Sea Level Rise Adaptation Funding and Investment Framework Final Report

Metropolitan Transportation Commission / Association of Bay Area Governments and the San Francisco Bay Conservation and Development Commission

July 2023

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Executive Summary

Sea level rise adaptation in the Bay Area will require a vivid reimagining of our relationship with the Bay, the Pacific Coast, and the Delta. From our iconic beaches, urban shorelines, bustling ports, and vast wetlands, no part of our shoreline will remain unchanged. Critically though, adapting successfully to this uncertain future will require significant amounts of funding that are not available now, nor anticipated to emerge in the near future.

The Sea Level Rise Adaptation Funding and Investment Framework (Framework) has been jointly developed by the San Francisco Bay Conservation and Development Commission, Metropolitan Transportation Commission, and Association of Bay Area Governments. It is the region's first report solely devoted to quantifying the magnitude of the funding required to protect the bay's shoreline from flooding due to sea level rise and storms by 2050. Fueled by the most robust data to date on what's been built, what's planned, and where the gaps are, it ultimately yielded the following key findings:

- Protecting all portions of the shoreline that will experience sea level rise and storm surge by 2050 is estimated to **cost $110 billion**. Some decisions may lower or raise the estimate, such as determining how the region prioritizes protection.
- Of that amount, Bay Area governments can account for **just over $5 billion being available through existing federal, state, regional, and local funding programs**. This leaves a gap of **approximately $105 billion** to fill in the next decades.
- While the cost of tackling this regional challenge is significant, failing to adapt would result in a much larger deficit. Even a partial estimate of the cost of inaction is anticipated to be **over $230 billion**.
- Some counties will experience more flooding sooner than others, meaning that adaptation **costs are not evenly distributed**. Some counties have planned and developed projects more than others, leading to questions about where new funding should go.
- Filling the funding gap will **require a mix of funding types and amounts**. There is no single "magic bullet" that can fill a $105 billion gap. Parcel taxes and ad-valorem taxes may be feasible options at the regional or county level, but both would need further study to advance equitable outcomes.
- **Developing equitable adaptation is paramount.** How we fill the funding gap can either exacerbate or maintain existing environmental injustices instead of ameliorating them. From who pays to who benefits, some solutions are simply more equitable than others.
- **A regional approach is critical.** Differences among counties in terms of vulnerability and planning indicate the need for a regional approach for funding and project development to ensure no one is left behind.

Despite these challenges, the Framework identifies some early steps to help further prepare the region for sea level rise adaptation, and many cities and counties have started to commit dollars to planning, developing project concepts, and even delivering projects. However, the challenge is significant, and the timeline is short. It is important that protections are in place ***before*** inundation occurs, and not rely on remediating potential social and economic damage.

In the months and years ahead, the following next steps are proposed to tackle this major regional challenge:

- **Prioritize sea level rise investments** through upcoming regional planning efforts by MTC/ABAG and BCDC, determining which areas require early action.
- **Explore opportunities to advance resilience through planned housing and transportation ballot measures.** To the extent possible, integrate policies and programs to support sea level rise adaptation.
- **Collect and maintain project data** through supporting the development of BCDC's Shoreline Adaptation Project Mapping Program.
- **Accelerate advocacy efforts.** Use updated data to pursue a larger share of state and federal dollars to protect people, places, and the environment.
- **Define lead roles to fund plans and projects.** There is no one clear agency tasked with securing and distributing funding, which means that this is not occurring in a timely and organized manner.
- **Support local and private efforts** to develop funding and financing tools.

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0. Introduction

Photo: Karl Nielsen, 2020

0.1 Context

The Bay Area is defined by its relationship to water, with iconic beaches on the outer coasts, vast wetlands and diverse habitats, maritime culture and commerce, and diverse shoreline communities spanning across the Bay, the Delta, and the Outer Coast. Transportation and infrastructure networks wind across the region's shoreline, connecting us to one another and supporting the region's vitality.

However, rising sea levels put the region at risk. The Bay Area is already experiencing the early impacts of rising sea level, including more extensive coastal flooding during storms, periodic tidal flooding, and increased coastal erosion. The California Ocean Protection Council estimates that the region may experience up to 1.4 feet of permanent sea level rise inundation by 2050, with 3.4-4.4 feet projected by 2100, dependent on global emissions[1], on top of storm-induced flooding. The impacts to the Bay Area will be significant - while the Bay Area accounts for a third of the California shoreline, two-thirds of the state's sea level rise impacts are anticipated to be felt in the region[2].

1 Based on the San Francisco projection for 5% exceedance. Ocean Protection Council. (2018). *State of California Sea-Level Rise Guidance: 2018 Update*. Page 18. https://www.opc.ca.gov/webmaster/ftp/pdf/agenda_items/20180314/Item3_Exhibit-A_OPC_SLR_Guidance-rd3.pdf

2 Barnard, P., Erikson, L., Foxgrover, A., et al. (2019). Dynamic Flood Modeling Essential to Assess the Coastal Impacts of Climate Change. *Scientific Reports*, 9, 4309. https://doi.org/10.1038/s41598-019-40742-z

The estimated impacts to the Bay Area through 2050 will be felt throughout the region (see Figure 2). Over 75,000 households are estimated to be directly at risk from sea level rise impacts, including over 12,000 in the region's most socially vulnerable communities[3], including households in communities like East Palo Alto, San Rafael's Canal District, and the Alviso neighborhood of San Jose. In addition, an estimated 200,000 jobs are anticipated to be at risk, affecting industries in Benicia, small businesses along the Marin County shorelines, the bustling tourism economy of San Francisco's Embarcadero, and internationally significant technology campuses lining the San Mateo County shore – among many others.

In addition, over 20,000 acres of the region's rich wetlands and other critical ecosystems are also at risk of inundation. As the sea levels rise, many habitats will not have the time or space to migrate upland and adapt. As a result, habitat for nearly a million migratory birds, nurseries for fish and shellfish, and other diverse species may all be affected. In addition, the wetlands help to mitigate flood impacts, enhance water quality, sequester carbon, and provide important recreational opportunities[4].

While there are cost estimates for some potential impacts, much of the impact of sea level rise is difficult to quantify. For example, the assessed value described below is not available as a market value, meaning that the true cost to parcels at risk in the region cannot currently be quantified. Other impacts are difficult to quantify in terms of dollars at all. For example, it is difficult to put a value on the region's diverse cultures, communities, and dynamic ecosystems. As such, the "cost of inaction" summaries in the Framework only captures a subset of the potential sea level rise impacts for the Bay Area.

Assets at risk of SLR flooding[5]:

75k total households, including **12k** in the most vulnerable communities.

200k total jobs, and **15k** total businesses.

20k vulnerable acres at risk, including depressional wetlands, lagoons, and tidal marshes[6].

Estimates of a Subset of Assets at Risk:
(in 2022 dollars)

$85 billion
Estimated assessed value of parcels at risk.

$151 billion
Estimated value of major roadways at risk[7].

3 Defined as moderate, high, or highest social vulnerability by BCDC's Community Vulnerability Data, which categorizes areas using a number of vulnerability indicators, such as income and race. https://data-bcdc.opendata.arcgis.com/datasets/BCDC::community-vulnerability-bcdc-2020/about

4 California State Coastal Conservancy. (2015). *The Baylands and Climate Change What We Can Do: Baylands Ecosystem Habitat Goals Science Update 2015.* Page xxiii. https://www.sfei.org/sites/default/files/biblio_files/Baylands_Complete_Report.pdf

5 Based on 4.9 feet of inundation. For additional information on the inundation assumption, please see Identifying Vulnerability.

6 BCDC and MTC/ABAG. (2020). *Adapting To Rising Tides Bay Area: Short Report Summary of Regional Sea Level Rise Vulnerability and Adaptation Study*. Page 11. https://www.adaptingtorisingtides.org/wp-content/uploads/2020/07/ARTBayArea_Short_Report_Final_March2020_ADA.pdf.

7 Calculated based on 230 miles of vulnerable major class roadways, using a median transportation adaptation cost of $125,000 per foot. Adaptation assumes only elevation or realignment and not protection in place or multi-benefit solutions. For additional cost assumptions, please see Estimating Regional Adaptation Needs Through 2050.

0.2 Regional and Local Planning Efforts

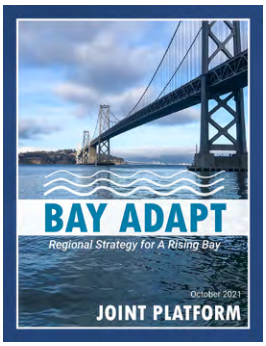
Regional agencies, including the Metropolitan Transportation Commission and the Association of Bay Area Governments (MTC/ABAG), the San Francisco Bay Conservation and Development Commission (BCDC), have strengthened the regional focus on sea level rise in recent years, building off long-standing regional efforts from California State Coastal Conservancy, the San Francisco Estuary Institute, the San Francisco Estuary Partnership (SFEP), and others. In 2021 and 2022, major regional planning efforts from MTC/ABAG, BCDC, and SFEP worked closely to align regional priorities on sea level rise.

Metropolitan Transportation Commission and Association of Bay Area Governments

Plan Bay Area 2050 Implementation Plan

2021

A multifaced regional plan that addresses housing, transportation, economic, and environmental challenges. “Adapt to Sea Level Rise” is one of 35 strategies in the Plan.

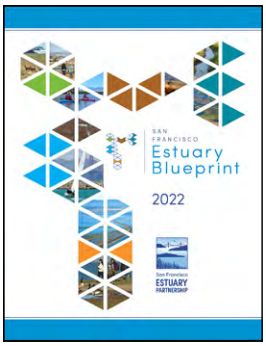


San Francisco Bay Conservation and Development Commission

Bay Adapt Joint Platform

2021

A Joint Platform of priority actions to advance long-term sea level rise adaptation in the Bay Area. The Joint Platform is made up of nearly two dozen priority actions, and is now advanced to implementation.



San Francisco Estuary Partnership

San Francisco Estuary Blueprint

2022

The Estuary Blueprint is a regional plan to achieve a healthy and resilient San Francisco Estuary. Sea level rise adaptation is embedded in the 25 identified actions.

Local efforts are more varied across the region. A 2021 regional survey on Bay Area Sea Level Rise Adaptation Progress, Gaps, and Needs focused on shoreline jurisdictions reported that 92 percent of respondents indicated they have insufficient resources to adequately plan and prepare for sea level rise, while 45 percent of respondents did not have an adaptation plan at all[8]. The local planning disparities emphasize the need for a regional approach. Without regional coordination and support, local jurisdictions with less capacity may not have the resources to either plan for or adapt to sea level rise.

