Institute
Total Award Amount: 450,000.00 Total Award Period Covered: 03/01/202 to 02/28/2024
Location of Project: UC Berkeley
Person-Months Per Year Committed to the Project. Cal: 1.00 Acad: Sumr:

*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

EPA

United States
ENVIRONMENTAL PROTECTION AGENCY
Washington, DC 20460

OMB Control No. 2030-0020
Approval expires 06/30/2024

Current and Pending Support

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: Ken Alex

Other agencies (including NSF) to which this proposal has been/will be submitted.
n/a

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: AmeriCorps--GrizzlyCorps

Source of Support: California Volunteers/AmeriCorps
Total Award Amount: 1,800,000.00 Total Award Period Covered: 09/01/2 to 08/31/2(
Location of Project: UC Berkeley and CA
Person-Months Per Year Committed to the Project. Cal: 3.00 Acad: 35.00 Sumr:

Support: ☑ Current ☑ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: AmeriCorps -- GrizzlyCorps

Source of Support: California Volunteers/AmeriCorps
Total Award Amount: 2,000,000.00 Total Award Period Covered: 09/01/20 to 08/31/20
Location of Project: UC Berkeley and CA
Person-Months Per Year Committed to the Project. Cal: 3.00 Acad: 35.00 Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal:

Source of Support:
Total Award Amount: Total Award Period Covered: to
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal:

Source of Support:
Total Award Amount: Total Award Period Covered: to
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal:

Source of Support:
Total Award Amount: Total Award Period Covered: to
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

EPA

United States
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Washington, DC 20460

OMB Control No. 2030-0020
Approval expires 06/30/2024

Current and Pending Support

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: Riley Duren

Other agencies (including NSF) to which this proposal has been/will be submitted.

Support: ☐ Current ☑ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Infusing CH4 and CO2 Point Source Emissions Data into Stakeholder Frameworks to Enable Mitigation and Uncover New Insights

Source of Support: NASA
Total Award Amount: 832,003.97 Total Award Period Covered: 01/01/2023 to 12/31/2025
Location of Project: global
Person-Months Per Year Committed to the Project. Cal: 0.60 Acad: Sumr:

Support: ☐ Current ☑ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Airborne Remote-Sensing Surveys of Methane Emissions in California

Source of Support: California Air Resources Board
Total Award Amount: 549,077.00 Total Award Period Covered: 03/01/2023 to 02/29/2024
Location of Project: California
Person-Months Per Year Committed to the Project. Cal: 1.00 Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal:

Source of Support:
Total Award Amount: Total Award Period Covered: to
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal:

Source of Support:
Total Award Amount: Total Award Period Covered: to
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal:

Source of Support:
Total Award Amount: Total Award Period Covered: to
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

United States
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Washington, DC 20460

OMB Control No. 2030-0020
Approval expires 06/30/2024

Current and Pending Support

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: Barbara Haya

Other agencies (including NSF) to which this proposal has been/will be submitted.

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Review of REDD+ Offset Standards and Protocols

Source of Support: Carbon Market Watch
Total Award Amount: 115,000.00 Total Award Period Covered: 12/15/2021 to 06/30/2023
Location of Project: Berkeley, California
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr: 1.00

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: The role of environmental credits in large commercial corporate decarbonization plans

Source of Support: Meta
Total Award Amount: 73,000.00 Total Award Period Covered: 09/01/2022 to 06/01/2023
Location of Project: Berkeley, California
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr: 1.00

Support: ☐ Current ☑ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Cookstove Carbon Offsets Quality Research

Source of Support: Amazon
Total Award Amount: 90,800.00 Total Award Period Covered: 01/01/2023 to 12/31/2023
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr: 1.25

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal:

Source of Support:
Total Award Amount: Total Award Period Covered: to
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal:

Source of Support:
Total Award Amount: Total Award Period Covered: to
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

United States
ENVIRONMENTAL PROTECTION AGENCY
Washington, DC 20460

OMB Control No. 2030-0020
Approval expires 06/30/2024

Current and Pending Support

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: Seth B.C. Shonkoff, PhD	Other agencies (including NSF) to which this proposal has been/will be submitted.

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: California Public Health Oil and Gas Rulemaking

Source of Support: CalDOC (CalGEM/UC Berkeley)
Total Award Amount: 2,239,679.00 Total Award Period Covered: 10/26/2020 to 01/31/2024
Location of Project: California
Person-Months Per Year Committed to the Project. Cal: 3.50 Acad: Sumr:

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Air Quality and Human Health Assessment of a Direct Air Capture Project in the Salton Sea of California

Source of Support: Climateworks
Total Award Amount: 250,000.00 Total Award Period Covered: 10/01/2021 to 02/28/2023
Location of Project: California
Person-Months Per Year Committed to the Project. Cal: 1.50 Acad: Sumr:

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Contra Costa Climate, Air Pollution and Pregnancy Study (CC CAPS)

Source of Support: EPA STAR Award
Total Award Amount: 1,350,000.00 Total Award Period Covered: 11/01/2022 to 11/01/2025
Location of Project: California
Person-Months Per Year Committed to the Project. Cal: 0.05 Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal:

Source of Support:
Total Award Amount: Total Award Period Covered: to
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal:

Source of Support:
Total Award Amount: Total Award Period Covered: to
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

United States
ENVIRONMENTAL PROTECTION AGENCY
Washington, DC 20460

OMB Control No. 2030-0020
Approval expires 06/30/2024

Current and Pending Support

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: Amanda Harmon	Other agencies (including NSF) to which this proposal has been/will be submitted. None

Support: ☑ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Advancing Hydrogen Leak Detection and Quantification Technologies Compatible with Hydrogen Blends
(role as Project Manager)

Source of Support: US DOE PHMSA, Operations Technology Development, Sensit Technologies
Total Award Amount: 1,499,070.00 Total Award Period Covered: 10/01/2022 to 09/30/2025
Location of Project: Des Plaines, Illinois
Person-Months Per Year Committed to the Project. Cal: 36.00 Acad: Sumr:

Support: ☐ Current ☑ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Storage Tank Emission Assessment and Quantification
(role as Project Manager)

Source of Support: US DOE
Total Award Amount: 6,000,000.00 Total Award Period Covered: 06/01/2023 to 05/31/2026
Location of Project: Des Plaines, Illinois
Person-Months Per Year Committed to the Project. Cal: 36.00 Acad: Sumr:

Support: ☐ Current ☑ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal: Next Generation Landfill Monitoring: A Multi-Scale Approach to Measuring Emissions for Evaluating and Financing Interventions
(role as subawardee)

Source of Support: US EPA
Total Award Amount: 1,000,000.00 Total Award Period Covered: 09/01/2023 to 08/31/2026
Location of Project: Berkeley, California
Person-Months Per Year Committed to the Project. Cal: 14.00 Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal:

Source of Support:
Total Award Amount: Total Award Period Covered: to
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal:

Source of Support:
Total Award Amount: Total Award Period Covered: to
Location of Project:
Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

December 12, 2022

U.S. Environmental Protection Agency
Office of Science Advisor, Policy and Engagement
Office of Research and Development
Science to Achieve Results (STAR) Program

Re: **FON EPA-G2023-STAR-B1**
Understanding and Control of MSW Landfill Air Emissions
Letter of Intent to Provide Resources in Support of UC Berkeley Proposal entitled: Next-Generation Landfill Monitoring: A Multi-Scale Approach to Measuring Emissions and Evaluating and Financing Interventions

To Whom It May Concern:

ReGen Monterey (Legal Name – Monterey Regional Waste Management District) is a California Special District public entity serving the tri-county area of Monterey, San Benito, and Santa Clara counties with solid waste management diversion, recycling, and disposal services. ReGen's facilities are located on its ~470-acre property in northwestern Monterey County, about 2 miles north of the City of Marina and 10 miles west of City of Salinas, at the Monterey Regional Environmental Park, 14201 Del Monte Blvd. The property consists of a 315-acre permitted sanitary landfill site, 20 acres for the resource recovery facilities, a 12 acre Community Franchise Collection Facility with rCNG fueling station, landfill gas to energy facility since 1983, administrative offices, and maintenance buildings. ReGen Monterey is pleased to provide this letter of intent to provide site access and staff resources in support of the UC Berkeley Proposal for FON EPA-G2023-STAR-B1 research grant solicitation titled "Understanding and Control of MSW Landfill Air Emissions". The proposed focus of the EPA grant aligns with ReGen's vision and mission, and continuous improvement of our operational improvement plans for mitigation of landfill gas emissions. We look forward to participating with EPA and UC Berkeley on this valuable and desired area of research for the solid waste industry.

Sincerely,

Felipe Melchor
General Manager

Physical Address
14201 Del Monte Blvd.
Salinas, CA 93908

Mailing Address
P.O. Box 1670
Marina, CA 93933

Phone / Fax
831-384-5313 PHONE
831-384-3567 FAX

Web / Social
ReGenMonterey.org
@ReGenMonterey

Let's not waste this.

December 12, 2022

U.S. Environmental Protection Agency
Office of Science Advisor, Policy and Engagement
Office of Research and Development
Science to Achieve Results (STAR) Program

Re: FON EPA-G2023-STAR-B1, Understanding and Control of Municipal Solid Waste Landfill Air Emissions; Letter of Intent to Provide Resources in Support of UC Berkeley Proposal entitled: Next-Generation Landfill Monitoring: A Multi-Scale Approach to Measuring Emissions for Evaluating and Financing Interventions

To Whom It May Concern:

University of California, Davis oversees a closed Class III landfill facility located approximately 3 ½ miles west of the City of Davis in Yolo County. The facility is comprised of an unlined unit with a compacted clay cover, operated between 1966 and 2001, and a lined unit with an engineered geosynthetic clay and geomembrane cover, operated between 2001 and 2015. Landfill gas is extracted from both units and used for district heating or flared. Given UC Davis's commitment to minimizing landfill gas impacts on air, water, and soil quality and maximizing the beneficial use of landfill gas, UC Davis is pleased to provide this letter of intent to provide resources in support of the UC Berkeley Proposal. UC Davis intends to provide access and other support as appropriate to enable UC Berkeley and partners to measure and monitor methane and co-pollutant emissions from the landfill.

