Exploratorium Sea Level Rise Education Initiative
February 21st, 2025
4th DRAFT FOR BCDC REVIEW

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1. INTRO AND SUMMARY

Despite a high level of agreement on climate change in the Bay Area,[1] there remains a gap between public understanding of the risks sea level rise poses to the region, and the urgency with which communities will need to prepare for the impacts. Responding to these risks will require an unprecedented level of collaboration across agencies, communities, academic institutions, and scientific and cultural institutions.

[1] Yale Project on Climate Change Communication, Yale Climate Opinion Maps, 2023
https://climatecommunication.yale.edu/visualizations-data/ycom-us/

Creating opportunities for Bay Area residents to build their understanding of the complexities and nuances of climate phenomena is critical in fostering participation in this process. As an institution dedicated to illuminating the interconnections between science, art, and human perception, the Exploratorium is well positioned to offer a holistic and interdisciplinary approach to public education about sea level rise.

The Exploratorium has developed a draft proposal for an education initiative focused on supporting public engagement with sea level rise content and adaptation efforts. Exploratorium's sea level rise education plan seeks to build upon recommendations made in regional[2], state[3], and national[4] guidance for sea level rise and climate adaptation. Public education, both in the classroom and in the public sphere, are complementary to civic engagement efforts. The initiative consists of several components, including public space activations, K-12 teacher professional development, public programming, and online resources. The initiative will be further developed and refined in collaboration with the Port of San Francisco, SF Bay Conservation and Development Commission, and other relevant partner organizations across the region.

A place-based approach to sea level rise education

Place-based education is a contemporary term referring to forms of pedagogy that connect learning to local ecological, cultural and historical contexts.[5] It has many precedents within traditional/Indigenous scholarship and western educational theory. Some examples include; traditional ecological knowledge, peripatetic teaching, nature studies, experiential learning, community-based education, environmental education, community science, real-world problem solving through internships and service work. As a practiced methodology it joins professional expertise and scholarship with every-day lived experience.

Rooted in the local, place-based learning connects people to their local landscape; the ecology, heritage and cultures that define their everyday experience. It is a form of learning that emphasizes participation in activities within one's home and community where cultural values, personal experience and beliefs are often shared. A place-based approach asks us to question histories and injustices that create current conditions.

For many, understanding the science and impacts of sea level rise can feel overwhelming and complex - and can be a place where science communication methods are over-professionalized and not easily translated. By focusing on one's own *sense of place*, landscape and community, learning can happen at a more intimate and manageable scale. In this way spaces can be created where personal knowledge and care are valued along with, and in dialogue with, the expertise of local scientists, planners and policy makers. A goal of place-based knowledge in relation to climate change is that it acts to guide and inform future perspectives on policy and adaptation planning.

The Exploratorium's focus on adaptation has evolved from a process of critical observation at Piers 15 and 17. Learning about the Bay and the future of sea level rise has led us to question how we can be a positive force for transforming the shoreline in a time of uncertainty. Bringing in expertise from science partners like NOAA, Indigenous knowledge through our relationships with Ohlone partners, and governance

[2] Bay Adapt Joint Platform, Action 3 https://www.bayadapt.org/joint-platform-information/#action-3
[3] California Adaptation Planning Guide https://www.caloes.ca.gov/wp-content/uploads/Hazard-Mitigation/Documents/CA-Adaptation-Planning-Guide-FINAL-June-2020-Accessible.pdf
[4] NOAA's Office of Education Environmental Literacy Program Community Resilience Education Theory of Change https://www.noaa.gov/education/explainers/noaas-community-resilience-education-theory-of-change
[5] Elfer, C. J. Sr. (2011). Title: Place-based education (Doctoral dissertation). University of Georgia, Mary Frances Early College of Education. https://esploro.libs.uga.edu/esploro/outputs/9949334514802959

perspectives through the Port of SF and others, allows us to offer a multidimensional approach to the problems at hand.

2. PROGRAM GOALS AND PUBLIC BENEFIT

In alignment with sea level rise and resilience guidance from local to national levels, we propose the following broad programmatic goals;

- Increase public understanding of sea level rise in the Bay Area from impacts to solutions
- Elevate public awareness of regional cooperation initiatives and shared vulnerabilities
- Expand student engagement with sea level rise content through teacher professional development and field trip opportunities

We offer that these goals will provide public benefit in both the short and medium term through direct engagement with elements of the program, and long-term through the impacts of increased understanding and elevated profile of sea level rise in the Bay Area.[6]

Short term 1-3 years:

The public will have access to high-quality exhibits and experiences about sea level rise usually reserved for the Exploratorium's paying visitors. This will include opportunities to interact with exhibits in public space, experience art installations, and engage in complex topics surrounding understanding and adapting to sea level rise in the Bay Area.