8 BCDC, BayCAN, MTC/ABAG, BARC, SFEI, SFEP. (2021). *Sea Level Rise Adaptation Progress, Gaps & Needs Survey: 2021 Survey of Sea Level Rise Adaptation in the Bay Area*. Page 4. https://www.adaptingtorisingtides.org/wp-content/uploads/2021/11/2021-Progress-Gaps-Needs-Survey-Report_final_ADA.pdf

0.3 Regional Adaptation Funding

The recent regional efforts collaboratively identified a number of priority actions for sea level rise, spanning topics from planning to implementation. However, all three efforts identified a high priority action to pursue a regional sea level rise adaptation funding plan.

The action was identified in response to regional analysis, including the Plan Bay Area 2050 Sea Level Rise Needs and Revenue Assessment and BCDC's Bridging the Gap: Funding Sea Level Rise Adaptation in the Bay Area. Plan Bay Area 2050 estimated that the region may need $19 billion to adapt to two feet of permanent inundation, estimating a $16 billion gap when accounting for projected existing revenue sources[9]. Bridging the Gap summarized sea level rise damage estimates for the region, including the Plan Bay Area 2050 estimate and a study by the University of California at Berkeley. The analysis resulted in an estimated regional funding gap of roughly $315 million to $570 million per year to protect against two feet of permanent inundation, with higher estimates projected through 2100[10].

However, previous regional studies had not accounted for current and planned adaptation projects, nor thoroughly analyzed potential new revenue sources. In addition, state guidance on planning for sea level rise inundation was updated after the regional studies were completed (for more information on updated state guidance, see 1.1 Identifying Vulnerability).

In response to the regional call to action identified in major regional planning efforts, MTC/ABAG and BCDC collaboratively kicked off the Sea Level Rise Adaptation Funding and Investment Framework (Framework) in December 2021.

Metropolitan Transportation Commission and Association of Bay Area Governments

Plan Bay Area 2050 Implementation Plan

2021

Action 9. "Develop a sea level rise funding plan to support the implementation of projects that reduce sea level rise risks to communities, infrastructure and ecology, prioritizing green infrastructure wherever possible."

San Francisco Bay Conservation and Development Commission

Bay Adapt Joint Platform

2021

Task 6.1 "Expand understanding of the financial costs and revenue associated with regional adaptation."

Task 6.2 "Establish a framework for funding plans and projects."

San Francisco Estuary Partnership

San Francisco Estuary Blueprint

2022

Task 3-6 "Milestone – A sea level rise adaptation funding and investment framework for the San Francisco Bay Area."

9 MTC/ABAG. (2021). *Technical Assumptions Report – Technical Assumptions for the Environmental Element*. https://www.planbayarea.org/sites/default/files/documents/Plan_Bay_Area_2050_Technical_Assumptions_Report_October_2021.pdf

10 BCDC. (2021). *Bridging the Gap: Funding Sea Level Rise Adaptation in the Bay Area*. https://www.adaptingtorisingtides.org/wp-content/uploads/2021/12/ART_FundingFinancingPaper2021.12.20.pdf

0.4 What is the Framework?

Photo: Ben Botkin, 2020

The Framework is a joint effort from MTC/ABAG and BCDC. The Framework was created to help the region prepare for near-term adaptation funding opportunities by improving our advocacy for additional state and federal sources, while informing future discussions for long term adaptation funding approaches at the local and regional scales. The study area includes all nine Bay Area counties, including the San Francisco Bay (Bay), the California Outer Coast (Outer Coast), and the Sacramento-San Joaquin Delta (Delta).

The Framework is centered on regional partnership. Local and regional engagement took place throughout the project to support the development of a regional adaptation project inventory, and to share goals and outcomes. A Technical Advisory Group (TAG) made up of local, regional, and state stakeholders also supported the analysis with local knowledge and subject matter expertise throughout the project.

The Framework has three focus areas, each of which is detailed as a section in this report:

FOCUS AREAS

FA1. Update and improve regional accounting of planned, anticipated, and potential sea level rise adaptation projects.

FA2. Update and characterize existing revenue sources for sea level rise adaptation.

FA3. Study how new revenues for sea level rise adaptation needs can be raised most equitably.

OUTCOMES

- Update prior regional analysis with local projects from recent planning efforts.
- Estimate the regional sea level rise adaptation needs through 2050.

- Inventory and forecast revenues for new state and federal funding programs.
- Characterize how existing adaptation funds are dispersed and for what purpose.

- Analyze a range of possible revenue measures (parcel taxes, ad-valorem property taxes, and assessment districts) at different scales to understand equitable approaches to close the sea level rise funding gap.

KEY FINDINGS

$110 billion - Estimated cost of sea level rise adaptation through 2050 (in Year of Expenditure dollars)

$ 5.5 billion - Estimated existing revenue forecast through 2050 (in Year of Expenditure dollars)

- Regional and/or local measures will not be capable of closing the funding gap.
- For geographic equity, using multiple types of funding measures would help to balance the tax burden.
- Parcel taxes are less socially equitable than an ad-valorem tax, as they place a higher burden on socially vulnerable areas.

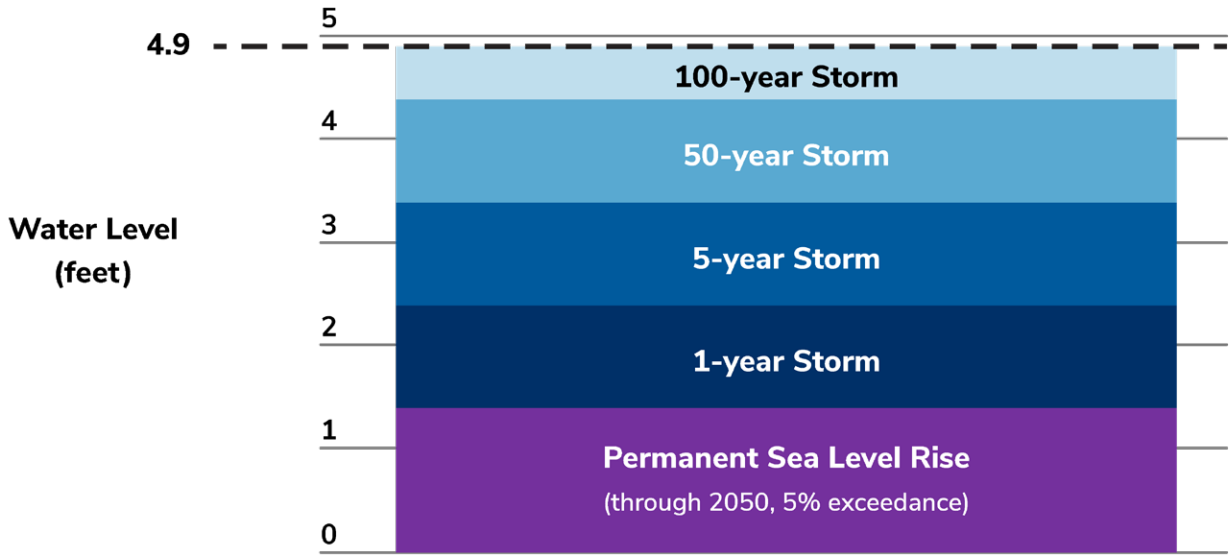
In addition to the report, details on Framework assumptions and methodologies can be found in the **Technical Appendix.** Connections to the Technical Appendix are referenced under relevant headings throughout the report. Not every heading has a related section in the Technical Appendix.

1. Update and Improve Regional Accounting of Anticipated Sea Level Rise Adaptation Projects

1.1 Identifying Vulnerability

The Framework assumed a threshold adaptation height to determine the scope of the analysis. The assumption focused on near-term inundation to align with other planning efforts. As such, the Framework relied on 2050 projections for permanent inundation by the California Ocean Protection Council published in 2018[11], plus an extreme storm surge scenario to meet state guidance recommendations to "Ensure California's coast is resilient to at least 3.5 feet of sea level rise by 2050[12]" and to coincide with many local planning efforts[13]. The Framework uses **4.9 feet of Total Water Level (TWL)** to identify adaptation vulnerability and protection.

Figure 1. Diagram Summarizing 4.9ft of Inundation



BCDC formally adopted the Ocean Protection Council Guidance in 2018 and it is currently considered "best available science" for regional sea level rise scenarios. The Ocean Protection Council recommended projections for 2050 range from 1.1-2.7 feet. The Framework also used regional precedents to support the inundation assumption. In Plan Bay Area 2050, one, two, and three feet of inundation were studied before a final two foot assumption for permanent inundation was used for the final plan. However, the state released updated guidance to plan for a minimum of 3.5 feet of sea level rise after initial Plan assumptions were set.

Supported by the TAG, the project team determined an approach to sum two values: a sea level rise projection height for the 2050 horizon year and additional height to account for temporary flooding risk from storms. The Framework used the 2018 Ocean Protection Council's 5% probability for 2050, which projects 1.4 feet of permanent inundation from sea level rise, combined with a 100 year storm, which is estimated to add 3.5 feet above MHW. The combined projected permanent inundation plus a 100 year storm is 4.9 feet TWL. While the sea level rise and storm impacts can at times be separately assessed, the Framework considers shoreline impacts as a whole, recognizing that short term inundation from storms overlaps with long term inundation from sea level rise over time.

11 Ocean Protection Council. (2018). *State of California Sea Level Rise Guidance: 2018 Update*. Page 18. https://www.opc.ca.gov/webmaster/ftp/pdf/agenda_items/20180314/Item3_Exhibit-A_OPC_SLR_Guidance-rd3.pdf

12 Ocean Protection Council. (2020). *Strategic Plan to Protect California's Coast and Ocean 2020-2025*. Page 7. http://www.opc.ca.gov/webmaster/ftp/pdf/agenda_items/20200226/OPC-2020-2025-Strategic-Plan-FINAL-20200228.pdf

13 The guidance was reinforced in: Sea-Level Rise Leadership Team. (2022). *State Agency Sea-Level Rise Action Plan for California*. https://www.opc.ca.gov/webmaster/_media_library/2022/08/SLR-Action-Plan-2022-508.pdf

The 4.9 foot assumption also allowed the Framework to align with currently available flood data layers. The 150 cm (or 4.9 foot) layer in United States Geological Survey Coastal Storm Modeling System mapping data was selected as the best available layer to study vulnerability in the Bay and Outer Coast. The dataset was selected based on how widely it was used in the industry, analytical ease, extensive availability of inundation heights, data resolution, and geographic coverage across the Bay and Outer Coast. Delta Adapts Flood Hazard data from the Delta Stewardship Council was used to represent Delta inundation due to its distinct hydrology. While depth of projected inundation varies in the Delta models due to its hydrology, the Framework used the mapping scenario that had inundation averages closest to the overall 4.9 foot inundation assumption.