Sincerely,

Martin Kim

Martin Kim, P.E.
University of California, Davis – FM Utilities
(530) 752-9079 (office)
(530) 574-9621 (cell)
mhykim@ucdavis.edu

U.S. Environmental Protection Agency
Office of Science Advisor, Policy and Engagement
Office of Research and Development
Science to Achieve Results (STAR) Program

Re: FON EPA-G2023-STAR-B1, Understanding and Control of Municipal Solid Waste Landfill Air Emissions; Letter of Intent to Provide Resources in Support of UC Berkeley Proposal entitled: Next-Generation Landfill Monitoring: A Multi-Scale Approach to Measuring Emissions and Evaluating and Financing Interventions

To Whom It May Concern:

The City of Midland Sanitary Landfill is a Municipal Solid Waste landfill that serves Midland County, Michigan for non-hazardous solid waste disposal. It accepts residential, commercial, industrial, and construction debris for landfill disposal. It also operates a large-scale yard waste composting operation on site. The landfill cells have active gas collection in place, with collected gas used to generate electricity. We have previously collaborated with the PI Dr. Zekkos and have jointly published scientific papers from his work. We are pleased to provide this letter of intent to provide resources in support of the UC Berkeley Proposal. Our facility intends to provide access and other support as appropriate to enable UC Berkeley and partners to measure gases from the landfill.

Sincerely,

Scott O'Laughlin

Landfill Superintendent
City of Midland, Michigan
4311 E. Ashman St.
Midland, MI 48642
989.837.6989

UNIVERSITY OF CALIFORNIA

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OFFICE OF THE PRESIDENT

Energy and Sustainability
1111 Franklin St
Oakland, California 94607-5200
(510) 987-0205

Date: December 15, 2022

To: Environmental Protection Agency

Subject: Letter of Support for EPA-G2023-STAR-B1, Understanding and Control of Municipal Solid Waste Landfill Air Emissions; and EPA-G2023-STAR-B2, Early Career: Understanding and Control of Municipal Solid Waste Landfill Air Emissions

The University of California's Office of the President sees tremendous value in the proposal developed by UC Berkeley in response to the above-referenced EPA program. As such, my team and I have offered our support as advisors for the proposed work to plan to design and test continuous methane monitoring systems at landfills. In November of 2013, all ten UC campuses committed to emitting net zero greenhouse gases from our buildings and vehicle fleet by 2025. After much success in reducing energy demand and installing renewable electricity projects, almost 80% of our remaining operation emissions are associated with the on-site combustion of natural gas in our central heating and cooling plants. UC operates seven combined heat and power plants, which have been extremely effective in support campus energy needs. Given our large capital investments, and the benefits the CHPs provide, UC is actively purchasing renewable natural gas—principally from landfills—as a key strategy to displace fossil natural gas and reach our climate goals. In our experience, additional research and technical breakthroughs are needed to accurately measure fugitive methane emissions at landfill sites. If this proposal is funded, my team and I at the Office of the President will participate in periodic project reviews and provide feedback based on our operational experience. We look forward to collaborating with the team on this project. We enthusiastically support this proposal and believe that its goals are well aligned with UC's own carbon reduction goals for gas turbines.

Sincerely,

David Phillips

David Phillips
Associate Vice President, Capital Programs, Energy and Sustainability
University of California, Office of the President

[1] https://www.ipcc.ch/report/ar6/wg1/downloads/report/IPCC_AR6_WGI_SPM.pdf, pg 27

STOPWASTE
at home • at work • at school

StopWaste is the Alameda County Waste Management Authority, the Alameda County Source Reduction and Recycling Board, and the Energy Council operating as one public agency.

Member Agencies:
Alameda County
Alameda
Albany
Berkeley
Dublin
Emeryville
Fremont
Hayward
Livermore
Newark
Oakland
Piedmont
Pleasanton
San Leandro
Union City
Castro Valley Sanitary District
Oro Loma Sanitary District

December 13, 2022

To whom it may concern,

Please accept this letter of support from StopWaste for the UC Berkeley proposal being submitted to the U.S. Environmental Protection Science to Achieve Results (STAR) Program, for the "Next-Generation Landfill Monitoring: A Multi-Scale Approach to Measuring Emissions for Evaluating and Financing Interventions" project. The Waste Management Authority (dba StopWaste) is a Joint Powers Agency comprised of the County of Alameda and all the cities within the county. StopWaste develops and implements programs and policies to support the goals of landfill obsolescence, responsible materials management, circular economy, climate resilience, and mitigating environmental impacts of landfills. California's Short Lived Climate Pollutants Act (SB 1383) places primary responsibility for diverting organics from landfill on cities. The UC Berkeley project to track methane emissions more accurately, will not just support better landfill management and appropriate methane reduction strategies, but also provide valuable information over time that will help track our progress in preventing these materials from being landfilled as well as maximizing climate and community health benefits. This project would help address a significant barrier that StopWaste has encountered, which is the difficulty of obtaining high quality data to gauge progress and help guide program efforts. If you have additional questions, please contact me at mstarkey@stopwaste.org.

Sincerely,

Meghan Starkey
Senior Management Analyst

1537 Webster Street
Oakland, CA 94612
p 510-891-6500
f 510-893-2308
www.stopwaste.org ♻

EXHIBIT C

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Dimitrios Zekkos <zekkos@berkeley.edu>

Notice of EPA Award: RD-84062301
35 messages

Brooks, Jennifer <Brooks.Jennifer@epa.gov> Thu, Oct 19, 2023 at 5:38 AM
To: "zekkos@berkeley.edu" <zekkos@berkeley.edu>
Cc: HQgrantsnotification <HQgrantsnotification@epa.gov>, "Barrow, Flora" <Barrow.Flora@epa.gov>

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
MISSION SUPPORT

Re: Notice of EPA Assistance Award

Dear Authorized Representative:

Attached is your Notice of Award from the U.S. Environmental Protection Agency. **Please carefully review the assistance agreement and all of the terms and conditions.**

Please make a copy for your records and provide the appropriate copies within your organization (page three of the award package intentionally left blank). The recipient's signature is not required on the enclosed agreement in order to signify acceptance. Award recipients demonstrate acceptance of the award and commitment to carry out the award by either: 1) drawing down funds within 21 calendar days after the mailing date indicated on the face page of the award; or 2) not filing a notice of disagreement with the award terms and conditions within 21 calendar days after the mailing date indicated on the face page of the award. The terms and conditions of some awards require additional signed certifications or assurances. These should be scanned and emailed to the EPA Grants Specialist listed on the face page of the award document. To file a notice of disagreement with the terms and conditions, the authorized representative of the recipient may also contact the Grants Specialist via email. Alternatively, hard copies of documents or correspondence may be sent to one of the addresses below:

For regular postal delivery:

U.S. Environmental Protection Agency
Office of Grants and Debarment
1200 Pennsylvania Avenue, NW (3903R)
Fifth Floor, Room 51234

Washington, DC 20460

For courier or Federal Express delivery:

U.S. Environmental Protection Agency
Office of Grants and Debarment
1300 Pennsylvania Avenue, NW
Fifth Floor, Room 51234

Washington, DC 20004

Payment will be made available after any required certifications and/or assurances are received, if applicable. The Research Triangle Park Finance Center (RTPFC) will provide information about how you will receive payment and report on your financial transactions during the period of performance.

Guidance, regulations and additional forms needed throughout the life of your award are located at https://www.epa.gov/grants/grant-regulations-and-forms-new-grantees. You may refer to the terms and conditions of your award for guidance on completing and submitting all forms requested or required.

Please pay particular attention to the following items that are procedural changes contained in EPA's Online General Terms and Conditions linked directly to within the Administrative Terms and Conditions of this award. Take note of the "Award Date," also listed on the award document face page, which corresponds to a set of online conditions unique to a specific period in time that apply to your individual award:

- ***SF-425: FEDERAL FINANCIAL REPORTS (FFR) ANNUAL SUBMISSION:***

Any monetary action (new, incremental and supplemental) issued on or after **October 6, 2015** now requires EPA grant recipients to submit the SF-425: Federal Financial Report no later than 30 days after the end of each specified reporting period for quarterly and semi-annual reports, and 90 calendar days for annual reports. Final reports are due no later than 120 calendar days after the end date of the period of performance of the award. Extension of reporting due dates may be approved by EPA upon request of the recipient. The FFR form is available on the internet at: http://www2.epa.gov/financial/forms. All FFRs and manual payment requests (if not using ASAP) must be submitted to the RTPFC via email at **rtpfc-grants@epa.gov** or mail to:

US Environmental Protection Agency

RTP-Finance Center (Mail Code AA216-01)

4930 Page Rd.

Durham, NC 27703

Refer to the Online General Term and Condition titled: “Federal Financial Reporting” or “Final Federal Financial Report” as applicable.

- ***SUBAWARDS:***

As of **March 29, 2016**, the Office of Grants and Debarment issued the EPA Subaward Policy for EPA Assistance Agreements Recipients. Monetary actions (new, incremental and supplemental) issued after March 29 are subject to the subaward reporting requirements provisions of 2 CFR 200 and the EPA Subaward Policy. If your work plan and budget include subawards of financial assistance as defined in 2 CFR 200.1 and 2 CFR 200.331, EPA’s National Term and Condition for Subawards titled: “Establishing and Managing Subawards” will apply.

By accepting this assistance agreement your organization is certifying that it either has systems in place to comply with the regulatory or EPA policy requirements specified in the National Term and Condition for Subawards, or that it will refrain from making subawards with funding EPA provides under this agreement until the systems are designed and implemented. Should your organization decide to make a subaward(s) that was not described in the work plan and budgeted for under this agreement, you must obtain prior written approval from EPA's Award Official as provided at 2 CFR 200.308(c)(6).

If you have any questions, please contact your Grants Specialist identified on the award document. Please reference the EPA assistance number on all future correspondence regarding this assistance agreement.