Teachers in the Bay Area will have access to high-quality professional development and enrichment around sea level rise education including in-person and remote trainings. Teachers, students, and their families will have access to online resources about sea level rise including "Science Snacks" at-home activities and consolidated resources on sea level rise from relevant regional sources.

Mid-term 3-5 years:

Public programming will be developed with communities in different parts of the Bay Area, and built elements will be assessed for longer-term installation possibilities in additional locations. Online materials will remain accessible and open to the public. At the mid-term mark, we expect that the elevated awareness about sea level rise will translate to greater public support of and engagement with local planning efforts to adapt to sea level rise.

Long-term 5+ years:

[6] For additional information about evaluation see section 8, Reporting and Evaluation

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Sea level rise education is elevated as critical learning material for Bay Area students, and teachers are more comfortable with and motivated to teach sea level rise content as a result of increased access to resources and trainings. Students engaged with sea level rise material in years 1-5 have an increased understanding of the impacts of sea level rise and are better prepared for adaptation planning in their communities.

3. CORE CONCEPTS

Content and concepts will be identified in partnership with BCDC, SF Port, and local partners. As a starting point, some of the topline concepts are as follows;

- Sea level rise foundations- Land ice melt, thermal expansion, tides, weather
- Climate resilience and adaptation pathways
- Groundwater rise and toxic sites
- Indigenous relationship to land and sea level
- Natural and nature-based solutions
- Historical ecology, land use, and bay fill
- Interconnectivity of the region through infrastructure vulnerability

4. PROGRAM OBJECTIVES

In order to achieve the goals outlined above, the Exploratorium proposes the following objectives, to be discussed and refined with SF Port and BCDC staff. Deliverables will need to be further developed to determine cost and feasibility, phasing, timeline, and work products. These are questions that will relate to broader site planning efforts at the museum and along the seawall.

Public Experience & Regional Engagement

Create exhibits, programs, and online media that amplify sea level rise content and adaptation activities that are free to the public.

- SF Waterfront- Exhibits including artworks in public space at the Exploratorium and/or additional waterfront locations, public programs focused on regional sea level rise, adaptation and resilience, and climate justice.
- Regional engagement - Programming and temporal Site Explorations around the Bay
- Adaptation resources, data visualizations, and stories hosted on the Exploratorium website and in the Bay Observatory, accessible during public events

Educator Experience & Student Engagement

Curricular material and educator workshops that support sea level rise and adaptation teaching that are free.

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- Sea level rise and adaptation solution classroom resources and educator professional development workshops
- Support adaptation-focused student field trips to the Exploratorium and Bay locations
- Offer professional development activities for community group leaders

Collaborative Design and Evaluation

Throughout the program, follow a collaborative design process and apply equity framework

- Consult with regional community collaborators to refine goals, equity approaches, actions, evaluation metrics
- Annual report out to the Port and BCDC

Exhibits in Public Space at Exploratorium- 'Field Station' concept

Contingent on strategic planning processes for our site and for the SF Waterfront, the public plaza at Piers 15 and 17 will offer an exciting opportunity for placemaking along the Embarcadero. Examples of concepts for a Field Station could include:

- Permanent Land Acknowledgment- Recognize Ohlone peoples and their connection to the waterfront, in partnership with the Association of Ramaytush Ohlone and the Am. Indian Cultural District
- Shifting Shorelines outdoor exhibit, highlighting the relationship between historic bay fill and sea level rise vulnerability
- Color of Water outdoor exhibit, highlighting the living dynamics of the bay
- Sea Level Rise Cylinder - a large scale cylinder-like piling with sea-level rise data inscribed around it so one can easily see the predicted rise over time.
- Tidal Ribbon outdoor exhibit - a 3d visualization/constructed to show tidal variation over time
- Ground Graphics: Designate the area between the grating and east railing with informative text, data, maps, or patterns.
- Climate Compass (ground graphic): Artist collaboration guiding visitors towards understanding sea level rise time horizons at the specific location
- Seawall Sculpture: A 3D representation of the seawall for tactile learning.
- Graphic exhibits (wall): Integrate graphics that represent the living seawall, infrastructure and historic maps, images - stories of change on the waterfront
- Commissioned artwork exploring sea level rise
- REVEAL the seawall - by opening up the grate or adding a viewing portal