The Framework analysis focuses on shoreline inundation from sea level rise and storm surge, but does not include stormwater, precipitation, and groundwater rise impacts. However, freshwater inflows from rivers and tributaries are estimated in some locations[14]. Groundwater mapping was not available at the regional level at the time of the analysis, though groundwater is accounted for in some local projects analyzed by the Framework. For additional information on sea level rise data assumptions, please see the **Technical Appendix**.

1.2 Creating a Shoreline Adaptation Inventory

The Framework created a shoreline adaptation project inventory to develop high-level cost estimates for regional adaptation, and to identify adaptation project implementation gaps.

Staff developed a draft inventory from two different sources:

- **Locally identified projects:** BCDC's Shoreline Adaptation Project Map (SAPMap) includes regionally identified adaptation projects that are in progress and mapped in the regional database, EcoAtlas[15].
- **Local project concepts:** identified by Framework project staff within local planning documents (e.g. General Plans, Vulnerability Assessments, Climate Adaptation Plans, Local Hazard Mitigation Plans) or through engagement with local jurisdictions. In addition to projects in progress, some early-stage adaptation concepts were also included[16]. Local project concepts were collected to find projects not yet identified in the SAPMap.
  - **Local studies** were defined as early-stage project concepts, and were represented separately due to the lack of definition in the project footprints, which would have inflated cost estimates.

BCDC's Shoreline Adaptation Project Mapping Program

The Shoreline Adaptation Project Map (SAPMap) identifies projects that have a nexus with sea level rise adaptation in the San Francisco Bay. The SAPMap is mapped within the EcoAtlas Project Tracker, a state-wide resource built to provide resources for wetland management. The SAPMap expands the scope of EcoAtlas to include adaptation activities that manage the shoreline, reduce flooding, or adapt to sea level rise, and may include gray, hybrid, or green design adaptation activities. The SAPMap was developed in coordination with the Framework, and will be maintained as a regional resource into the future to support the region's needs to track progress toward shoreline resilience goals.

The inventory projects span from nearshore, subtidal restoration projects to upland and developed flood protection projects, including some projects along stream channels where the head of tide has influence. Projects were selected based on sufficient design information, including a defined geography, identified adaptation activities (spanning green, hybrid, and gray activities, such as marsh restoration, ecotone levees, and seawalls, respectively), sea level rise design details, and project status. Adaptation activities were also sorted into generalized activity categories, or "archetypes", to help with estimating unknown costs later in the process. Projects that were too early in the planning stages to meet these data thresholds were generally not included in the inventory.

14 Our Coast Our Future. (2014). *San Francisco Bay – CoSMoS v.2.x Frequently Asked Questions*. https://ourcoastourfuture.org/wp-content/uploads/2022/02/San-Francisco-Bay_FAQ_2014.pdf

15 EcoAtlas: San Francisco Bay Adaptation Group. (2022, December). *San Francisco Bay Adaptation*. https://www.ecoatlas.org/groups/303

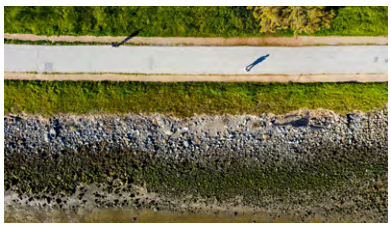
16 Local adaptation plans by utilities were not included in the scope of the analysis.

Figure 2. (Top to Bottom) Examples of Green, Hybrid, and Gray Infrastructure

Green Infrastructure Example

Marsh Restoration: rehabilitating or re-establishing a marsh area to return its natural functions and restore wetland habitat; 100,000 acres of marsh restoration is a goal for the region.

Photo: Kingmond Young



Hybrid Infrastructure Example

Ecotone Levees: creating a gently sloped levee, which can attenuate waves, ecotone levees provide a wetland-upland transition zone habitat and allow marshland to migrate upslope.

Photo: Noah Berger

Gray Infrastructure Example

Seawalls: constructing physical barriers of human-engineered materials in the case of sea walls to deter erosion and inundation[17].

Photo: Mike Gifford, Flickr

When available, cost and funding information was also collected, in addition to design conditions related to sea level rise height and extreme storm events to determine level of protection. In addition to projects, local studies were included when identified by a local jurisdiction.

Outreach on the draft inventory to local agencies was conducted in fall 2022 to verify the details of each project and to identify additional projects, starting and concluding with regional outreach meetings. To review the inventory, interviews were done with local staff across all nine Bay Area counties, including over 90 local contacts, including county staff, local staff, or staff at other agencies that led projects. The outreach began in September 2022 and was completed in December 2022. With local assistance, the project team was able to update two-thirds of the existing inventory with additional or updated project details, while adding 47 additional projects. In total, approximately 200 projects and study areas were identified, many with multiple sites or adaptation activities.

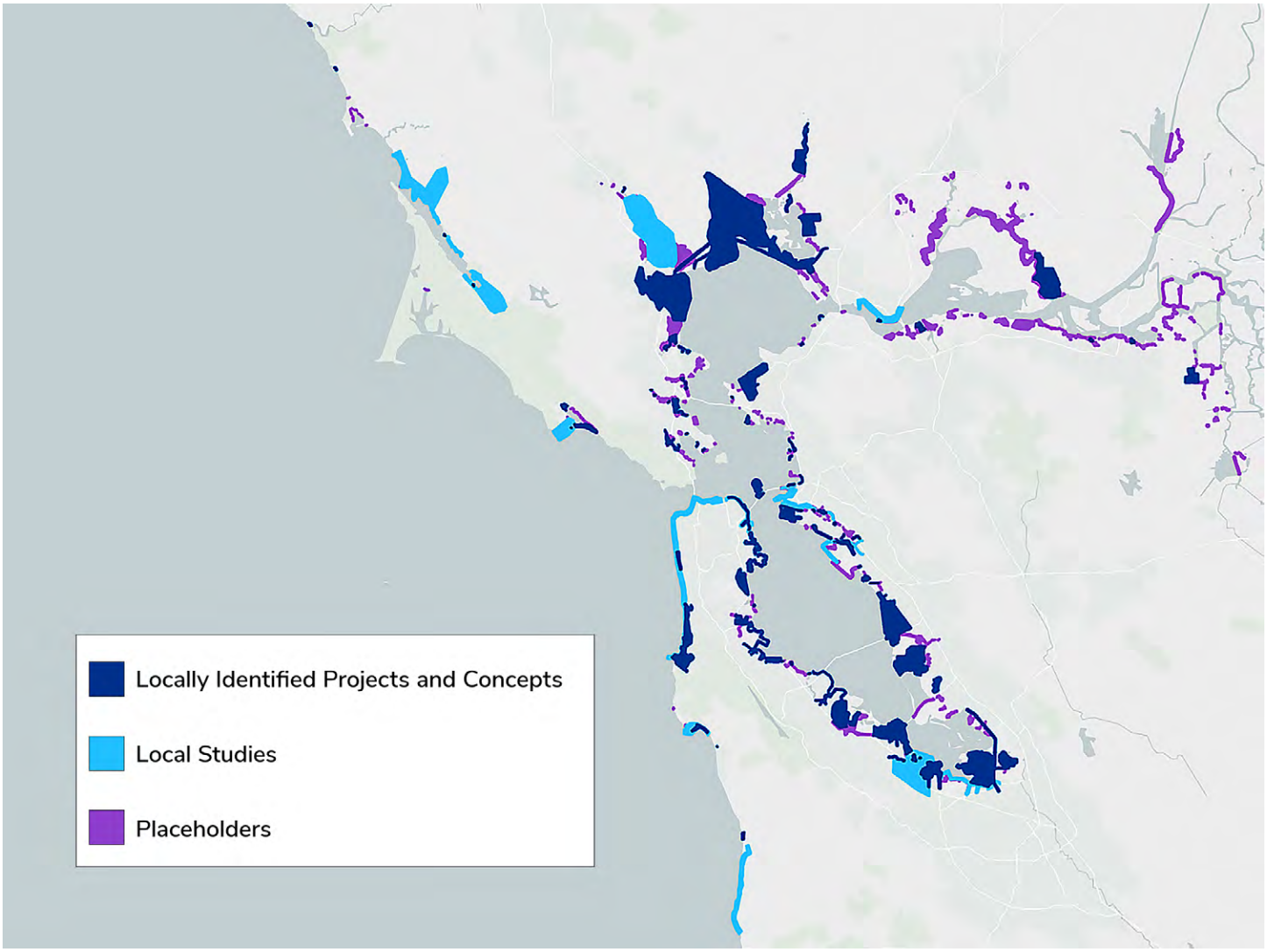
The Framework assumed the protection of all vulnerable segments of the shoreline in place through 4.9ft TWL of inundation, including low density areas and agricultural land. Based on the inventory, certain vulnerable shoreline segments were identified as not yet having sufficient project plans in place to provide adequate sea level rise protection. For example, projects that increased sea level rise resilience through means other than direct flood protection, such as providing wave attenuation, sediment accretion, erosion control and groundwater infiltration were kept in the inventory when identified due to their indirect benefits. However, additional flood protection was assumed to protect the developed edge of the shoreline.

To understand the regional funding need, the Framework needed to account for costs in areas with less advanced project planning or implementation. To this end, staff created **placeholders** to estimate adaptation costs in significantly inundated areas by assuming the protection of the shoreline in place. Placeholders were added in areas with no known project plans, local study areas, and areas where a project was not confirmed to provide sufficient protection to 4.9 feet TWL, such as the projects with indirect benefits described above, or projects built to withstand a lower inundation height. As such, they may overlap with inventory projects in some locations. Placeholders were developed by determining locations with overtopping and significant flooding. Vulnerable locations were then assigned an appropriate activity archetype by comparing the area to the San Francisco Estuary Institute's Adaptation Atlas suitability analysis, and the levee information from the Delta Stewardship Council. Green archetypes were assumed wherever possible within the suitability analysis. The placeholders were drawn to address the overtopping

17 MTC/ABAG. (2021). *Plan Bay Area 2050*. Page 100. https://www.planbayarea.org/finalplan2050

and inundation as it related to the shoreline, emphasizing protection in lieu of other regional goals, such as restoration. To this end, placeholders were identified that could have activity archetype costs applied. For additional information on the placeholder development, please see the Technical Report.

Figure 3. Final Framework Inventory



The Framework inventory uses local projects and study areas along with placeholders to estimate regional adaptation costs. It is not intended to recommend specific adaptation activities in any given location, to prioritize one adaptation area over another, or to supersede or contradict ongoing local adaptation planning. The inventory also does not include managed retreat, or other approaches that strategically plan to not protect the shoreline in place. Inventory projects referenced by the Framework were developed by local jurisdictions and project proponents independently, not by MTC/ABAG or BCDC. However, inventory projects often lacked critical project details; for example, 49 percent of the projects in the inventory did not have flood protection data available from local project sponsors and 20 percent were missing a locally identified project cost. In these circumstances, the project team filled data gaps by estimating or approximating details such as project cost, project type, and flood protection. In addition, the Framework acknowledges that information on inventory projects will change as projects proceed through advanced planning, local engagement, and implementation.