Attachment (Official EPA Award Document)

Jennifer Brooks

Senior Grants Management Specialist

Environmental Protection Agency

Grants & Interagency Agreement Management Division

1200 Pennsylvania Ave., NW Mail Code 3903R

Washington, DC 20460

202-564-6374

Office Hours 6:30am – 3:00pm EST

2 attachments

image001.png
21K

Assistance Agreement 84062301-0.pdf
218K

Barrow, Flora <Barrow.Flora@epa.gov> Thu, Oct 19, 2023 at 12:24 PM
To: "zekkos@berkeley.edu" <zekkos@berkeley.edu>
Cc: "Chung, Serena (she/her/hers)" <chung.serena@epa.gov>

Dear Dimitrios,

Congratulations on your award! The 1st attachment and email below represent the official notification of your EPA grant (OMB Form 84062301). *Please make sure that you or somebody from your team confirms receipt.*

Please review all the administrative and programmatic terms & conditions carefully. I am the project officer for this grant. Please contact me if you have any questions.

At this time I want to draw to your attention to two of the requirements under the programmatic terms and conditions that require your immediate attention:

- **Quality Assurance Project Plan** (QAPP)

  This is due to me via email on or before Friday, December 15, 2023 (60 days from the award date). Attached are the instruction and a file that you may use as a template. If you have any questions or need clarification, you are encouraged to contact Michelle Henderson (henderson.michelle@epa.gov), who is my office's director of quality assurance (while copying me in all correspondences).

- **IRB Material**

  Before you start any human subject research supported by EPA funds, you must email me the following for EPA review and approval.

  - IRB Approval or Exemption Letter
  - IRB Application
  - IRB Approved Consent Form
  - Correspondence with the IRB, including responses to special considerations for observational research involving children

I also want to mention one other requirement in the programmatic terms & conditions:

- **Annual Progress Reports**

  Among the programmatic terms & conditions are annual progress reports. The first report is due over a year from now. However, I thought it may be useful for you to know the requirements for the reports now so you have a sense of what you will need to keep track of and report on. The requirements for the reports are in the research terms and conditions of the grant, provided at https://www.epa.gov/grants/epa-office-research-and-development-research-terms-and-conditions-effective-may-11-2023-or. For your convenience, I have extracted the requirements into the 4th attachment, which you may use as a template.

We are funding several grants under the same solicitation, and this is the final award made under this RFA. EPA will send out a press release and all the abstracts will be posted on our public website, and we are aiming for Monday (10/23). I will let you know when it is live. I will also be in touch later about a grantee meeting, after all of the awards are made.

Congratulations again on receiving this EPA grant! We appreciate your effort in putting together a great team and proposal, and we are looking forward to the results coming out over the next few years!

Best regards,

Flora

Flora Barrow, MPH, PMP (she/her)

Project Officer, Extramural Research Branch

Extramural Research and Partnerships Division

Office of Science Advisor, Policy, and Engagement

Office of Research and Development

U.S. Environmental Protection Agency

barrow.flora@epa.gov | (202)564-0478

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5 attachments

image001.png
21K

Quality-Assurance-Project-Plan-Instructions.doc
104K

Quality-Assurance-Project-Plan.docx
45K

annual progress report requirements_May 2023 and later .docx
35K

OMB Form 84062301-0.pdf
218K

Dimitrios Zekkos <zekkos@berkeley.edu> Fri, Oct 27, 2023 at 1:25 PM
To: "Barrow, Flora" <Barrow.Flora@epa.gov>, Mary Cuison <mcuison@berkeley.edu>, Anne Marie G Anderssen <aanderssen@berkeley.edu>
Cc: "Chung, Serena (she/her/hers)" <chung.serena@epa.gov>

Hi Flora,

thank you for the e-mail. I apologize for the delay in responding as I was in Turkey for a research workshop. This is really exciting news. I copy my administrators to this e-mail so that they are aware. Will also forward the documents you provided.

This is super exciting!

Dimitrios
[Quoted text hidden]
--

Dimitrios Zekkos, Ph.D., P.E.

http://www.dimitrioszekkos.org

Professor, University of California at Berkeley
Partner & Technical Advisor, ARGO-E GROUP
https://argo-e.com/

Anne Marie G Anderssen <aanderssen@berkeley.edu> Mon, Oct 30, 2023 at 12:11 PM
To: Dimitrios Zekkos <zekkos@berkeley.edu>

Thank you for the update, Dimitrios.
I did not receive any attachments. Can you please re-send?
Thank you,
Anne
[Quoted text hidden]
--

Anne Anderssen
Research Support Officer
ERSO, Berkeley Regional Services
University of California, Berkeley
ERSO Main Phone: 510-664-7800

Effective 9/1/23, I will no longer work on Friday.

Upcoming Campus Holidays:
November 10, 2023 - Veterans Day
November 23-24, 2023 - Thanksgiving

Scheduled Days Off:
November 2, 2023

Dimitrios Zekkos <zekkos@berkeley.edu> Fri, Nov 3, 2023 at 2:33 PM
To: Anne Marie G Anderssen <aanderssen@berkeley.edu>, Mary Cuison <mcuison@berkeley.edu>

Hi Anne,

attached are all the documents from the EPA. How do we proceed to establish the grant. Then, we also need to have our subcontractors linked. Who does that?

Also, can we move my post-doc Youngseok from my startup funds to this grant?

Thanks,

Dimitrios
[Quoted text hidden]
[Quoted text hidden]

5 attachments

image001.png
21K

Quality-Assurance-Project-Plan-Instructions.doc
104K

Quality-Assurance-Project-Plan.docx
45K

annual progress report requirements_May 2023 and later .docx
35K

OMB Form 84062301-0.pdf
218K

Dimitrios Zekkos <zekkos@berkeley.edu> Fri, Nov 3, 2023 at 2:52 PM
To: Youngseok Jo <ysjo_david@berkeley.edu>, "Duren, Riley - (rduren)" <rduren@arizona.edu>, Gil Damon <gil.damon@berkeley.edu>, Ken Alex <ken.alex@berkeley.edu>, Barbara K Haya <bhaya@berkeley.edu>, Seth Shonkoff <sshonkoff@psehealthyenergy.org>, Amanda Harmon <aharmon@gti.energy>, Lee Ann Hill <lhill@psehealthyenergy.org>

Hello everyone,

I am excited to share that our EPA grant was funded! I received the news 1.5 week ago, but I was traveling internationally for a project and was not able to tackle this. This is very exciting. My administrator will be in contact with you to coordinate the sub-awards. Also, there are some more documents that we need to submit such as QAPP that I will work on.

Dr. Youngseok Jo, is a post-doc in my group and will be coordinating our meetings. We would like to start by scheduling a kick off meeting during which all of us can meet and discuss what the plans for our work are and make sure we are working collaboratively.

I look forward to working with you.

Dimitrios

Professor, University of California at Berkeley
Partner & Technical Advisor, ARGO-E GROUP
https://argo-e.com/

Barrow, Flora Thu, Oct 19, 2023 at 12:24 PM

to **Serena**, me

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image002.jpg
4K

Dimitrios Zekkos <zekkos@berkeley.edu> Fri, Nov 3, 2023 at 2:53 PM
To: Youngseok Jo <ysjo_david@berkeley.edu>

Youngeok,

below is the e-mail with all the docs. Please make sure you go through this. It look like we need to submit a QAPP, so please coordinate this, schedule a meeting for maybe the week after Thanksgiving, and also be aware of the progress reports we need to be submitting.

Thanks for all the help! I am also moving your appointment from my startup to the EPA grant.

Thanks,

Dimitrios

---------- Forwarded message ---------
From: **Barrow, Flora** <Barrow.Flora@epa.gov>
Date: Thu, Oct 19, 2023 at 12:24 PM
Subject: RE: Notice of EPA Award: RD-84062301
To: zekkos@berkeley.edu <zekkos@berkeley.edu>
Cc: Chung, Serena (she/her/hers) <chung.serena@epa.gov>

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--

Dimitrios Zekkos, Ph.D., P.E.

http://www.dimitrioszekkos.org

Professor, University of California at Berkeley
[Quoted text hidden]

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5 attachments

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Quality-Assurance-Project-Plan-Instructions.doc
104K

Quality-Assurance-Project-Plan.docx
45K

annual progress report requirements_May 2023 and later .docx
35K

OMB Form 84062301-0.pdf
218K

Youngseok Jo <ysjo_david@berkeley.edu> Fri, Nov 3, 2023 at 3:33 PM
To: Dimitrios Zekkos <zekkos@berkeley.edu>

Dear Professor,

Thank you for the email. After I look over documents, I will ask our team for cooperation for QAPP.
Also in compliance with your instruction, I will coordinate a kick-off meeting.

Always appreciate your support and patience! and please instruct, educate, and advise me until I achieve my goal :)

Sincerely
Youngseok Jo
[Quoted text hidden]
--
Sincerely
Youngseok Jo
(+1) (510)-409-1636

Seth Shonkoff <sshonkoff@psehealthyenergy.org> Sun, Nov 5, 2023 at 9:33 AM
To: Dimitrios Zekkos <zekkos@berkeley.edu>
Cc: Youngseok Jo <ysjo_david@berkeley.edu>, "Duren, Riley - (rduren)" <rduren@arizona.edu>, Gil Damon <gil.damon@berkeley.edu>, Ken Alex <ken.alex@berkeley.edu>, Barbara K Haya <bhaya@berkeley.edu>, Amanda Harmon <aharmon@gti.energy>, Lee Ann Hill <lhill@psehealthyenergy.org>, Regine Zamor <regine@psehealthyenergy.org>

Fantastic!
Really looking forward to working with this great team.
I'm CCing our director of development, Regine Zamor who will help assist -- on the PSE side -- getting paperwork in order.
Very best,
Seth

--
Seth B.C. Shonkoff, PhD, MPH
Executive Director | PSE Healthy Energy
Associate Researcher | Environmental Health Sciences, School of Public Health, UC Berkeley
Affiliate | Energy Technologies Area, Lawrence Berkeley National Lab
1440 Broadway, Suite 750, Oakland, CA 94612
Pronouns: he/him/his
sshonkoff@psehealthyenergy.org | (510) 330-5554

PSE Bringing science to energy policy

[Quoted text hidden]

Duren, Riley - (rduren) <rduren@arizona.edu> Sun, Nov 5, 2023 at 12:19 PM
To: Seth Shonkoff <sshonkoff@psehealthyenergy.org>, Dimitrios Zekkos <zekkos@berkeley.edu>
Cc: Youngseok Jo <ysjo_david@berkeley.edu>, Gil Damon <gil.damon@berkeley.edu>, Ken Alex <ken.alex@berkeley.edu>, Barbara K Haya <bhaya@berkeley.edu>, Amanda Harmon <aharmon@gti.energy>, Lee Ann Hill <lhill@psehealthyenergy.org>, Regine Zamor <regine@psehealthyenergy.org>, Judy Lai-Norling <judy@carbonmapper.org>

Same here! Copying Judy Lai-Norling (Carbon Mapper COO).

