



# SAN FRANCISCO PLANNING DEPARTMENT

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## Executive Summary

### Sea Level Rise Vulnerability and Consequences Assessment Informational Briefing

HEARING DATE: MAY 23, 2019

*Project Name:* Sea Level Rise Vulnerability and Consequences Assessment  
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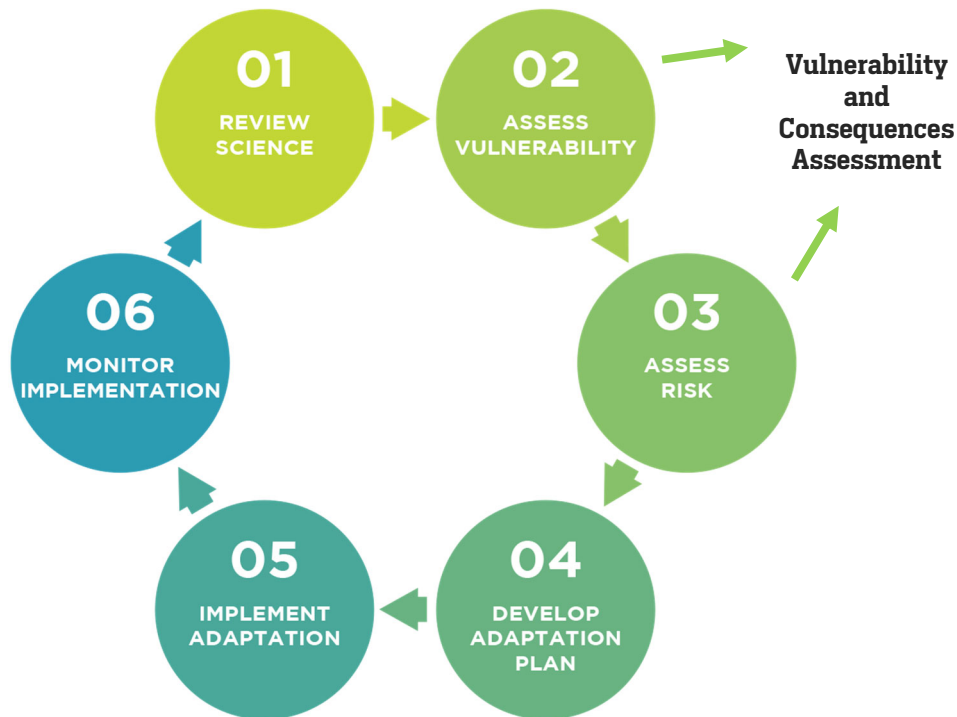
## SUMMARY

The Department is working with other City agencies to address sea level rise and advance the goals of the 2016 Sea Level Rise Action Plan. The Planning Department, along with the interagency Sea Level Rise Coordinating Committee (SLRCC), has prepared a citywide Sea Level Rise Vulnerability and Consequences Assessment. This assessment quantifies and describes the impacts of sea level rise and future coastal flooding on public infrastructure across San Francisco. The assessment also studies the consequences of sea level rise and coastal flooding for people, the economy, and the environment. The Assessment also describes next steps in developing strategies to adapt the city to sea level rise, including several ongoing projects that address near-term flooding concerns and start to plan for longer-term solutions.

## BACKGROUND

In March 2015, Mayor Edwin Lee convened a Sea Level Rise Coordinating Committee (SLRCC) so that city departments could build a collaborative understanding of sea level rise and work to mitigate impacts of sea level rise in San Francisco. The SLRCC is currently co-chaired by the Planning Department and the Office of Resilience and Capital Planning, and includes key staff from several City departments, including the Mayor's Office, San Francisco Public Utilities Commission, Metropolitan Transportation Agency, Public Works, San Francisco International Airport, Recreation and Parks Department, Department of the Environment, and the Department of Public Health.

In March 2016, the SLRCC published the Sea Level Rise Action Plan. The goal of the Sea Level Rise Action Plan is to make San Francisco a more resilient city in the face of immediate and long-term threats from sea level rise by taking measures to protect and enhance public and private assets, natural resources, and quality of life for all. The Sea Level Rise Action Plan identifies actions that San Francisco can take now and in the future to meet the challenge of rising seas.



**Figure 1. Adaptation planning process per 2016 San Francisco Sea Level Rise Action Plan. The Sea Level Rise Vulnerability and Consequences Assessment accomplishes steps two and three of the process.**

The Sea Level Rise Action Plan identified an adaptation framework to address the impacts of sea level rise. The initial steps include reviewing available science, and assessing vulnerability and consequences. Over the last two years, the Department, in coordination with the SLRCC, has been working to understand the vulnerability and consequences associated with future sea level rise on public infrastructure and the city as a whole, which will be published in a Sea Level Rise Vulnerability and Consequences Assessment. This informational presentation includes key findings from that assessment. The final Vulnerability and Consequences Assessment is expected to be published in summer 2019.