Additionally, the Framework acknowledges that placeholders do not represent recommended projects, and that they were created for the sole purpose of estimating regional adaptation costs. The placeholders have not been proposed, have not undergone local reviews, or been analyzed for consistency with BCDC laws and policies. In future efforts, it is anticipated that placeholders will be replaced by locally identified projects or land use plans.

1.3 Estimating Regional Adaptation Needs Through 2050

The Framework uses the inventory to develop a regional cost estimate for sea level rise adaptation. Staff utilized two different methods of cost estimation:

- **Known costs:** project costs identified by local staff or the SAPMap. Known costs were prioritized for inclusion if available.
- **Activity Archetype estimates:** costs estimated if no known project cost data was provided, and for placeholders.

Activity archetype cost estimates were developed based on the adaptation activity, including horizontal levees, marsh restoration, seawalls, or other adaptations and the dimensions, including area or length. The Framework analysis builds on work done in Plan Bay Area 2050, which identified initial activity archetype cost estimates to develop a $19 billion estimate for regional adaptation need. The Framework expanded the Plan Bay Area 2050 activity archetype estimates by adding additional archetypes common to the Bay Area, incorporating recent constructed project costs, and seeking guidance from the TAG to expand and improve activity archetype cost estimates. The final estimates are summarized in Table 2. Additional detail on the final cost estimates is available in the **Technical Appendix**.

Table 1. Archetype Cost Estimates for Adaptation Activity Types (in 2022 dollars)

Adaptation Activity Archetype	Adaptation Type	Units	Lower Estimate	Mid-Point Estimate	Higher Estimate
Elevated Roadway	Gray	/foot	$65,000	**$125,000**	$199,000
Tidal Gate	Gray	/unit	$7,351,000	**$14,175,000**	$23,775,000
Seawall	Gray	/foot	$9,000	**$18,000**	$35,000
Riprap	Gray	/foot	$6,000	**$11,000**	$19,000
Traditional Levee	Gray	/foot	$3,000	**$6,000**	$11,000
Ecotone Levee	Hybrid	/foot	$13,000	**$18,000**	$23,000
Marsh Restoration	Green	/acre	$36,000	**$43,000**	$50,000
Marsh Sediment Management	Green	/acre	$39,000	**$191,000**	$342,000
Beach Restoration	Green	/acre	$295,000	**$590,000**	$1,180,000
Beach Sediment Management	Green	/acre	$407,000	**$815,000**	$1,629,000
Upland and Creek Restoration	Green	/acre	$594,000	**$601,000**	$608,000
Polder Restoration	Green	/acre	$20,000	**$25,000**	$56,000
Restoration Submerged Vegetation	Green	/acre	$67,000	**$189,000**	$310,000

Activity archetype costs were used to fill cost gaps in the inventory and to assign costs to placeholders, and then summarized along with known costs to develop a regional cost estimate for sea level rise adaptation. When a range of costs was identified for a project for both known or activity archetype costs, staff used the median or mid-point value to summarize regionally[18]. An assumed regional cost was also added to account for additional sediment management needs to maintain and manage existing and planned tidal marsh habitat restoration.

18 Studies were not included in the cost estimate unless a known cost was identified.

The final regional estimate is represented in year-of-expenditure dollars through 2050. Construction dates were unknown for most projects; as such, the estimate was created by assuming that an equal number of projects will be constructed each year, followed by assuming a 3 percent escalation rate year over year. Partially spent funding, where known, was subtracted from the regional cost estimate, though there may be additional projects with partial funding that were not known at the time of the analysis. Other adaptation strategies not estimated or assumed within the Framework analysis would likely change regional estimates, including adaptation activities without protection (including managed retreat), building code changes, or other local land use policy adjustments that may change a community's ability to adapt to sea level rise. In addition, future analysis will need to include riverine and groundwater data as it becomes regionally available, as well as additional adaptation project plans, such as those made by utilities.

The total regional cost estimate for sea level rise adaptation **through 2050 is $110 billion** using the median estimate for all projects. Using the assumptions in Table 1 for gaps and any known project cost ranges, total regional cost estimates were also developed using low and high estimate levels, as shown in Table 2.

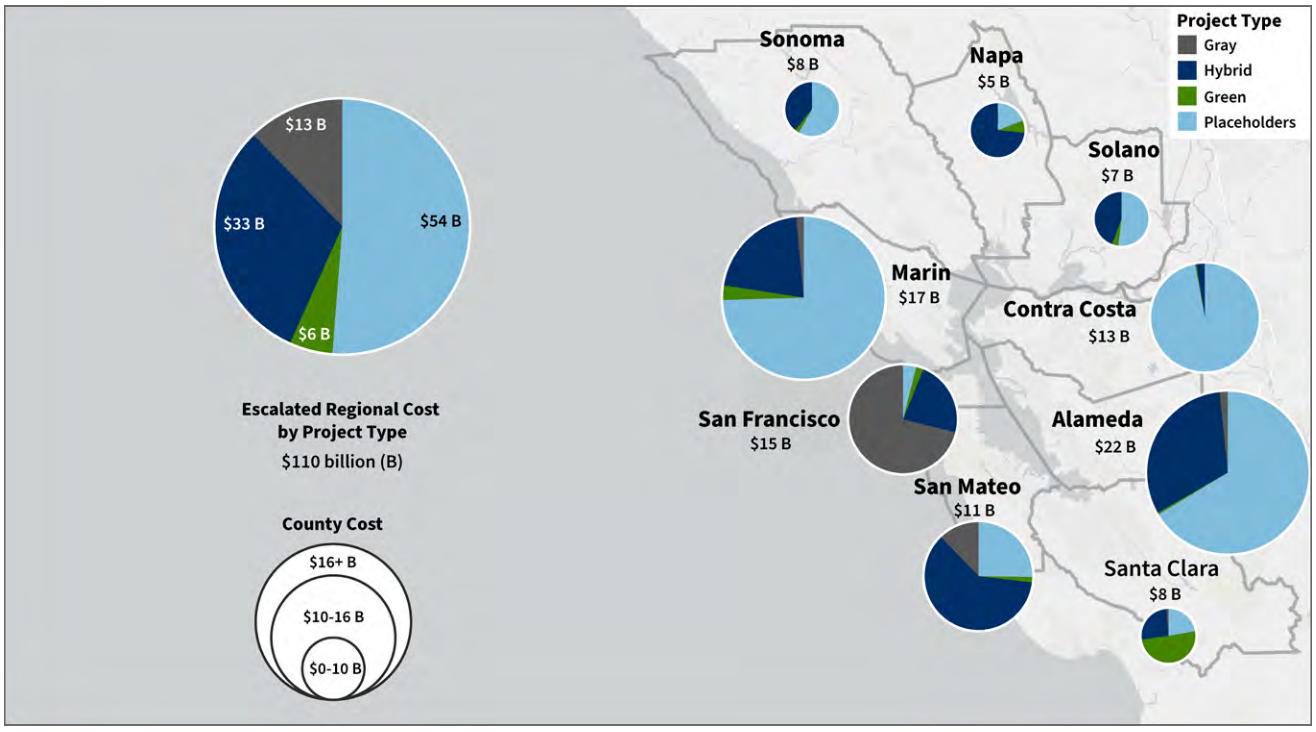
Table 2. Range of Total Regional Cost Estimates (year-of-expenditure dollars)

Low Estimate	Median/Mid-Point Estimate	High Estimate
$ 81 billion	**$110 billion**	$ 147 billion

However, this value does not necessarily represent the actual amount of revenues required to adapt. As mentioned previously, the Framework utilizes the conservative assumption of protecting the entirety of the vulnerable shoreline in place, and assumes 4.9 feet of inundation within the study period, which is significantly higher than 2050 projections for permanent inundation. In addition, many of the projects and placeholders included in the Framework required project costs to be estimated: 63 percent of the total cost estimate came from activity archetype costs, 51 percent of which represented placeholders. Actual project costs may be lower or higher than the estimated costs. The inventory is also snapshot of a moment in time, and adaptation efforts and their costs will continue to develop or shift, especially for projects that are in the early planning or conceptual stages.