Riley

From: Seth Shonkoff <sshonkoff@psehealthyenergy.org>
Date: Sunday, November 5, 2023 at 9:35 AM
To: Dimitrios Zekkos <zekkos@berkeley.edu>
Cc: Youngseok Jo <ysjo_david@berkeley.edu>, Riley Duren <rduren@arizona.edu>, Gil Damon <gil.damon@berkeley.edu>, Ken Alex <ken.alex@berkeley.edu>, Barbara K Haya <bhaya@berkeley.edu>, Amanda Harmon <aharmon@gti.energy>, Lee Ann Hill <lhill@psehealthyenergy.org>, Regine Zamor <regine@psehealthyenergy.org>
Subject: [EXT]Re: Notice of EPA Award: RD-84062301

External Email

Fantastic!

Really looking forward to working with this great team.

I'm CCing our director of development, Regine Zamor who will help assist -- on the PSE side -- getting paperwork in order.

Very best,

Seth

--

Seth B.C. Shonkoff, PhD, MPH

Executive Director | PSE Healthy Energy
Associate Researcher | Environmental Health Sciences, School of Public Health, UC Berkeley
Affiliate | Energy Technologies Area, Lawrence Berkeley National Lab
1440 Broadway, Suite 750, Oakland, CA 94612
Pronouns: he/him/his

sshonkoff@psehealthyenergy.org | (510) 330-5554

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On Fri, Nov 3, 2023 at 2:52 PM Dimitrios Zekkos <zekkos@berkeley.edu> wrote:

> Hello everyone,
>
> I am excited to share that our EPA grant was funded! I received the news 1.5 week ago, but I was traveling internationally for a project and was not able to tackle this. This is very exciting. My administrator will be in contact with you to coordinate the sub-awards. Also, there are some more documents that we need to submit such as QAPP that I will work on.
>
> Dr. Youngseok Jo, is a post-doc in my group and will be coordinating our meetings. We would like to start by scheduling a kick off meeting during which all of us can meet and discuss what the plans for our work are and make sure we are working collaboratively.
>
> I look forward to working with you.
>
> Dimitrios
>
> Professor, University of California at Berkeley
>
> Partner & Technical Advisor, ARGO-E GROUP
>
> https://argo-e.com/

Barrow, Flora Image removed by sender. Attachments Oct 19, 2023, 12:24 PM Image removed by sender. Image removed by sender.

to **Serena**, me

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Regine Zamor <regine@psehealthyenergy.org> Mon, Nov 6, 2023 at 9:34 AM
To: "Duren, Riley - (rduren)" <rduren@arizona.edu>
Cc: Seth Shonkoff <sshonkoff@psehealthyenergy.org>, Dimitrios Zekkos <zekkos@berkeley.edu>, Youngseok Jo <ysjo_david@berkeley.edu>, Gil Damon <gil.damon@berkeley.edu>, Ken Alex <ken.alex@berkeley.edu>, Barbara K Haya <bhaya@berkeley.edu>, Amanda Harmon <aharmon@gti.energy>, Lee Ann Hill <lhill@psehealthyenergy.org>, Judy Lai-Norling <judy@carbonmapper.org>

Congratulations on the award! I'll wait to hear back on any subaward items and administration requests on the PSE side.

Sincerely,

Regine
[Quoted text hidden]

Anne Marie G Anderssen <aanderssen@berkeley.edu> Mon, Nov 6, 2023 at 12:13 PM
To: Dimitrios Zekkos <zekkos@berkeley.edu>
Cc: Mary Cuison <mcuison@berkeley.edu>

Good Afternoon, Dimitrios.
Thank you for forwarding these documents.

I will follow-up with SPO regarding the status of this award and will cc you.
Once the award is fully executed by SPO, it will be sent to CGA (this is when the fund number is established).

After CGA has set up the fund in the campus financial system, I will prepare the fund for your use (there are several steps) - this is when the fund will appear in the drop down menus and on your financial page on the ERSO Intranet.

I will follow-up with you directly to set up the subawards (this process will occur after all of the others listed above).
And, I will follow-up with you regarding the Postdoc funding.

Thank you,
Anne

[Quoted text hidden]
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Anne Marie G Anderssen <aanderssen@berkeley.edu> Mon, Nov 6, 2023 at 4:57 PM
To: Jeffrey Bui <jeffreybui@berkeley.edu>
Cc: Dimitrios Zekkos <zekkos@berkeley.edu>

Good Afternoon, Jeff.
Just a quick check-in to see if this award is being processed?
I'm attaching the documents Prof Zekkos received with the original email from Flora - I'm not sure if these were provided to SPO?
Thanks!
Anne

---------- Forwarded message ---------
From: **Mary Cuison** <mcuison@berkeley.edu>
Date: Fri, Oct 27, 2023 at 1:30 PM
Subject: Fwd: Notice of EPA Award: RD-84062301
To: Spoawards Departmental <spoawards@berkeley.edu>
Cc: Anne Marie Anderssen <aanderssen@berkeley.edu>

FYI...

---------- Forwarded message ---------
From: **Dimitrios Zekkos** <zekkos@berkeley.edu>
Date: Fri, Oct 27, 2023 at 1:25 PM
Subject: Re: Notice of EPA Award: RD-84062301
To: Barrow, Flora <Barrow.Flora@epa.gov>, Mary Cuison <mcuison@berkeley.edu>, Anne Marie G Anderssen <aanderssen@berkeley.edu>
Cc: Chung, Serena (she/her/hers) <chung.serena@epa.gov>

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--
Thank you,
Mary

Mary Cuison
Contracts and Grants Manager
University of California, Berkeley
Berkeley Regional Services, (ERSO)
Email: mcuison@berkeley.edu

BERKELEY 150 1868 ★ 2018 | 150 YEARS OF LIGHT

--
Anne Anderssen
Research Support Officer
ERSO, Berkeley Regional Services
University of California, Berkeley
ERSO Main Phone: 510-664-7800

Effective 9/1/23, I will no longer work on Friday.

Upcoming Campus Holidays:
November 10, 2023 - Veterans Day
November 23-24, 2023 - Thanksgiving

Scheduled Days Off:
November 13-16, 2023

---

4 attachments

Zekkos EPA proposal timeline.docx
17K

Quality-Assurance-Project-Plan.docx
40K

annual progress report requirements_May 2023 and later .docx
35K

OMB Form 84062301-0.pdf
218K

Jeffrey Bui (AOR) <jeffreybui@berkeley.edu> Tue, Nov 7, 2023 at 9:11 AM
To: Anne Marie G Anderssen <aanderssen@berkeley.edu>
Cc: Dimitrios Zekkos <zekkos@berkeley.edu>

I don't believe they were. I am having them logged in so that we can have this processed. - Jeff
[Quoted text hidden]
--
Jeffrey Bui
Contract and Grant Officer
University of California, Berkeley

Sponsored Projects Office

Please use the following link if you would be willing to answer a few questions about the quality of the services provided. SPO feedback FY 2020

Anne Marie G Anderssen <aanderssen@berkeley.edu> Tue, Nov 7, 2023 at 9:14 AM
To: "Jeffrey Bui (AOR)" <jeffreybui@berkeley.edu>
Cc: Dimitrios Zekkos <zekkos@berkeley.edu>

Great - thanks for the update, Jeff!
[Quoted text hidden]

Judy Lai-Norling <judy@carbonmapper.org> Tue, Nov 7, 2023 at 10:41 AM
To: Regine Zamor <regine@psehealthyenergy.org>, rduren <rduren@arizona.edu>
Cc: Seth Shonkoff <sshonkoff@psehealthyenergy.org>, Dimitrios Zekkos <zekkos@berkeley.edu>, Youngseok Jo <ysjo_david@berkeley.edu>, Gil Damon <gil.damon@berkeley.edu>, Ken Alex <ken.alex@berkeley.edu>, Barbara K Haya <bhaya@berkeley.edu>, Amanda Harmon <aharmon@gti.energy>, Lee Ann Hill <lhill@psehealthyenergy.org>, Jade Dhatchayangkul <jade@carbonmapper.org>

Congratulations everyone! Looking forward to working with everyone on this effort.

Please forward any contractual and administrative materials needed from Carbon Mapper to myself (judy@carbonmapper.org) and Carbon Mapper CFO Jade Dhatchayangkul (jade@carbonmapper.org cc'ed).

Best,

Judy

Judy Lai-Norling

Chief Operating Officer

Carbon Mapper
e: judy@carbonmapper.org
w: carbonmapper.org
p: 626.995.7765

Providing precise, timely, accessible emissions data to empower climate action.