5. PROJECT PHASING

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	PHASE 1, 2025-2026	PHASE 2, 2026-2027	PHASE 3 2027-2029
PUBLIC EXPERIENCE AND REGIONAL ENGAGEMENT			
Output 1: Develop sea level rise exhibits and programs at the Exploratorium site that are free and open to the public.	Develop and prototype Field Station; public exhibits, programs, and waterfront activations **(See Fig. 1 for additional detail)**	Fabrication and Installation at Exploratorium public plaza, and artwork with programmatic activations. Prototyping programs and exhibits at additional sites along waterfront.	Evaluation and assessment of Field Station, with assessment of exhibit re-location to additional sites across the waterfront
Output 2: Engage with regional partners for temporal, site-specific programming	Test existing prototypes with partners at 'Site Exploration' pop-ups in public space along the shoreline.	Refine concepts, round two prototyping contingent on community response and funding availability. Assess additional locations.	Contingent on community response and funding availability, pilot installations at selected sites for exhibit relocation
Output 3: Sea level rise online engagement, data visualizations for Observatory wall	Identify existing resources for Exploratorium website and assess potential approaches for story collection	Website up and running with existing resources and new content, social media posts	
EDUCATOR AND STUDENT ENGAGEMENT			
Output 1: Develop and distribute activities for use in K-12 classrooms	Develop classroom 'Science Snacks'[7]	Classroom 'Science Snacks' published online	
Output 2: Develop and offer workshops for Bay Area teachers and community leaders	Educator workshops in-person and online, offered to community leaders	Develop additional classroom activities through summer workshops, test with teachers and community leaders	
Output 3: Guided field trips to Exploratorium	Field trip days with guided shoreline tours, King Tides programming	Field trip days with guided shoreline tours, King Tides programming	Field trip days with guided shoreline tours, King Tides programming
COLLABORATIVE DESIGN AND EVALUATION			

[7] 'Science Snacks' are "Low cost, teacher-tested activities for the classroom and the curious." https://www.exploratrium.edu/snacks

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Output 1: Collaborate with regional partners on public space engagement	Planning meetings to direct program content	Continuing collaboration, annual meeting	Planning and evaluation of program
Output 2: Evaluation and report	Annual report out to SF Port, BCDC	Annual report out	Final evaluation

6. ARCHITECTURAL AND EXHIBIT TIMELINE

The following timeline corresponds to built and physical program elements. Educational and programmatic deliverables will occur throughout these three phases, and will serve to enrich the collaborative process with stakeholders. This timeline will be contingent on project approval and permitting requirements.

Pre-Launch and Stakeholder Engagement
January 2025 - March 2025
3-5 Meetings with SF Port, BCDC, Association of Ramaytush Ohlone, and other relevant stakeholders to define concept toward staff report and Commission review.

Kick off and Concept Design
February 2025 - May 2025
Phase 1 Concept Design
March deliverable- 25% architectural and exhibit design package
2-4 meetings with SF Port, BCDC staff and relevant stakeholders
1 Public space prototypng sessions with exhibits under development

Phase 2 Concept Design
May Deliverable: 50% architectural and exhibit design package delivered
2 meetings with SF Port, BCDC staff and relevant stakeholders
3 Public space prototyping sessions with exhibits under development

Exhibit Design and Development
March, 2025 - September, 2025
Phase 1 Design and Development
Deliverable: 75% architectural and exhibit design package delivered
2-4 meetings with SF Port, BCDC staff and relevant stakeholders
2-4 Public Space prototyping sessions with exhibits under development

Phase 2 Design and Development
July Deliverable: 100% architectural and exhibit design package delivered
2-4 meetings with SF Port, BCDC staff and relevant stakeholders