1.4 Additional Findings

Figure 4. County Need Estimates by Project Type

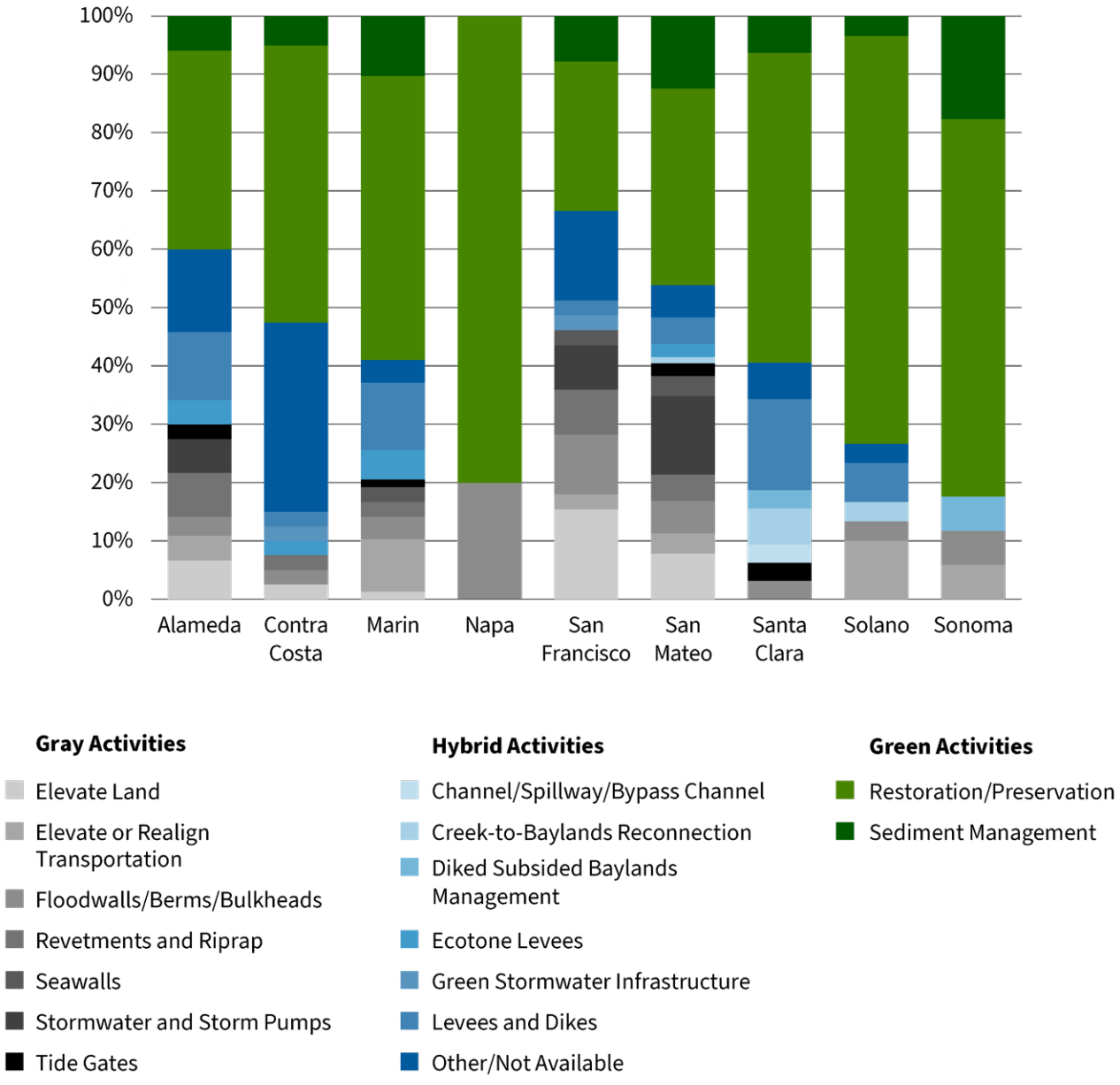


Project Types: Green, Gray, and Hybrid

The analysis has shown that most of the planned projects are "hybrid" in nature, as seen in Figure 4, representing a regional focus on multiple benefits, such as levees paired with marsh restoration. For the purposes of the Framework, the term "hybrid" includes projects that have at least one green and one Gray adaptation activity, without consideration of the percent of the project that uses the activity types. As such, the multiple benefits of hybrid projects may be over-represented in the inventory.

However, Figure 5 illustrates a regional trend toward green, or nature-based projects. When accounting for number of projects, restoration and sediment management activities collectively make up the majority of activities in most counties, as shown. Alameda, San Francisco, and San Mateo counties have a mix of Gray, hybrid, and green projects currently planned, while Marin, Santa Clara, and the North Bay have a greater proportion of green activities. This distinction aligns with the constraints on green projects due to shoreline development in the highly urbanized counties. Additionally, many of Contra Costa and San Francisco's projects are identified as "Other," which can represent adaptation activities that are non-physical in nature such as education and capacity building, combinations of activities, or singular activities that the Framework did not categorize as an activity, such as replacing wharfs or docks.

Figure 5. Share of Inventory Projects by Activity by County (Excluding Placeholders)

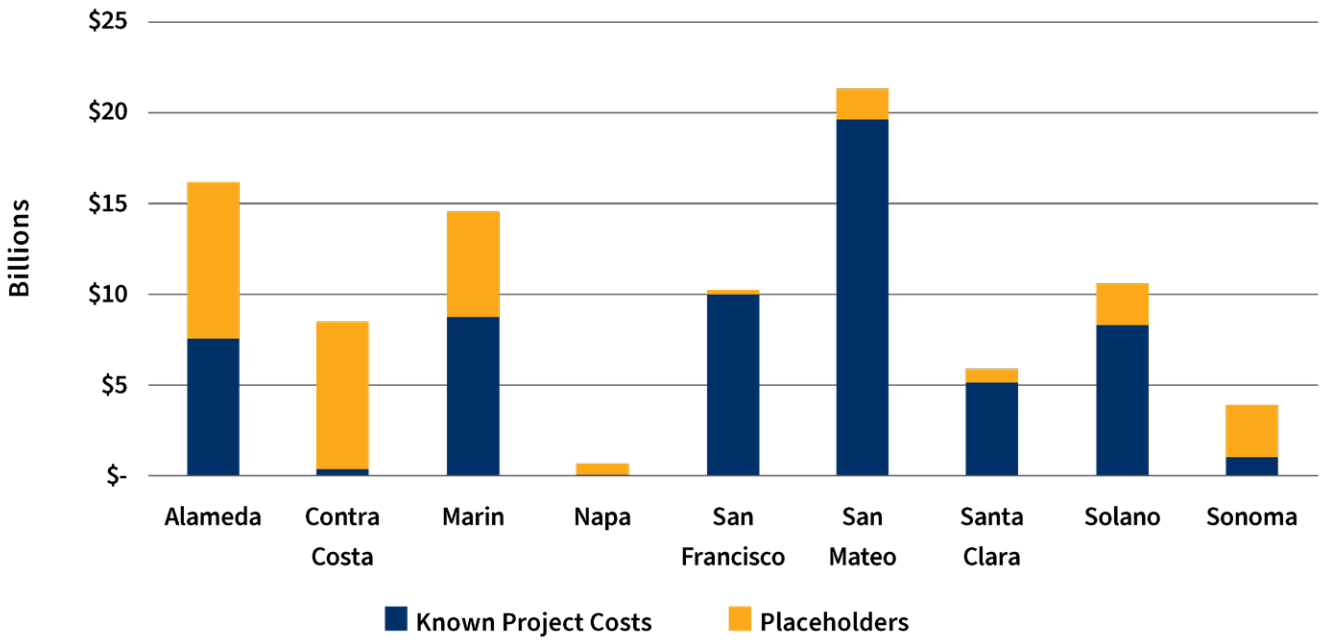


Implementation Gaps

Looking across the nine counties (Figure 6), Alameda and Marin counties have the highest cost estimates based on the information gathered. Notably, approximately half of the estimated value across the full Bay Area region comes from "placeholders" created to develop cost estimates, with significant project implementation gaps identified in Alameda, Contra Costa, and Marin counties. Figure 6 illustrates the variance from county to county. However, while identifying project implementation gaps is helpful in identifying where projects are still needed, project implementation gaps alone obscure a key nuance between counties. For example, while Marin County appears to have significant project implementation gaps where placeholders have been identified, the county has relatively few planning gaps when accounting for identified studies, meaning they are closer to developing adaptation solutions. By contrast, in Contra Costa County, the placeholder value represents a significant project implementation and planning gap and will require more resources to get to project development.

The differences in level of preparedness across the Bay Area, as illustrated by the level of implementation solutions, will continue to shift over time. The differences can help the region identify where additional support and capacity building may be needed to advance adaptation plans and projects. However, initiatives are already underway which can help ensure that cities and counties are advancing their adaptation efforts in consistent and effective ways, such as BCDC's Regional Shoreline Adaptation Plan. The Regional Shoreline Adaptation Plan will develop common sea level rise planning guidelines to facilitate regional coordination across planning efforts and to simplify local planning. It will also provide technical assistance to ensure that the entire Bay Area shoreline has the resources to adapt to sea level rise.

Figure 6. Estimated Cost by Source and by Majority County Share: Locally Identified Projects and Placeholders (in year-of-expenditure dollars through 2050)



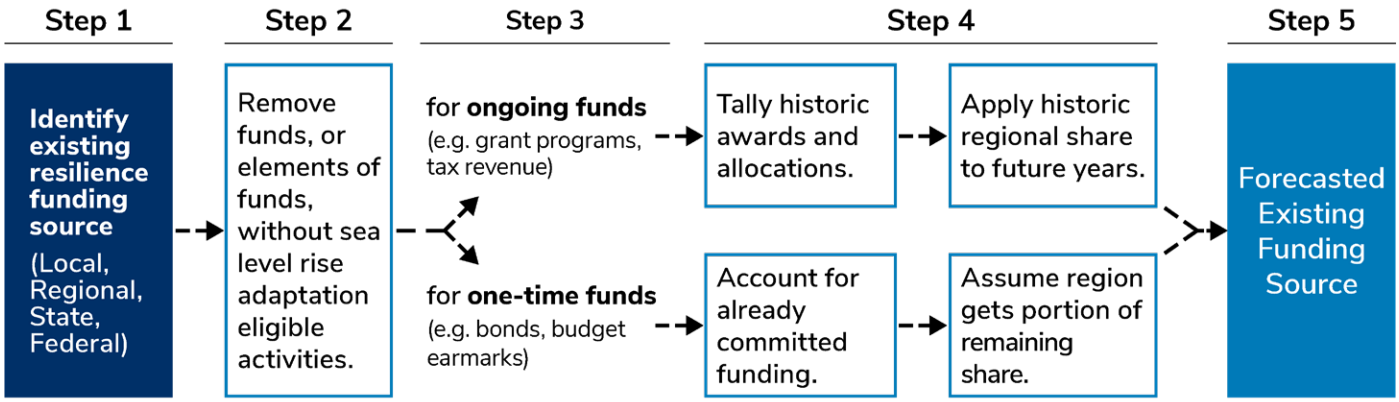
2. Update and Characterize Existing Revenue Sources for Sea Level Rise Adaptation

2.1 Updating Existing Public Revenue Estimates

The Framework developed a revenue forecast of existing sources that are funding sea level rise adaptation to estimate how much revenue the region can anticipate through 2050. The Framework built upon past research as part of Plan Bay Area 2050 Sea Level Rise Needs and Revenue Assessment and BCDC's Bridging the Gap: Funding Sea Level Rise Adaptation in the Bay Area.

The existing revenue forecast identified likely sources of sea level rise adaptation funding at the local, regional, state, and federal levels that exist today, and used a methodology to estimate how much revenue from those sources is expected through the year 2050. It also estimated how much of that revenue is likely to flow to the nine-county Bay Area, and how much is likely to be eligible for sea level rise needs. The process to develop the existing revenue forecast is illustrated in Figure 7.

Figure 7. Process to forecast existing revenues for each sea level rise funding source.



Step 1: Identify existing resilience fund sources

The analysis revisited previously identified funding sources, updated the forecast for those funds, and added over 30 new sources created by 2021 and 2022 Federal and State legislation and budget making. In total, the Framework identified 58 local, regional, state, and federal funding sources that may support sea level rise adaptation planning and implementation.

Step 2: Determine approach to forecast each funding source

Each funding source was split into ongoing funds or one-time funds. The forecast approach followed the same steps for each category, but the methodology differed to reflect differences in information available as well as how the funding is likely to be raised.

Step 3a: Account for committed funding and understand historic Bay Area awards

For **one-time funds**, administering agency budget documents were used to determine how much money, if any, had already been obligated. For state bonds, annual budget reports were used to confirm remaining funding. A majority of the IIJA, IRA, and California budget actions were one time increases or creations of new programs over the next one to five fiscal years. In those cases, because so much of that funding has yet to be spent, the total value of the program was used.