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> [Quoted text hidden]
> [Quoted text hidden]
>
> [Quoted text hidden]
>
> On Fri, Nov 3, 2023 at 2:52 PM Dimitrios Zekkos <zekkos@berkeley.edu> wrote:
>
> > Hello everyone,
> >
> > I am excited to share that our EPA grant was funded! I received the news 1.5 week ago, but I was traveling internationally for a project and was not able to tackle this. This is very exciting. My administrator will be in contact with you to coordinate the sub-awards. Also, there are some more documents that we need to submit such as QAPP that I will work on.
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> > Dr. Youngseok Jo, is a post-doc in my group and will be coordinating our meetings. We would like to start by scheduling a kick off meeting during which all of us can meet and discuss what the plans for our work are and make sure we are working collaboratively.
> >
> > I look forward to working with you.
> >
> > Dimitrios
> >
> > Professor, University of California at Berkeley
> >
> > Partner & Technical Advisor, ARGO-E GROUP
> >
> > https://argo-e.com/

Barrow, Flora Oct 19, 2023, 12:24 PM

to **Serena**, me

[Quoted text hidden]

From: Brooks, Jennifer <Brooks.Jennifer@epa.gov>

[Quoted text hidden]

[Quoted text hidden]

Jeffrey Bui (AOR) <jeffreybui@berkeley.edu> Tue, Nov 28, 2023 at 4:06 PM
To: Anne Marie G Anderssen <aanderssen@berkeley.edu>
Cc: Dimitrios Zekkos <zekkos@berkeley.edu>

Hi Anne and Dr. Zekkos,

The award looks fine for acceptance.

Has the Quality Assurance Project Plan been submitted to EPA?

Jeff
[Quoted text hidden]
[Quoted text hidden]

Anne Marie G Anderssen <aanderssen@berkeley.edu> Tue, Nov 28, 2023 at 4:47 PM
To: "Jeffrey Bui (AOR)" <jeffreybui@berkeley.edu>
Cc: Dimitrios Zekkos <zekkos@berkeley.edu>

Thank you for the update, Jeff.

Dear Dimitrios,
Please advise re: the Quality Assurance Project Plan.

Thank you,
Anne

[Quoted text hidden]
[Quoted text hidden]
Upcoming Campus Holidays:
December 25, 2023 - January 2, 2024 - Winter Curtailment

Scheduled Days Off:
December 14, 2023

Dimitrios Zekkos <zekkos@berkeley.edu> Tue, Nov 28, 2023 at 6:58 PM
To: Anne Marie G Anderssen <aanderssen@berkeley.edu>
Cc: "Jeffrey Bui (AOR)" <jeffreybui@berkeley.edu>

Hi all,

we are working on the QAPP that I think is due by Dec. 15th. Can you clarify if we can start charging on the project?

Dimitrios
[Quoted text hidden]
[Quoted text hidden]
Founder & Partner, ARGO-E GROUP
https://argo-e.com/

Jeffrey Bui (AOR) <jeffreybui@berkeley.edu> Wed, Nov 29, 2023 at 12:57 PM
To: Dimitrios Zekkos <zekkos@berkeley.edu>
Cc: Anne Marie G Anderssen <aanderssen@berkeley.edu>

We cannot. Terms say that we need an approved plan first. - Jeff
[Quoted text hidden]

Dimitrios Zekkos <zekkos@berkeley.edu> Thu, Dec 7, 2023 at 10:47 AM
To: "Barrow, Flora" <Barrow.Flora@epa.gov>, Youngseok Jo <ysjo_david@berkeley.edu>
Cc: "Chung, Serena (she/her/hers)" <chung.serena@epa.gov>

Hi Flora,

we are finalizing the QAPP that I am hoping to submit very soon, certainly before the deadline. The instruction read that we should "include EPA PO and DQA". I wanted to confirm that you are the P.O (I know that) and that Michelle Henderson is the DQA.

Also, do you know how long the approval process of the QAPP typically takes? I was told within the University that we are not allowed to charge the grant until this is approved.

Finally, is there an EPA policy for collaborations between team members? One of my colleagues (Tina Katopodes) here at Berkeley was also funded through this program from a different grant and wanted to see if collaboration is encouraged.

Thanks,

Dimitrios

On Thu, Oct 19, 2023 at 12:24 PM Barrow, Flora <Barrow.Flora@epa.gov> wrote:
[Quoted text hidden]

[Quoted text hidden]

Dimitrios Zekkos <zekkos@berkeley.edu> Thu, Dec 7, 2023 at 10:49 AM
To: "Jeffrey Bui (AOR)" <jeffreybui@berkeley.edu>, Youngseok Jo <ysjo_david@berkeley.edu>
Cc: Anne Marie G Anderssen <aanderssen@berkeley.edu>

Jeff,

I am about to submit the QAPP, but there is a process within the EPA to approve this also. Meanwhile according to EPA the grant was approved in October and next October I and my collaborators need to be able to have charged our expenses. Are you sure, we cannot start charging and move on with the project given that the award has been approved (even if we have not received the funds)?

Thanks,

Dimitrios
[Quoted text hidden]

Jeffrey Bui (AOR) <jeffreybui@berkeley.edu> Thu, Dec 7, 2023 at 11:24 AM
To: Dimitrios Zekkos <zekkos@berkeley.edu>
Cc: Youngseok Jo <ysjo_david@berkeley.edu>, Anne Marie G Anderssen <aanderssen@berkeley.edu>

I will double check.
[Quoted text hidden]

Jeffrey Bui (AOR) <jeffreybui@berkeley.edu> Fri, Dec 8, 2023 at 4:06 PM
To: Dimitrios Zekkos <zekkos@berkeley.edu>
Cc: Youngseok Jo <ysjo_david@berkeley.edu>, Anne Marie G Anderssen <aanderssen@berkeley.edu>

You were right. I released the award. I highlighted the restriction. Please let me know if you have any questions.
[Quoted text hidden]

Dimitrios Zekkos <zekkos@berkeley.edu> Mon, Dec 11, 2023 at 1:51 PM
To: "Jeffrey Bui (AOR)" <jeffreybui@berkeley.edu>
Cc: Youngseok Jo <ysjo_david@berkeley.edu>, Anne Marie G Anderssen <aanderssen@berkeley.edu>

That is great to hear because it was becoming difficult to proceed. Thanks!

Dimitrios
[Quoted text hidden]

Dimitrios Zekkos <zekkos@berkeley.edu> Tue, Feb 4, 2025 at 4:48 PM
To: Youngseok Jo <ysjo_david@berkeley.edu>, Yitong Yang <yitong_yang@berkeley.edu>

Hi both,

this is from the original e-mail with the announcement of the EPA award. It talks about the annual report that we need to submit asap. See the link provided by Flora and let's create a template report where address this issues.

Youngseok: Can you take the lead on this? Can you work on this this week, so that we can finalize sometime next week?

Thanks,

Dimitrios

---------- Forwarded message ---------
From: **Barrow, Flora** <Barrow.Flora@epa.gov>
Date: Thu, Oct 19, 2023 at 12:24 PM
Subject: RE: Notice of EPA Award: RD-84062301
To: zekkos@berkeley.edu <zekkos@berkeley.edu>
Cc: Chung, Serena (she/her/hers) <chung.serena@epa.gov>

[Quoted text hidden]

[Quoted text hidden]

5 attachments

image001.png
21K

Quality-Assurance-Project-Plan-Instructions.doc
104K

Quality-Assurance-Project-Plan.docx
45K

annual progress report requirements_May 2023 and later .docx
35K

OMB Form 84062301-0.pdf
218K

Youngseok Jo <ysjo_david@berkeley.edu> Sun, Feb 9, 2025 at 1:43 PM
To: Dimitrios Zekkos <zekkos@berkeley.edu>
Cc: Yitong Yang <yitong_yang@berkeley.edu>

Dear both,
Please find an attached file. I've written a draft of the annual report.
Thanks!

Youngseok Jo
[Quoted text hidden]
[Quoted text hidden]

annual progress report requirements_May 2023 and later_v2.docx
3067K

Dimitrios Zekkos <zekkos@berkeley.edu> Tue, Feb 11, 2025 at 6:58 PM
To: Youngseok Jo <ysjo_david@berkeley.edu>
Cc: Yitong Yang <yitong_yang@berkeley.edu>

Yitong: Just a reminder to make your additions and send back. Thanks!
dz
[Quoted text hidden]

Yitong Yang <yitong_yang@berkeley.edu> Tue, Feb 11, 2025 at 7:23 PM
To: Dimitrios Zekkos <zekkos@berkeley.edu>
Cc: Youngseok Jo <ysjo_david@berkeley.edu>

Hi Prof. Zekkos,

I'm working on it and will send back soon!

Best,
Yitong
[Quoted text hidden]

Youngseok Jo <ysjo_david@berkeley.edu> Tue, Feb 11, 2025 at 7:30 PM
To: Yitong Yang <yitong_yang@berkeley.edu>
Cc: Dimitrios Zekkos <zekkos@berkeley.edu>

Dear Yitong,
Could you share an optical image of Kiefer landfill?

Youngseok Jo
[Quoted text hidden]

Yitong Yang <yitong_yang@berkeley.edu> Tue, Feb 11, 2025 at 10:49 PM
To: Youngseok Jo <ysjo_david@berkeley.edu>
Cc: Dimitrios Zekkos <zekkos@berkeley.edu>

Sure! I'll send it to you after exporting it. Could you send me the gas concentration data of both landfill?

Thanks,
Yitong
[Quoted text hidden]

Youngseok Jo <ysjo_david@berkeley.edu> Wed, Feb 12, 2025 at 7:31 AM
To: Yitong Yang <yitong_yang@berkeley.edu>
Cc: Dimitrios Zekkos <zekkos@berkeley.edu>

Sure! I will send them :)

Youngseok Jo

Get Outlook for iOS

From: Yitong Yang <yitong_yang@berkeley.edu>
Sent: Tuesday, February 11, 2025 10:49:01 PM
To: Youngseok Jo <ysjo_david@berkeley.edu>
Cc: Dimitrios Zekkos <zekkos@berkeley.edu>
Subject: Re: Notice of EPA Award: RD-84062301

[Quoted text hidden]

Yitong Yang <yitong_yang@berkeley.edu> Wed, Feb 12, 2025 at 9:23 AM
To: Youngseok Jo <ysjo_david@berkeley.edu>
Cc: Dimitrios Zekkos <zekkos@berkeley.edu>

Hi Prof. Zekkos and Youndseok,

Please find the attached file. I have revised the sections related to machine learning. Let me know if any further modifications are needed.