Permitting and Installation
August 2025- March 2026

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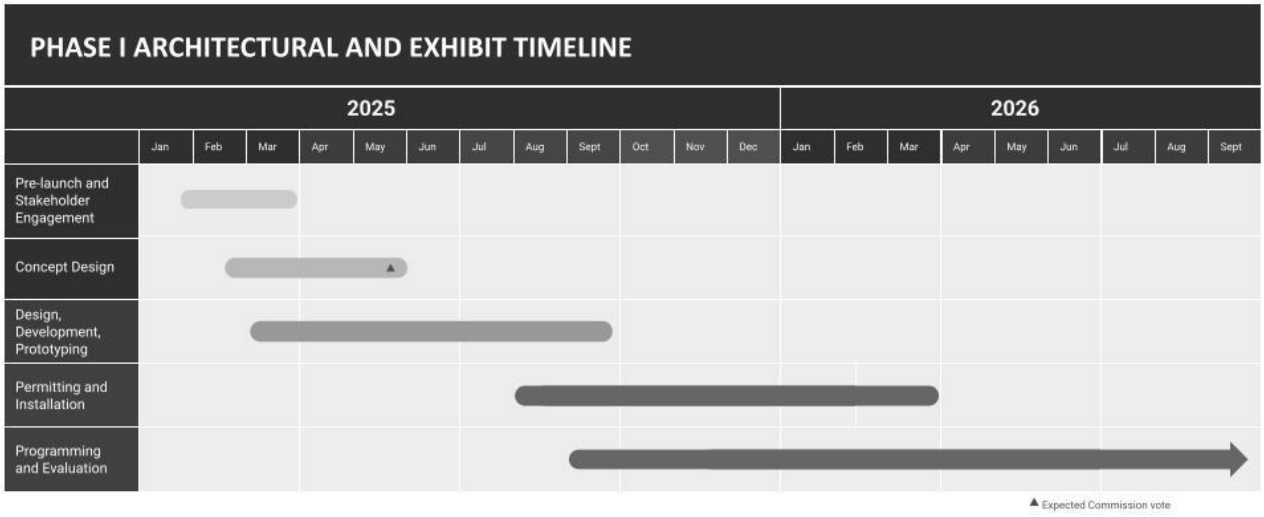
Exhibit Installation Drawings
August Deliverable: 100% exhibit fabrication package delivered

Permitting
August 2025 -November 2025
2-4 meetings with SF Port, BCDC staff and relevant stakeholders
3 Public space prototyping sessions with exhibits under development

Fabrication and installation
December 2025 – March 2026
Deliverable: 100% architectural and exhibit design fabricated and installed
On-going exhibit support and maintenance

Programming and Evaluation
April 2026 - September 2026
April deliverable- Opening program
Programming and activation at Field Station
Exhibit evaluation and waterfront resilience planning alignment
Long-term maintenance assessment

Fig. 1 High level Phase 1 Timeline for built elements



7. KEY PARTNERS IN PHASE 1

In addition to the Port of SF and BCDC, the Exploratorium will continue identifying partners for Site Exploration programs along the shoreline in low-lying areas of the Bay. Some of the partners we will be working with this year are:

Mycelium Youth Network

Mycelium Youth Network is a non-profit organization based in Oakland. MYN "prepares youth in the SF Bay Area — who are most vulnerable to and already feeling the effects of environmental racism — for climate change."[8] MYN will be engaged in developing sea level rise curriculum for the classes they work in, and will be a collaborator on potential Site Exploration events on the SF Waterfront and potentially in other locations across the Bay.

Association of Ramaytush Ohlone

The Exploratorium has been in conversation with the Association of Ramaytush Ohlone and the American Indian Cultural District for a number of years about the Ohlone Waterfront Trail- a series of site-markers and interpretation illuminating the Ramatush Ohlone people and their homeland. This will be in further development in 2025 as a part of the Field Station concept. This could also be an opportunity for engagement with other SF institutions that could serve as sites and stewards of additional sites.

Additional partners and sites for consideration

The following are organizations we have worked with in the past on Site Explorations, or are in conversations with currently about installation opportunities. Additional partners in the nine counties could be approached.

- San Rafael- Canal Alliance
- Cooley Landing- Grassroots Ecology, Climate Resilient Communities, KQED Live
- MLK Shoreline- Sacred Spaces project
- Lake Merritt Boathouse- Rotary Nature Center Friends
- Heron's Head Park- EcoCenter and SF Port

8. REPORTING AND EVALUATION

Reporting

Proposed formal integrated reporting process

The progress of this initiative will be integrated into the official reporting structure outlined in the Special Conditions of the Major Permit. We will provide a written annual report on or before January 1st of each calendar year that summarizes both the type and number of engagement events in each of the program objective categories, along with the estimated attendance for each event. In addition we will provide a progress report that documents the collaborative design process and summarizes the additional touch points held throughout the previous year.