For **ongoing funds**, historic awards and allocations to the Bay Area were collected as far back as was possible. The total received by year was then escalated to 2022 dollars. The average across past years, in 2022 dollars, was used to forecast future years. If the funding trend changed significantly at any point, at times a rate of increase was reflected.

Ongoing funding programs that receive annual allocations were forecasted through the year 2050, or in the case of Measure AA, are forecasted through their approval year.

Step 3b: Determine share of funding for the Bay Area

The Framework assumes that the Bay Area only receives a share of State and Federal funding. For some ongoing fund sources, the past Bay Area share was used to assume the region's future share. For some one-time fund sources, there were specific callouts to Bay Area projects, or Bay Area specific programs which resulted in special assumptions on the Bay Area share. Otherwise, the share of the funding assumed for the Bay Area was calculated using population share in two different ways.

If the funding source specifically focused on sea level rise, coastal, or ocean actions, it was assumed that the Bay Area would receive a share comparable to the nine-county population share of California coastal counties, or comparable to the nine-county population share of US coastal states. The nine county Bay Area accounts for 29.1 percent of the State of California's coastal county population, and is 3.7 percent of the US coastal state population.

If the funding source was more general (e.g. focused on climate adaptation), it was assumed that the Bay Area would receive a share comparable to the nine-county population share of the California state population, or comparable to the nine-county population share of the United States. The nine County Bay Area accounts for 19.3 percent of the State of California's population, and 2.3 percent of the US population.

Step 4: Determine share of funding for sea level rise adaptation

Funding amounts were reduced to reflect how much of the overall funding is likely to be awarded to sea level rise adaptation. Many fund sources have broad eligibility. For example, many FEMA programs are focused on reducing risks from any climate impact or natural hazard. The Framework does not assume that all FEMA funds are spent toward sea level rise adaptation, but rather a percentage of funding. In other cases, a fund source, like bonds, may have programmatic categories with specific funding amounts of different goals. For each funding source a sea level rise share was assumed. For flexible funds with very broad programming goals, or funds for which a non-sea level rise adaptation was listed as the primary goal of the program, small shares of overall funding were assumed. For some fund sources with access to historic funding awards in the region, the assumption of the share of sea level rise was informed by past awards.

Step 5: Forecast existing funding sources

For most ongoing programs, it was assumed that the fund source would grow over time to track with inflation. This is not the case for all ongoing funding programs like Measure AA that are a uniform amount over time, or annual allocations that are defined by a flat value. For other ongoing programs, it was assumed that each year the value would increase at a rate of 3 percent, as established in **1.3 Estimating Regional Adaptation Needs Through 2050**.

The **total estimate for existing public sea level rise revenues is $5.5 billion** through 2050, detailed in Table 3. Additional detail will be available in the Existing Revenue Sources Spreadsheet.

Table 3. Existing Revenue Estimate by Funding Source

Funding Level	Funding Source	Estimated Funding Timeline	Revenue Estimate (in millions Year of Expenditure)
Local	Local Adaptation Bonds	One-time	$520
Local	Committed Project Funding Estimate	One-time	$980
Regional	Measure AA	Through 2037	$430
State	State Bonds	One-time	$90
State	2021 and 2022 State Budgets	One-time	$600
Federal	NOAA	Through 2050	$70
Federal	EPA	Through 2050	$110
Federal	FEMA	Through 2050	$970
Federal	U.S. Army Corps of Engineers	Through 2050	$1,590
Federal	Infrastructure Investment and Jobs Act (IIJA)	One-time	$70
Federal	Inflation Reduction Act (IRA)	One-time	$30
Various	Other State and Federal Sources	Various	$60
		Total	**$5,500**

2.2 Characterizing the Funding Landscape

In addition to forecasting total public funding sources, the Framework sought to understand the characteristics of the money as a next step. To this end, the Framework created a "periodic table" of funding sources to help identify patterns, and to support future conversations about how the region can complement and build on existing fund sources. The periodic table visualizes fund sources along with additional characteristics such as the agency, amount forecasted, funding nexus, and other factors, designed as a resource that can be referenced quickly and easily.

The 58 funding sources that made up the $5.55 billion were characterized by 7 factors.

- **Fund name** describes the grant name or fund source name.
- **Agency** that administers or awards funds.
- **Amount forecasted** for sea level rise adaptation in the Bay Area. Importantly, this value built off of assumptions in the revenue forecast, as outlined in **2.1 Updating Existing Public Revenue Estimates**. Whether a fund is ongoing or one-time was also included and denoted by an asterisk.

Poto: Karl Nielsen, 2021

- **Equity priority** determined if the funds have an equity requirement, equity priority, or no equity component. For newer fund sources (e.g. 2022 state budget line items), the assumption is based on early program descriptions rather than formal guidelines. The search for each funding source explored whether disadvantaged or environmental justice communities were specifically named in program requirements or priority.
- **Funding focus** was characterized in different ways and determined based on available fund guidelines. Many fund sources are a result of new 2021 and 2022 state and federal action, and as such, there was limited information. When funding guidelines were not available, legislative language was used to understand the anticipated nexus for each fund. In some cases, a fund source description had broad eligibility, but historic fund awards suggested a narrower focus of the funding program.
  - **Eligible adaptation types** described if funds lean green, hybrid, or Gray. The hybrid tag was used for funds that could apply to any adaptation type.
  - **Eligible activities** described if the funding is weighted more toward planning or construction. Planning encompasses other activities like capacity building and engagement. Construction encompasses any implementation phase of a project. Engineering, design, and environmental phases between planning and construction were not explicitly identified. In general, O&M was not often an eligible expense, except in some cases with the United States Army Corps of Engineers (USACE).
  - **Targeted asset class** identified if there is an essential focus for the funds (e.g. transportation asset protected, habitat improved, communities adapted).

After collecting this information for each fund source, the information was compiled together to visualize the overall funding landscape, as shown in Figure 8. The "periodic table" design of the figure is in part to organize information in a quick reference table.

The characterization of funding uncovers a number of key takeaways.

- **There are almost no funding sources specific to sea level adaptation.** Most funding sources have sea level rise adaptation as only a component of how funds can be used, in contrast to other hazards such as wildfire. As such, fund sources have been filtered down significantly to account for sea level rise specifically.
- **In the past few years there have been many changes.** The number of federal agencies with funding has doubled, and many state agencies now have funding to support adaptation. However, new fund sources such as the IIJA and IRA have broad programming goals, which limits the amount of funding that the region can expect to receive.
- **Only a portion of fund sources have equity goals.** No green or Gray fund sources have equity goals identified, but they are a part of many identified hybrid programs. However, most equity goals are a part of one-time fund sources or smaller programs such as NOAA's National Coastal Resilience Fund and OPR's Adaptation Planning Grants. FEMA's Building Resilient Infrastructure and Communities program is a promising exception of a large new funding source with embedded equity goals.
- **The largest regional fund sources are federal programs from FEMA and the USACE.** As summarized in Table 4, the USACE and FEMA are estimated to provide approximately half of the region's forecasted existing revenue through 2050, with the most significant support identified from USACE. It is also important to recognize that FEMA's Building Resilient Infrastructure and Communities program is relatively new, and as such has a more uncertain long term funding outlook.
- **The biggest funding sources tend to fund "gray" adaptation.** However, programs such as FEMA'S BRIC program have recently been supporting more hybrid projects. Regional fund sources from Measure AA and the California State Coastal Conservancy also provide significant funding for green adaptation in the Bay Area.

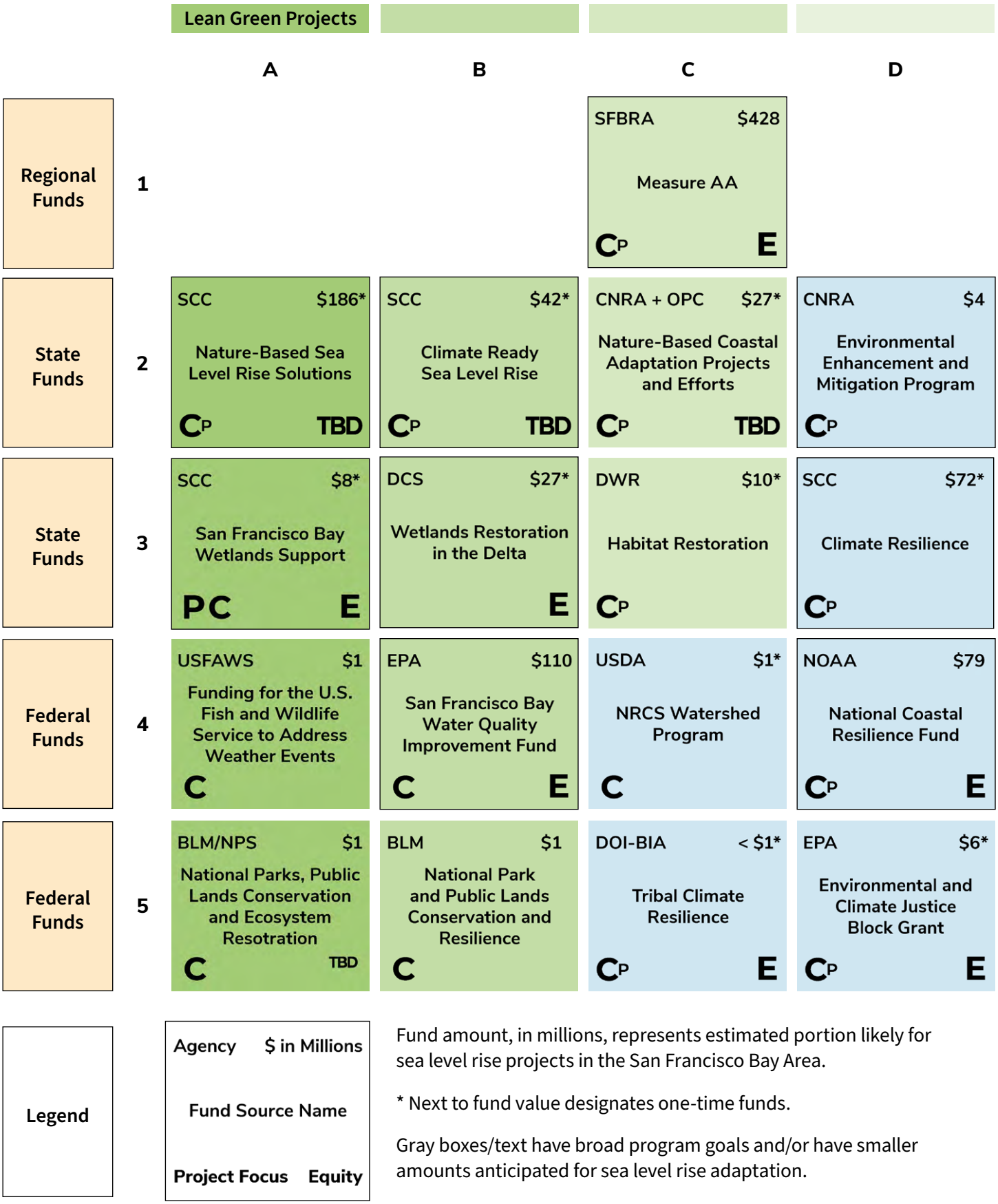
The table is designed to set up future conversations around the properties of existing (and future/desired) funding sources and facilitate an understanding of the relationship between sources that lead to easy or challenging funding combinations. For example, programs with limited funding might be harder to get and less likely to be able to blend with other fund sources, while larger programs may be more accessible for use in adaptation project funding portfolios. Understanding which programs blend well with each fund source, as well as which ones do not, is helpful in understanding the existing landscape and considering desirable attributes for future funding sources and/or a Framework to help organize strategic and coordinated pairings.