Best,
Yitong
[Quoted text hidden]

annual progress report requirements_May 2023 and later_Yitong.docx
2840K

Yitong Yang <yitong_yang@berkeley.edu> Wed, Feb 12, 2025 at 9:33 AM
To: Youngseok Jo <ysjo_david@berkeley.edu>
Cc: Dimitrios Zekkos <zekkos@berkeley.edu>

Hi Younseok,

Please see the attached optical image.

Best,
Yitong

Optical.tif

[Quoted text hidden]

Youngseok Jo <ysjo_david@berkeley.edu> Wed, Feb 12, 2025 at 2:33 PM
To: Yitong Yang <yitong_yang@berkeley.edu>
Cc: Dimitrios Zekkos <zekkos@berkeley.edu>

Thanks, YItong.
Please find attached files.

Youngseok Jo
[Quoted text hidden]

---

2 attachments

3 in (Western).csv
216K

3 in (Regen).csv
445K

EXHIBIT E

U.S. ENVIRONMENTAL PROTECTION AGENCY

Assistance Amendment

GRANT NUMBER (FAIN): 84062301 **MODIFICATION NUMBER:** 1 **PROGRAM CODE:** RD	**DATE OF AWARD** 12/16/2024
TYPE OF ACTION Augmentation: Increase	**MAILING DATE** 12/19/2024
PAYMENT METHOD: ASAP	**ACH#** 0016

RECIPIENT TYPE:
State Institution of Higher Learning

Send Payment Request to:
Contact EPA RTPFC at: rtpfc-grants@epa.gov

RECIPIENT:
Regents of the University of California, The
1608 4th St Ste 220
Berkeley, CA 94710-1749
EIN: 94-6002123

PAYEE:
Regents of the University of California, The
1608 4th Street, Suite 201
Berkeley, CA 94710-1749

PROJECT MANAGER	EPA PROJECT OFFICER	EPA GRANT SPECIALIST
Dimitrios Zekkos 425 Davis Hall Berkeley, CA 94720-0001 **Email:** zekkos@berkeley.edu **Phone:** 510-289-7598	Elizabeth Rilee 1200 Pennsylvania Ave NW, 8101R Washington, DC 20460 **Email:** rilee.elizabeth@epa.gov **Phone:** 202-564-0069	Jennifer Brooks 1200 Pennsylvania Ave. NW, 3903R Washington, DC 20460 **Email:** brooks.jennifer@epa.gov **Phone:** 202-564-6374

PROJECT TITLE AND EXPLANATION OF CHANGES

Next-Generation Landfill Monitoring: A Multi-Scale Approach to Measuring Emissions for Evaluating and Financing Interventions

The project will : 1) test the hypothesis that continuous air monitoring of municipal solid waste landfills is feasible and cost-effective through an integrated multi-scale approach (e.g., coordinated observations with multiple sensors deployed on flux chambers, Unmanned Aerial Vehicles (UAVs), aircrafts, and satellites); and 2) explore how this approach can establish the efficacy of interventions and create financial incentives to reduce emissions by serving as the basis for robust landfill emissions reduction quantification protocols.

Incremental; Completion of Partial Funding; This amendment provides incremental funding in the amount of $562,500.

BUDGET PERIOD	PROJECT PERIOD	TOTAL BUDGET PERIOD COST	TOTAL PROJECT PERIOD COST
11/01/2023 - 10/31/2026	11/01/2023 - 10/31/2026	$ 1,000,000.00	$ 1,000,000.00

NOTICE OF AWARD

Based on your Application dated 12/21/2022 including all modifications and amendments, the United States acting by and through the US Environmental Protection Agency (EPA) hereby awards $ 562,500.00. EPA agrees to cost-share 100.00% of all approved budget period costs incurred, up to and not exceeding total federal funding of $ 1,000,000.00. Recipient's signature is not required on this agreement. The recipient demonstrates its commitment to carry out this award by either: 1) drawing down funds within 21 days after the EPA award or amendment mailing date; or 2) not filing a notice of disagreement with the award terms and conditions within 21 days after the EPA award or amendment mailing date. If the recipient disagrees with the terms and conditions specified in this award, the authorized representative of the recipient must furnish a notice of disagreement to the EPA Award Official within 21 days after the EPA award or amendment mailing date. In case of disagreement, and until the disagreement is resolved, the recipient should not draw down on the funds provided by this award/amendment, and any costs incurred by the recipient are at its own risk. This agreement is subject to applicable EPA regulatory and statutory provisions, all terms and conditions of this agreement and any attachments.

ISSUING OFFICE (GRANTS MANAGEMENT OFFICE)	AWARD APPROVAL OFFICE
ORGANIZATION / ADDRESS	**ORGANIZATION / ADDRESS**
Environmental Protection Agency, Grants Management & Business Operations Division 1200 Pennsylvania Ave, NW Mail code 3903R Washington, DC 20460	Environmental Protection Agency, OSAPE ORD - Office of Research and Development 1200 Pennsylvania Ave., NW Washington, DC 20460

THE UNITED STATES OF AMERICA BY THE U.S. ENVIRONMENTAL PROTECTION AGENCY

Digital signature applied by EPA Award Official LaShaun Phillips - Associate Award Official	**DATE** 12/16/2024

EPA Funding Information

FUNDS	FORMER AWARD	THIS ACTION	AMENDED TOTAL
EPA Amount This Action	$ 437,500	$ 562,500	$ 1,000,000
EPA In-Kind Amount	$ 0	$ 0	$ 0
Unexpended Prior Year Balance	$ 0	$ 0	$ 0
Other Federal Funds	$ 0	$ 0	$ 0
Recipient Contribution	$ 0	$ 0	$ 0
State Contribution	$ 0	$ 0	$ 0
Local Contribution	$ 0	$ 0	$ 0
Other Contribution	$ 0	$ 0	$ 0
Allowable Project Cost	$ 437,500	$ 562,500	$ 1,000,000

Assistance Program (CFDA)	Statutory Authority	Regulatory Authority
66.509 - Science to Achieve Results (STAR) Program	Clean Air Act: Sec. 103	2 CFR 200, 2 CFR 1500, 40 CFR 33 and 40 CFR 40

Fiscal									
Site Name	Req No	FY	Approp. Code	Budget Organization	PRC	Object Class	Site/Project	Cost Organization	Obligation / Deobligation
-	252631G010	2425	C	2631000	000FK6XR1	4141	-	26A6A	$ 256,234
-	252631G010	2425	C	2631000	000FK6XR2	4141	-	26A6A	$ 306,266
									$ 562,500

Budget Summary Page

Table A - Object Class Category (Non-Construction)	Total Approved Allowable Budget Period Cost
1. Personnel	$ 295,905
2. Fringe Benefits	$ 40,003
3. Travel	$ 15,512
4. Equipment	$ 0
5. Supplies	$ 28,483
6. Contractual	$ 0
7. Construction	$ 0
8. Other	$ 343,172
9. Total Direct Charges	$ 723,075
10. Indirect Costs: 60.50 % Base MTDC	$ 276,925
11. Total (Share: Recipient 0.00 % Federal 100.00 %)	$ 1,000,000
12. Total Approved Assistance Amount	$ 1,000,000
13. Program Income	$ 0
14. Total EPA Amount Awarded This Action	$ 562,500
15. Total EPA Amount Awarded To Date	$ 1,000,000

Administrative Conditions

A. General Terms and Conditions

The General Terms and Conditions of this agreement are updated in accordance with the link below. However, these updated conditions apply solely to the funds added with this amendment and any previously awarded funds not yet disbursed by the recipient as of the award date of this amendment. The General Terms and Conditions cited in the original award or prior funded amendments remain in effect for funds disbursed by the recipient prior to the award date of this amendment.

The recipient agrees to comply with the current EPA general terms and conditions available at: https://www.epa.gov/grants/epa-general-terms-and-conditions-effective-october-1-2024-or-later

These terms and conditions are binding for disbursements and are in addition to or modify the assurances and certifications made as a part of the award and the terms, conditions, or restrictions cited throughout the award.

The EPA repository for the general terms and conditions by year can be found at: https://www.epa.gov/grants/grant-terms-and-conditions#general.

B. Correspondence Condition (updated 06/21/24)

The terms and conditions of this agreement require the submittal of reports, specific requests for approval, or notifications to EPA. Unless otherwise noted, all such correspondence should be sent to the following email addresses:

- Federal Financial Reports (SF-425): rtpfc-grants@epa.gov and **EPA Grants Specialist listed on the award document.**

- MBE/WBE reports (EPA Form 5700-52A): DBE Coordinator, Debora Bradford (Bradford.Debora@epa.gov), OMS-OGD-MBE_WBE@epa.gov and **EPA Grants Specialist listed on the award document**

- All other forms/certifications/assurances, Indirect Cost Rate Agreements, Requests for Extensions of the Budget and Project Period, Amendment Requests, Requests for other Prior Approvals, updates to recipient information (including email addresses, changes in contact information or changes in authorized representatives) and other notifications: **EPA Project Officer** and **EPA Grants Specialist listed on the award document.**

- Payment requests (if applicable): **EPA Project Officer listed on the award document.**

- Quality Assurance documents, workplan revisions, equipment lists, programmatic reports and deliverables: **EPA Project Officer listed on the award document.**

All Other Administrative Conditions Remain the Same.

Programmatic Conditions

A. Cybersecurity Grant Condition for Other Recipients, Including Intertribal Consortia

(a) The recipient agrees that when collecting and managing environmental data under this assistance agreement, it will protect the data by following all applicable State or Tribal law cybersecurity requirements.

(b) (1) EPA must ensure that any connections between the recipient's network or information system and EPA networks used by the recipient to transfer data under this agreement, are secure. For purposes of this Section, a connection is defined as a dedicated persistent interface between an Agency IT system and an external IT system for the purpose of transferring information. Transitory, user-controlled connections such as website browsing are excluded from this definition.