[8] Mycelium Youth Network, Mission and Vision https://www.myceliumyouthnetwork.org/mission-vision

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Evaluation

Phase 1- Front-end Evaluation

For Phase 1, Senior Researcher Dr. Shawn Rowe of the Exploratorium's in-house Visitor Research and Engagement department (VRE) will work with a small team of VRE staff to carry out front-end evaluation to explore:

- Relationships among audiences' familiarity with and knowledge about sea level rise locally and as a global phenomenon
- Relationships among their sense of place, skills and dispositions relative to observing the natural world,
- Stories they tell about impacts from and solutions for sea level rise in the Bay Area.

The sample for this stage of evaluation will include:

- Approximately 100 short guided interviews with surveys will be carried out as part of the front-end evaluation utilizing quote sampling to reach a representative sample of visitors.
- Approximately 25 in depth interviews focused on observation and storytelling relative to sense of place and sea level rise.

This front-end work will inform the development of prototype exhibits and experiences in phase 1 as well as helping to develop instruments for data collection for formative evaluation.

Formative Evaluation

Beginning in Phase 1 and continuing through Phase 2, the evaluation focus will shift to formative work as part of prototyping exhibits and experiences. The VRE team will conduct cycles of formative evaluation of visitors' responses to the prototypes. These formative evaluations will use a variety of methods which may include:

- Focused observation of exhibit interaction and use
- Think aloud protocols
- Interviews designed to maximize exhibit useability and accessibility.

Where possible pre and post data will be collected to assess and track changes to content knowledge, dispositions, and narratives about sea level rise emerging as part of interaction with exhibit or program components. These methods are designed to allow the exhibit developers to quickly move through exhibit iterations before final fabrication and installation while at the same time identifying potential substantive and long-term impacts for visitors related to the overall project goals.

Summative Evaluation

Summative evaluation will be carried out with visitors, partners, and educators working with all aspects of the project. It will focus on content knowledge gains, changes in perspectives about the future of sea level rise in the Bay area, and knowledge about efforts being undertaken to create coordinated current and future responses. Data will be collected via observation, exit interviews, and surveys with subsets of visitor and professional groups. Qualitative and quantitative analysis will explore patterns of response, measurable changes to attitudes, beliefs, self-efficacy and knowledge, and will align these patterns with experiences and backgrounds of participants.

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Additional Evaluation Research and Context[9]

Long-term impact data from informal science learning experiences in museums and natural sites is sparse primarily because of logistical difficulties tracking visitors over time following any given visit (Anderson, Storksdieck, and Spock, 2006). Nonetheless, we do know from existing research that visits to museums and natural sites can and do have long-term impacts on knowledge and identity. These long-term impacts are associated with initial experiences that are social, emotionally charged (either positively or negatively), and often novel (Anderson, et al., 2006). Adults can often recall and describe experiences in specific museums or even with specific exhibits from family or school trips to museums decades after the fact (Anderson, 2003; Falk & Dierking, 1990). Experiences seeing charismatic cultural (e.g., mummies and sarcophagi) and natural (e.g., moon rocks and dinosaur skeletons) objects in particular create long-term memories and subsequent engagement with science topics in school or as hobbies (Anderson, 1999; Adelman, Falk & James, 2000; Bielick & Karns, 1998; Medved & Oatley 2000). We also know from research that natural environments (e.g., the Grand Canyon) and human-built environments (e.g., the Vietnam Veterans Memorial in Washington DC) often create long-term memories that shape not only knowledge but also contribute to sense of self (Stevenson, 1991; Ballantyne, et al., 2011).

The proposed "Field Station" can support such long-term impacts for visitors. One side of the site is dominated by the charismatic built-environment of the San Francisco skyline, an iconic image in popular culture worldwide. The other side of the site is occupied by the charismatic natural environment of the San Francisco Bay. When a visitor stands at the site, they will be standing at the very dynamic place where these two environments meet and change each other. This creates opportunities for experiences that can support individual and collective long-term engagement with environmental issues.

As mentioned, documenting such long-term impacts directly is out of the scope of this project. However, we know from the research cited above that 1) emotional engagement with the Field Station, 2) cognitive engagement with the Field Station, and 3) increased agency and efficacy relative to future engagement with environmental issues may serve as predictors of long-term impacts and may be documented through onsite observations, surveys and interviews.

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[9] Prepared by Shawn Rowe, Visitor Research and Engagement Researcher

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