Other information about some of these fund sources has been collected by the California Office of Planning and Research (OPR[19]) and the Bay Area Climate Adaptation Network (BayCAN[20]) and include attributes that would be beneficial for individuals/staff interested in advancing funding proposals in the short term. Attributes include maximum award size, match requirements, applicant eligibility, schedules, and deadlines.

19 Office of Planning and Research, State Resilience Funding Program Timeline Chart, July 2022. https://opr.ca.gov/climate/icarp/tac/meetings/2022-07-18/docs/20220718-Gantt_Chart_Universal.pdf

20 Bay Area Climate Adaptation Network, Funding Tracker, Accessed April 2023. https://www.baycanadapt.org/fundingtracker

Figure 8. Sources of Potential Sea Level Rise Funding



Fund amount, in millions, represents estimated portion likely for sea level rise projects in the San Francisco Bay Area.

* Next to fund value designates one-time funds.

Gray boxes/text have broad program goals and/or have smaller amounts anticipated for sea level rise adaptation.

			Lean Gray Projects
E	F	G	H
Caltrans $49* State Transportation Infrastructure Climate Adaptation Program C TBD	Caltrans $8* Transportation Infrastructure Climate Adaptation Planning Program P	SGC $1* Regional Climate Collaboratives P E	OPR $16* ICARP - Regional Resilience Planning and Implementation PC E
DWR/SFEP $29* Prop 1 (2014) C	CTC $39* Local Transportation Infrastructure Climate Adaptation Program CP E	OPC/SCC $9* Prop 68 (2018) CP E	OPR $2 ICARP - Adaptation Planning Grants P E
NOAA $3* Community Based Restoration Project CP	FEMA $691 BRIC CP E	FEMA $6* STORM C	
FHWA $16* PROTECT (Competitive) CP	USACE $1,586 Flood Risk Management Program CP	FEMA $300 HMA HMGP/FMA CP	

E = Delineats programs with equity priority requirements

C = Anticipate 100% of the focus is construction

P = Anticipate 100% of the focus is planning

CP = Anticipate >50% of the focus is construction, but not all

PC = Anticipate >50% of the focus is planning, but not all

Photo: Karl Nielsen, 2021

3. Study How New Revenues for Sea Level Rise Adaptation Needs Can Be Raised Most Equitably

3.1 The Funding Gap

The Framework analysis has also found that estimate for adaptation need pales in comparison to what is at risk. Even just a partial estimate of the cost of inaction of over $200 billion, not including a number of assets that have not been fiscally quantified, shows that with an estimated $110 in estimated adaptation need, regional adaptation actions will be a worthwhile investment.

However, the Framework analysis has identified a significant funding gap of over $104 billion using median estimates, reflecting $110 billion is estimated adaptation need and $5.5 billion in estimated existing revenue sources through 2050. The funding gap will require a number of funding, financing, and planning strategies to fill or reduce it.

The region will need to focus on project prioritization to identify which areas should be adapted first, and which areas are suitable for alternative adaptation strategies. Prioritizing adaptation projects regionally will help to ensure that areas with more risk and less resources are protected, and developing priority guidelines for local projects will also be an important step toward long term adaptation goals.

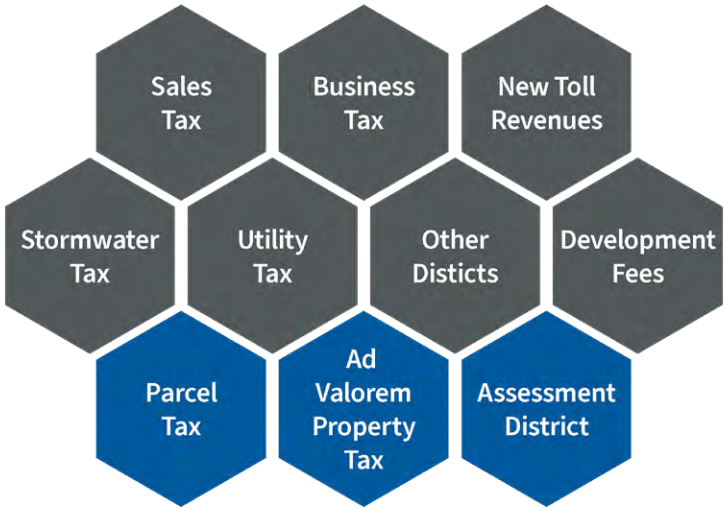
The region will also need to pursue strategies to minimize the impacts of sea level rise, such as discouraging or adapting new developments in highly vulnerable areas to reduce the need for future shoreline protection, facilitating faster permitting and construction of adaptation projects, and identifying alternative strategies for adaptation, such as adaptation without protection.

Finally, increasing regional revenue sources will also be critical, including advocating for additional funds from state and federal sources, leveraging private investment, as well as exploring potential new revenue sources at the local or regional levels.

3.2 Exploring Potential Revenue Sources

The Framework analyzed the potential of three local and regional revenue sources at a high, exploratory level to provide a starting point for future research on potential new revenue sources at the local and regional levels. While many revenue-generating mechanisms were considered for this analysis, which are summarized in in Figure 9, the Framework focused on three that that seemed feasible based on regional precedence. These include parcel taxes, ad valorem (AV) property taxes/general obligation bonds, and assessment districts. Descriptions of each of these revenue-generating mechanisms are provided in Figure 10.

Figure 9. Types of revenue measures considered by the Framework[21]



21 Other Districts includes value capture mechanisms such as Community Facility Districts and Tax Increment Financing.

In support of the Framework goals, the analysis of the three revenue-generating mechanisms focused on revenue generation potential, bond issuance potential, and the initial equity implications for "who pays?". Parcel and AV property taxes were analyzed at both the county and regional scales, whereas assessment districts were analyzed at the district scale using hypothetical case studies across the region. This section provides a summary of findings from this analysis, while further details are provided in the Technical Appendix.

Figure 10. Funding Sources Explored by the Framework

Scale: County and Regional

Regional and county taxes distribute tax burden across wider base

Parcel Tax

- Typically, a flat rate property tax: each parcel charged the same amount
- Does not account for value or size of the property

Ad Valorem Property Tax/GO Bond

- Property-related tax that
- can be progressive: higher assessed properties pay more
- Subject to Prop 13 limitations

Scale: District-based (sub-local)

Regional and county taxes distribute tax burden across wider base

Assessment District

- Directly tied to specific benefits
- Most feasible in areas with greater resources and/or more direct impacts of SLR

3.3. Revenue and Bonding Potential

This analysis found that, based on local and regional precedence over the last 10 years, none of these potential revenue measures would likely be capable of addressing the funding gap alone. For example, a hypothetical 30-year regional parcel tax of $25 per parcel has potential to earn an annual revenue of $55 billion per year, which has the potential to support $750 million in bond issuance. Meanwhile, precedent research suggests that Bay Area voters may support a regional general obligation bond issuance between $7 and $13 billion, which would result in an average annual tax of $55 per parcel[22]. However, while the parcel tax and AV property tax are each unlikely to be capable of covering a significant portion of the region-wide funding gap, their bonding potentials would still be able to fund many impactful projects. Both parcel taxes and AV property taxes require a two-thirds approval rate to pass, requiring significant public outreach and support.

An assessment district is different than the parcel and AV property taxes in that it would be formed at a sub-local level. In other words, it would not cover an entire city, county, or region; instead, only a portion of parcels within an area. Other similar types of districts, such as Community Facilities Districts, were not studied within the scope of the Framework due to their more flexible design and variable analysis results. To develop an assessment district, parcel owners would self-organize and vote on whether to pay for an additional property-related assessment that would fund specific improvements or services within their self-defined district. In the context of adaptation, an assessment district could be formed to fund the implementation of an adaptation project (or suite of projects) which would primarily benefit the district itself. As a revenue-generating mechanism, it is a tool that can be deployed at the hyper local level to fund site-specific interventions. Rather than comparing it to a parcel tax or an AV property tax, it may be beneficial to consider the assessment district as a revenue-generating tool that may be paired with a local or regional tax.

22 General obligation bonds are backed by ad valorem taxes, which are a tax on assessed value of a property. The actual tax rate would be between $5 and $14 per $100,000 of assessed value. The estimated average tax rate of $55 per parcel is based on the regional median single-family home value.