If the recipient's connections as defined above do not go through the Environmental Information Exchange Network or EPA's Central Data Exchange, the recipient agrees to contact the EPA Project Officer (PO) no later than 90 days after the date of this award and work with the designated Regional/Headquarters Information Security Officer to ensure that the connections meet EPA security requirements, including entering into Interconnection Service Agreements as appropriate. This condition does not apply to manual entry of data by the recipient into systems operated and used by EPA's regulatory programs for the submission of reporting and/or compliance data.

(2) The recipient agrees that any subawards it makes under this agreement will require the subrecipient to comply with the requirements in (b)(1) if the subrecipient's network or information system is connected to EPA networks to transfer data to the Agency using systems other than the Environmental Information Exchange Network or EPA's Central Data Exchange. The recipient will be in compliance with this condition: by including this requirement in subaward agreements; and during subrecipient monitoring deemed necessary by the recipient under 2 CFR 200.332(d), by inquiring whether the subrecipient has contacted the EPA Project Officer. Nothing in this condition requires the recipient to contact the EPA Project Officer on behalf of a subrecipient or to be involved in the negotiation of an Interconnection Service Agreement between the subrecipient and EPA.

All Other Programmatic Conditions Remain the Same.

EXHIBIT F

Understanding and Control of Municipal Solid Waste Landfill Air Emissions Grants

Across the world, communities generate residential, commercial, and industrial waste that goes to municipal landfills, which generate gas as the waste degrades. About half of landfill gas emissions are methane, which contribute significantly to climate change.

Landfills also emit other gases that can adversely affect human health and the environment. Due to the significant health and climate impacts of these emissions, EPA is committed to developing and identifying better technologies for measuring and mitigating them.

Historically, there has been a limited ability to understand and quantify landfill gas emissions. These include hazardous air pollutants like benzene, odor nuisance compounds like hydrogen sulfide (H2S), and contaminants of emerging concern like per- and poly-fluoroalkyl substances (PFAS). While EPA has developed several landfill emissions estimation tools for public use, lack of quantitative data relating to landfills, how they are managed, and environmental conditions that affect their emissions has limited the accuracy of these tools.

EPA awarded $4.6 million in research grants to quantify and mitigate municipal solid waste landfill emissions.

These projects will help advance methods for monitoring and quantifying landfill emissions of methane and other pollutants, evaluate strategies for reducing these emissions, and improve understanding of how municipal solid waste landfill emissions may change due to future climatic conditions, including extreme weather events. Grantees will use a variety of sensing techniques and modeling approaches to compare current landfill technologies and provide a basis for the future of landfill emission mitigation and management.

To learn more, visit the RFA webpage.
<https://cfpub.epa.gov/ncer_abstracts/index.cfm/fuseaction/display.rfatext/rfa_id/701>

The following institutions are receiving an award:

University of Delaware, Newark, Del.

Project Title: Evaluation and Control of Emissions from Municipal Solid Waste (MSW) Landfills: Direct Measurement and Modeling

Principal Investigator: Paul T. Imhoff

Award Amount: $999,831

Project Summary: Grantees will use stationary, mobile, aerial, and remote sensing technologies to characterize methane emissions at two landfills and evaluate the accuracy of new emissions estimation methodologies. The team will then apply an atmospheric dispersion model, the Weather Research Forecasting (WRF) model, to the data. Researchers will use the WRF to predict emissions for unmeasured periods, evaluate landfill management practices, quantify errors in measurement technologies, and guide technology application. At a significantly lower cost than field testing alone, this project aims to improve uncertainty estimates for methane emissions and enable extrapolation for measuring unmeasured gas emission periods.

View the research abstract from the University of Delaware.
<https://cfpub.epa.gov/ncer_abstracts/index.cfm/fuseaction/display.abstractdetail/abstract_id/11432/report/0>

University of Miami, Miami, Fla.

Project Title: Integrating multi-source data for landfill methane emission quantification

Principal Investigator: Jiayu Li

Award Amount: $594,550

Project Summary: The objectives of the proposed project are to 1) develop low-cost air quality sensors to capture spatial and temporal variation in methane; 2) use sensor data from fixed locations, mobile sampling, and drone surveys to map pollution distribution and estimate emission fluxes; and 3) evaluate methane reduction techniques by correlating resolved methane emission data with multiple environmental factors. Researchers will use the data to identify key drivers for landfill methane emissions and lay the basis for evaluating and comparing current landfill technologies.

View the research abstract from the University of Miami.
<https://cfpub.epa.gov/ncer_abstracts/index.cfm/fuseaction/display.abstractdetail/abstract_id/11434/report/0>

University of Wisconsin, Madison, Wis.

Project Title: Analysis of Continuous Monitoring Data with Inverse Atmospheric Models to Improve Landfill Gas Emissions Data and Elucidate Drivers of Emissions

Principal Investigator: James J. Schauer

Award Amount: $998,049

Project Summary: The goal of this project is to demonstrate and standardize inverse modeling and spatial mapping methods for quantifying emissions of methane and other health-impacting gases, such as carbon dioxide and hydrogen sulfide. The team will deploy high-sensitivity laser-based sensors to measure methane and other gas emissions at downwind locations of four landfills in the U.S. Drone mapping will be used to identify emission hotspots and the location of fugitive emissions. Researchers

will use their low-cost method to provide continuous measurements of landfill emissions at these four landfills and quantify the impact of landfill design and operation on gaseous emissions.

View the research abstract from the University of Wisconsin Madison.
<https://cfpub.epa.gov/ncer_abstracts/index.cfm/fuseaction/display.abstractdetail/abstract_id/11431/report/0>

University of Colorado, Boulder, Boulder, Colo.

Project Title: Integrating Measurements Across Platforms to Feasibly Assess Emissions and Mitigation of Methane and VOCs from Landfills

Principal Investigator: Michael Hannigan

Award Amount: $1,000,000

Project Summary: Grantees will develop multiple sets of cost-effective tools and approaches that the landfill industry can use to improve sustainability. At three landfills, researchers will use a combination of ground-based, aircraft, and satellite tools to assess uncertainty in landfill methane emissions. The project will produce subsets of all available landfill emission and volatile organic compounds (VOC) emissions data, focusing on complementary strengths and weaknesses. This data can be applied by the waste management industry to establish a baseline for the next steps in landfill technology innovation.

View the research abstract from the University of Colorado Boulder.
<https://cfpub.epa.gov/ncer_abstracts/index.cfm/fuseaction/display.abstractdetail/abstract_id/11433/report/0>

University of California, Berkeley, Berkeley, Calif.

Project Title: Next-Generation Landfill Monitoring: A Multi-Scale Approach to Measuring Emissions for Evaluating and Financing Interventions

Principal Investigator: Dimitrios Zekkos

Award Amount: $1,000,000

Project Summary: This project will develop a multi-scale, multi-sensor approach to monitor emissions more effectively and at a lower cost. Researchers will 1) test methodology for emissions measurements, 2) assess emission mitigation strategies, and 3) quantify the emissions benefits from a range of mitigation and landfill management methodologies to form the basis of a new emissions reduction quantification methodology. The multi-sensing, multi-temporal dataset will quantify the impact of weather and climate, landfill conditions and management practices, and mitigation strategies on emissions to inform future data-driven methane models. This dataset can then be used to generate carbon offsets and create financial incentives to reduce emissions.

View the research abstract from the University of California Berkeley. <https://cfpub.epa.gov/ncer_abstracts/index.cfm/fuseaction/display.abstractdetail/abstract_id/11430/report/0>

Related Resources

- Learn more about these awards <https://cfpub.epa.gov/ncer_abstracts/index.cfm/fuseaction/recipients.display/rfa_id/701/records_per_page/all>
- EPA Research Grants <https://epa.gov/research-grants>

Last updated on October 21, 2024

EXHIBIT G

U.S. ENVIRONMENTAL PROTECTION AGENCY

Assistance Amendment

GRANT NUMBER (FAIN): 84062301 **MODIFICATION NUMBER:** 2 **PROGRAM CODE:** RD	**DATE OF AWARD** 04/29/2025
TYPE OF ACTION No Cost Amendment	**MAILING DATE** 04/29/2025
PAYMENT METHOD: ASAP	**ACH#** 0016

RECIPIENT TYPE:
State Institution of Higher Learning

Send Payment Request to:
Contact EPA RTPFC at: rtpfc-grants@epa.gov

RECIPIENT:
Regents of the University of California, The
1608 4th St Ste 220
Berkeley, CA 94710-1749
EIN: 94-6002123

PAYEE:
Regents of the University of California, The
1608 4th Street, Suite 201
Berkeley, CA 94710-1749

PROJECT MANAGER	EPA PROJECT OFFICER	EPA GRANT SPECIALIST
Dimitrios Zekkos 425 Davis Hall Berkeley, CA 94720-0001 **Email:** zekkos@berkeley.edu **Phone:** 510-289-7598	Elisa Davey 1200 Pennsylvania Ave NW Washington, DC 20460 **Email:** Davey.Elisa@epa.gov **Phone:** 202-564-8924	Jennifer Brooks 1200 Pennsylvania Ave. NW, 3903R Washington, DC 20460 **Email:** brooks.jennifer@epa.gov **Phone:** 202-564-6374

PROJECT TITLE AND EXPLANATION OF CHANGES

Next-Generation Landfill Monitoring: A Multi-Scale Approach to Measuring Emissions for Evaluating and Financing Interventions

This amendment is to stop work; terminate the agreement; reduce performance period duration; curtail scope of work; and waive certain reporting requirements. Administrative terms and conditions are added.

Per 2 CFR 200.340 and the Termination General Terms and Conditions of this agreement, EPA is terminating this award. Your organization shall immediately stop work and take all reasonable steps to minimize the incurrence of costs otherwise allocable to the assistance agreement. See terms and conditions.