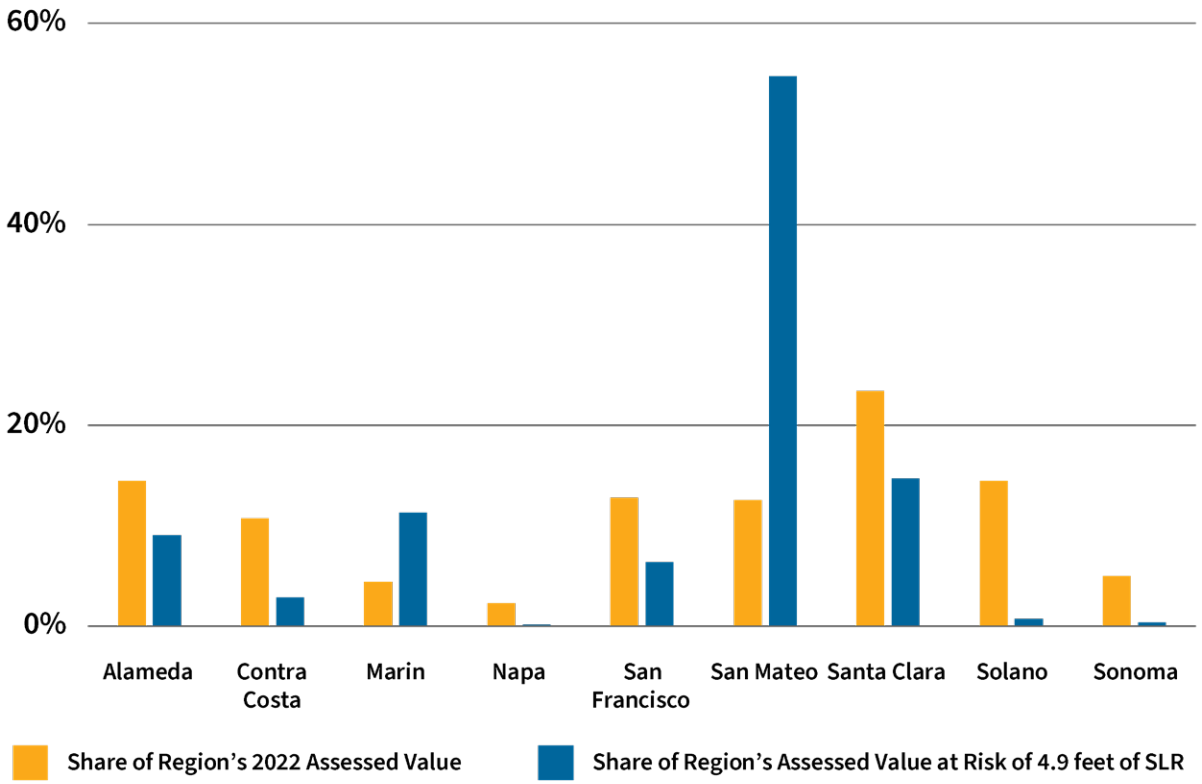
3.4 "Who Pays?": Initial Understandings of Geographic Balance and Social Equity

Both MTC/ABAG and BCDC are committed to advancing social equity in sea level rise adaptation. As such, the Framework generated initial equity findings related to begin to understand "who pays?" in terms of both geographic balance and social equity. The findings are focused on AV property taxes and parcel taxes, as they are scaled to the county and regional levels and impact entire counties. For AV property taxes and parcel taxes, revenues are expected to be higher, and benefits will be dispersed throughout the county or region. Assessment districts generally occur at the sub-local level and only impact a small subset of parcels that have primarily self-selected to participate. The self-organized nature of assessment districts makes it difficult to assess equity implications, as they are specific to the community or district in question. As such, the Framework does not include them in this initial, high-level equity analysis.

Geographic Balance

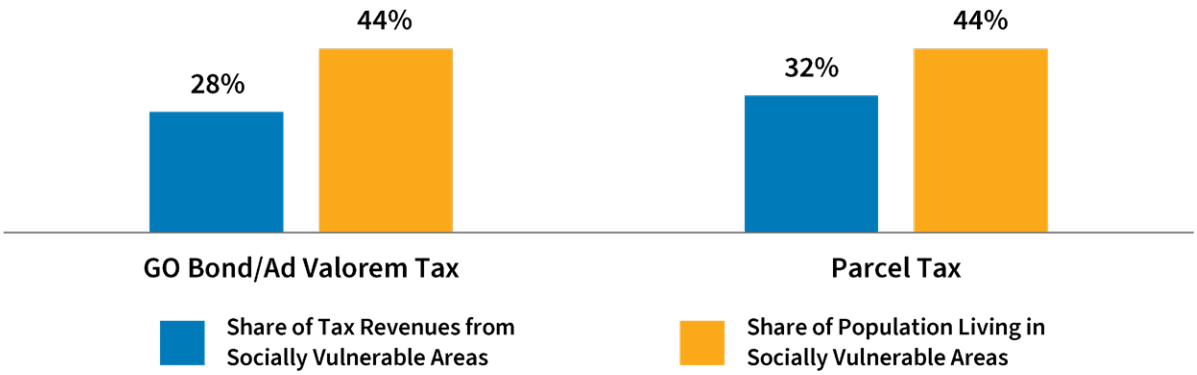
The geographic analysis sought to understand the relationship of local revenue contribution through AV property tax potential, and the risk of sea level rise inundation. With regards to geographic balance, local revenue contribution and SLR flood risk are not distributed evenly throughout the region. For example, as shown in Figure 11, Alameda, San Francisco, and Santa Clara Counties have the largest property tax base (based on assessed value), indicating that these counties would proportionally contribute more revenue to a regional AV property tax. Findings for a parcel tax are slightly different, because a parcel tax generally applies the same rate to all properties. As such, the number of tax-paying parcels would be more indicative of regional contribution than assessed value.

Figure 11. Geographic Balance for Ad-Valorem Property Taxes by County



With both AV property taxes and property taxes, San Mateo and Marin counties have a disproportionate share of regional property value at risk. A regional tax measure provides the opportunity to distribute the costs of paying for SLR adaptation throughout the Bay Area. This ability to distribute costs is particularly important given that SLR will not only impact property owners, but will also impact major regional assets, such as highways, train lines, business districts, ports, etc. Protecting these regional assets will benefit everyone, regardless of whether they live in Contra Costa or San Mateo counties. A key finding of the Framework is that **using multiple funding measures, such as AV property taxes or parcel taxes, would help to balance the tax burden geographically.**

Figure 12. Social Vulnerability for Parcel and Ad-Valorem Property Taxes at the Regional Level



Social Vulnerability

In terms of social equity, socially vulnerable areas were defined using BCDC's Community Vulnerability data, which categorizes a community's ability to plan for, respond to, or recover from natural disasters using a number of vulnerability indicators, such as income and race[23]. The analysis sought to understand if socially vulnerable communities would pay a disproportionate share of the tax burden, and to compare those findings across AV property taxes and parcel taxes. As illustrated in Figure 12, the analysis found that **with both AV property and parcel taxes, households within socially vulnerable areas would contribute less to a regional tax than their regional share of the population, therefore distributing costs across low socially vulnerable areas and advancing equity. Additionally, parcel taxes were found to be comparatively less equitably than AV property taxes, as they place a higher tax burden on socially vulnerable areas[24].** The trend was consistent at both the regional and county scales.

The Framework only studied initial, high-level findings for "who pays?" with regards to geographic and social equity. If a local jurisdiction or the region were to pursue a tax measure to support adaptation, additional research and analysis should be conducted, particularly to ensure that revenue-generation strategies ensure equitable outcomes. With consideration for equity, other important factors to consider are tax design (e.g., exemptions for certain households), the existing local tax burden, and distribution of funding (e.g., which projects are funded and who they benefit).

23 Social vulnerability defined by medium, high, and highest levels of BCDC's Community Vulnerability Data. https://data-bcdc.opendata.arcgis.com/datasets/BCDC::community-vulnerability-bcdc-2020/about

24 A parcel tax is, generally, a flat tax on all parcels regardless of value, whereas an AV tax is based on assessed value and increases (or decreases) based on property value. By design, higher value properties pay more.

4. Next Steps

The Framework builds off of and advances several major regional efforts, and serves as a stepping stone for other local and regional efforts in the future. While specific outputs such as the shoreline project inventory, revenue forecasts, and analysis findings may all inform future work, the Framework has identified six specific next steps for both MTC/ABAG and BCDC, and the region at large.

Cross-Agency Efforts

Better define lead agency roles for sea level rise funding efforts in the Bay Area. While tackling sea level rise requires robust partnerships, the lack of a lead agency to secure additional funding and distribute it equitably hinders the Bay Area's ability to mitigate climate impacts. Regional agencies currently lack the resources needed to lead in the funding space, and thus they will need the support of elected officials to both identify and support the development of regional leadership in this area.

Engage, educate, and mobilize elected officials to accelerate advocacy at the state and federal levels to secure more funding for the Bay Area by messaging the magnitude of need. The Framework analysis indicated that based on regional precedent, it is unlikely that any single fund source at the local or regional level will be able to close the regional funding gap. As such, the region will need additional funding from the state and federal levels to support sea level rise adaptation. The region has an opportunity to advocate for a larger share of sea level rise adaptation funding due to its relatively high vulnerability and the significance of the potential impacts, as referenced in X.1 Context.

Through regional plans, prioritize sea level rise investments to reduce the funding gap and better align local and regional planning. MTC/ABAG's Plan Bay Area 2050+ and BCDC's Regional Shoreline Adaptation Plan are opportunities to explore which resilience projects require early action and which low-density areas might be more appropriate for lower-cost adaptation activities. Plan Bay Area 2050+ will be focused on the initial prioritization of projects, while the Regional Shoreline Adaptation Plan is expected to develop future prioritization goals through the creation of regional guidelines that encourage local sea level rise adaptation planning and project prioritization within a regional framework. The Regional Shoreline Adaptation Plan is anticipated to support the development of prioritized adaptation projects at the local scale, complementing Plan Bay Area 2050+'s efforts to prioritize the identified inventory projects at the regional scale.

Support cities, counties, and the private sector to develop funding and financing tools at multiple scales. In addition to new or increased state and federal funding, private or philanthropic funding, and the potential financing tools identified by the Framework, there are other opportunities for other local revenue sources that can fill the gap. While some jurisdictions have developed measures in this space, such as 2018 bond measures in San Francisco and Foster City to support local infrastructure, communities with less resources will need support to develop appropriate funding tools. These tools can be facilitated by regionally available assistance, information, and support.

MTC/ABAG

Explore how envisioned regional measures can make communities and transportation more resilient. With no regional sea level rise measure on the horizon, it is critical to explore how planned measures for affordable housing and transportation could, to the extent possible, integrate policies or programs to advance more resilient outcomes. With expenditure plans likely to be developed in the coming months for both measures, resilience will be a key lens to consider.

BCDC

Complete and maintain the development of the Shoreline Adaptation Project Mapping Program to ensure that the region has access to the best possible inventory data. The Framework has illustrated the utility of having an inventory of shoreline projects. In addition to assisting with regional cost estimates, inventory data can help the region to understand planning and implementation gaps, to share and learn from best practices, and more.

4.1 Additional Sources

Additional details on Framework assumptions and methodologies can be found in the **Technical Appendix**. Other Framework resources are also available for local and regional use, including:

Framework Shoreline Project Inventory Interactive Map: an interactive GIS webmap of the Shoreline Project Inventory including select attributes used in the analysis such as cost, adaptation activity, and project status. Corresponds with the spreadsheet.

- Framework Shoreline Project Inventory Interactive Map: an interactive GIS webmap of the Shoreline Project Inventory including select attributes used in the analysis such as cost, adaptation activity, and project status. Corresponds with the spreadsheet.
- Framework Shoreline Project Inventory Spreadsheet: a list of the project inventory and placeholders, including select attributes used in the analysis such as cost, adaptation activity, and project status. Corresponds with the interactive map.
- Estimating Activity Archetype Costs Spreadsheet: a resource of the full activity archetype cost assumptions.
- Existing Revenue Sources Spreadsheet: a resource of the full existing revenue sources identified, and the assumptions used in the analysis.