BUDGET PERIOD	PROJECT PERIOD	TOTAL BUDGET PERIOD COST	TOTAL PROJECT PERIOD COST
11/01/2023 - 04/29/2025	11/01/2023 - 04/29/2025	$ 1,000,000.00	$ 1,000,000.00

NOTICE OF AWARD

Based on your Application dated 12/21/2022 including all modifications and amendments, the United States acting by and through the US Environmental Protection Agency (EPA) hereby awards $ 0.00. EPA agrees to cost-share 100.00% of all approved budget period costs incurred, up to and not exceeding total federal funding of $ 1,000,000.00. Recipient's signature is not required on this agreement. The recipient demonstrates its commitment to carry out this award by either: 1) drawing down funds within 21 days after the EPA award or amendment mailing date; or 2) not filing a notice of disagreement with the award terms and conditions within 21 days after the EPA award or amendment mailing date. If the recipient disagrees with the terms and conditions specified in this award, the authorized representative of the recipient must furnish a notice of disagreement to the EPA Award Official within 21 days after the EPA award or amendment mailing date. In case of disagreement, and until the disagreement is resolved, the recipient should not draw down on the funds provided by this award/amendment, and any costs incurred by the recipient are at its own risk. This agreement is subject to applicable EPA regulatory and statutory provisions, all terms and conditions of this agreement and any attachments.

ISSUING OFFICE (GRANTS MANAGEMENT OFFICE)	AWARD APPROVAL OFFICE
ORGANIZATION / ADDRESS	**ORGANIZATION / ADDRESS**
Environmental Protection Agency, Grants Management & Business Operations Division 1200 Pennsylvania Ave, NW Mail code 3903R Washington, DC 20460	Environmental Protection Agency, OSAPE ORD - Office of Research and Development 1200 Pennsylvania Ave., NW Washington, DC 20460

THE UNITED STATES OF AMERICA BY THE U.S. ENVIRONMENTAL PROTECTION AGENCY

Digital signature applied by EPA Award Official for LaShaun Phillips - Associate Award Official **by** LaShaun Phillips - Award Official Delegate	**DATE** 04/29/2025

EPA Funding Information

FUNDS	FORMER AWARD	THIS ACTION	AMENDED TOTAL
EPA Amount This Action	$ 1,000,000	$ 0	$ 1,000,000
EPA In-Kind Amount	$ 0	$ 0	$ 0
Unexpended Prior Year Balance	$ 0	$ 0	$ 0
Other Federal Funds	$ 0	$ 0	$ 0
Recipient Contribution	$ 0	$ 0	$ 0
State Contribution	$ 0	$ 0	$ 0
Local Contribution	$ 0	$ 0	$ 0
Other Contribution	$ 0	$ 0	$ 0
Allowable Project Cost	$ 1,000,000	$ 0	$ 1,000,000

Assistance Program	Statutory Authority	Regulatory Authority
66.509 - Science to Achieve Results (STAR) Program	Clean Air Act: Sec. 103	2 CFR 200, 2 CFR 1500, 40 CFR 33 and 40 CFR 40

Budget Summary Page

Table A - Object Class Category (Non-Construction)	Total Approved Allowable Budget Period Cost
1. Personnel	$ 295,905
2. Fringe Benefits	$ 40,003
3. Travel	$ 15,512
4. Equipment	$ 0
5. Supplies	$ 28,483
6. Contractual	$ 0
7. Construction	$ 0
8. Other	$ 343,172
9. Total Direct Charges	$ 723,075
10. Indirect Costs: 60.50 % Base MTDC	$ 276,925
11. Total (Share: Recipient 0.00 % Federal 100.00 %)	$ 1,000,000
12. Total Approved Assistance Amount	$ 1,000,000
13. Program Income	$ 0
14. Total EPA Amount Awarded This Action	$ 0
15. Total EPA Amount Awarded To Date	$ 1,000,000

Administrative Conditions

UNILATERAL TERMINATION

1. The Agency is asserting its right under 2 CFR 200.340 and the Termination General Term and Condition of this agreement to unilaterally terminate this award. This amendment serves as required notice under 2 CFR 200.341.

2. Consistent with 2 CFR 200.343 Effect of suspension and termination, costs to the recipient or subrecipient resulting from financial obligations incurred by the recipient or subrecipient after the termination of a Federal award are not allowable. Costs after termination are allowable if:

a. The costs result from financial obligations which were properly incurred by the recipient or subrecipient before the effective date of suspension or termination, and not in anticipation of it; and

b. The costs would be allowable if the Federal award was not suspended or expired normally at the end of the period of performance in which the termination takes effect.

c. The costs are reasonable and necessary termination costs consistent with 2 CFR 200.472.

3. Federal Financial Reporting (FFR) General Terms and Conditions is still in full force and effect. EPA recipients must submit the SF-425 no later than 120 calendar days after the end date of the period of performance of the award.

4. Programmatic Terms and Conditions. Performance reporting is still in full force and effect. The recipient must submit the final report no later than 120 calendar days after the period of performance.

In accordance with 2 CFR 200.329, the recipient agrees to submit performance reports that include information on each of the following areas:

a. A comparison of accomplishments to the outputs/outcomes established in the assistance agreement work plan for the reporting period;

b. Explanations on why established outputs/outcomes were not met; and

c. Additional information, analysis, and explanation of cost overruns or high-than-expected-unit costs.

5. Waiver of Reports

The following reports are waived:

a. Utilization of Disadvantaged Business Enterprises General Terms and Conditions, EPA Form 5700-52A.

b. Tangible Personal Property Report, SF-428, General Terms and Conditions.

6. Record Retention

Access to Records, 2 CFR 200.337, is still in full force and effect. The termination of this award does not affect the right of EPA to disallow costs and recover funds on the basis of a later audit or other reviews. Information regarding record retention, property disposition in accordance with EPA regulations, and other frequently asked questions can be accessed at https://www.epa.gov/grants/frequent-questions-about-closeouts.

Programmatic Conditions

All Programmatic Conditions Remain the Same.

EXHIBIT H

OFFICE OF MISSION SUPPORT

WASHINGTON, D.C. 20460

April 29, 2025

MEMORANDUM

SUBJECT: Termination of EPA Assistance Agreement RD 84062301 under 2 CFR 200.340

FROM: EPA Award Official

TO: Peter Gudlewski, Contracts and Grants Officer
The Regents of the University of California

The purpose of this communication is to notify you that the U.S. Environmental Protection Agency (EPA) is hereby terminating Assistance Agreement No. RD 84062301 awarded to The Regents of the University of California. This EPA Assistance Agreement is terminated in its entirety effective immediately on the grounds that the award no longer effectuates the program goals or agency priorities. The objectives of the award are no longer consistent with EPA funding priorities.

The EPA Administrator has determined that, per the Agency's obligations to the constitutional and statutory law of the United States, this priority includes ensuring that the Agency's grants do not conflict with the Agency's policy of prioritizing merit, fairness, and excellence in performing our statutory functions. In addition to complying with the law, it is vital that the Agency assess whether all grant payments are free from fraud, abuse, waste, and duplication, as well as to assess whether current grants are in the best interests of the United States.

The grant specified above provides funding for programs that promote initiatives that conflict with the Agency's policy of prioritizing merit, fairness, and excellence in performing our statutory functions; that are not free from fraud, abuse, waste, or duplication; or that otherwise fail to serve the best interests of the United States. The grant is inconsistent with, and no longer effectuates, Agency priorities.

The process for closeout is generally outlined in 2 CFR 200.344. EPA is clarifying what reports are required and what reports are waived below. Other requirements are still in effect if applicable to your grant.

EPA is requiring the following closeout reports due within 120 days of closeout (2 CFR 200.344a:)

- Final Federal Financial Report, SF-425
- Final Technical Report
- Other programmatic reports identified in your terms and conditions

As part of this termination, EPA is waiving the following closeout reports:

- Property Report, SF-428
- Final Minority Business Enterprise/Woman Business Enterprise Utilization Under Federal Grants and Cooperative Agreements, EPA Form 5700-52A

The recipient may request payment from the Automated Standard Application Payments (ASAP) system for allowable costs incurred up to the date of this memo provided that such costs were contained in the approved workplan. Costs incurred by you after this termination are allowable only if (a) those costs were properly incurred by you before the effective date of this termination, and not in anticipation of it; and (b) those costs would be allowable if your federal award was not suspended or expired normally at the end of the period of performance in which the termination takes effect. *See* 2 C.F.R. § 200.343. You are encouraged to carefully review and discharge your closeout responsibilities set forth in 2 C.F.R. § 200.344-45 and your award agreement. Those responsibilities include, but are not limited to, your obligation to "promptly refund any unobligated funds" that have been paid out but "are not authorized to be retained." *See* 2 C.F.R. § 200.344(g).

Also, per 2 CFR 200.472, a recipient may use grant funds to properly closeout their grant including reasonable and necessary costs that might occur after the date of this memo. If the recipient drew down funds from ASAP for costs beyond the termination date or for costs that exceed the amount necessary to properly closeout their grant, the recipient must contact RTPFC at rtpfc-grants@epa.gov for instructions on how to return the excess funds.

The EPA Grants Management Office has issued an amendment to the agreement to document the termination.

If you wish to dispute this termination decision, the Disputes Decision Official (DDO), Schindel.Phillip@epa.gov must receive the Dispute no later than 30 calendar days from the date this termination notice is electronically sent to you. Disputes must be sent electronically by email to the DDO, with a copy to the EPA Award Official, Phillips.LaShaun@epa.gov within the 30-day period stated above. The Dispute submitted to the DDO must include: (1) A copy of the disputed Agency Decision; (2) A detailed statement of the specific legal and factual grounds for the Dispute, including copies of any supporting documents; (3) The specific remedy or relief you seek under the Dispute; and (4) The name and contact information, including email address, of your designated point of contact for the Dispute. *See* 2 CFR 1500.15

The requirements on post-closeout adjustments and continuing responsibilities, including audit and record retention requirements, at 2 CFR 200.345 remain in effect.

ATTACHMENT
Amendment Document

cc: Jennifer Brooks, EPA Grant Specialist
Elisa Davey, EPA Project Officer
Dimitrios Zekkos, Grantee Program Manager