## **SEA LEVEL RISE VULNERABILITY AND CONSEQUENCES ASSESSMENT**

San Francisco is committed to planning for and adapting to the anticipated and unavoidable effects of climate change. Its innovative and aggressive climate change policies have helped boost the local economy and advance environmental goals to reduce greenhouse gas emissions. San Francisco's efforts exceeded emissions reduction targets of 20 percent below 1990 levels by the end of 2012 and are on track to reduce emissions by 40 and 80 percent by 2025 and 2050 respectively.

San Francisco is also continuing its leadership on climate change by placing a strategic focus on the immediate and long-term threats of sea level rise and associated coastal flooding. The Planning Department, with the Sea Level Rise Coordinating Committee, conducted a detailed assessment on sea level rise, because sea level rise and coastal flooding present a significant new natural hazard for San Francisco. This assessment provides information to support individual agency decision-making about vulnerable facilities and will support citywide climate adaptation and resilience planning.

The vulnerability portion of the assessment studies public infrastructure including transportation, utilities, recreation and open space, city facilities, and Port facilities across the city's Sea Level Rise Vulnerability Zone. This zone includes areas of the city that may experience sea level rise and/or coastal flood impacts between now and 2100 (Figure 1). In the last century, sea levels have risen eight inches around the San Francisco Bay and Pacific Coast. By the end of this century, they are likely to rise an additional 36 to 66 inches (Figure 2). Temporary events like El Niño, King Tides and large storms can periodically raise waters an additional 12 to 42 inches. The joint impacts of sea level rise and coastal flooding could add 108 inches to today's high tides. The city has mapped potential flooding caused by that water level to create the Sea Level Rise Vulnerability Zone which is shown in Figure 1.

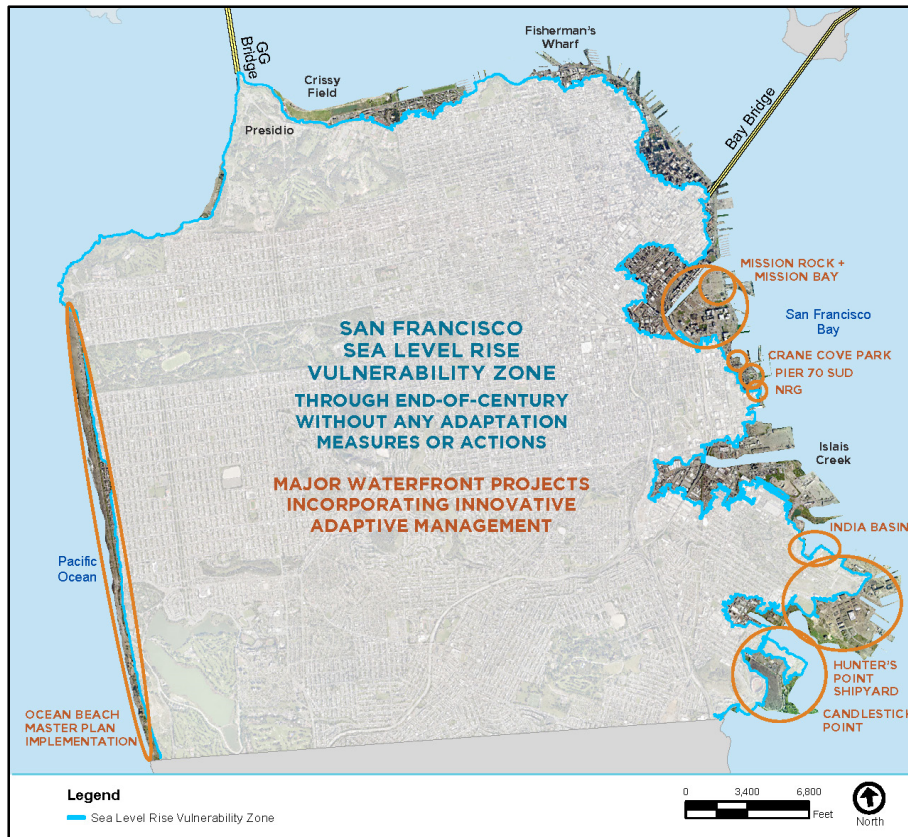


Figure 2. San Francisco Sea Level Rise Vulnerability Zone

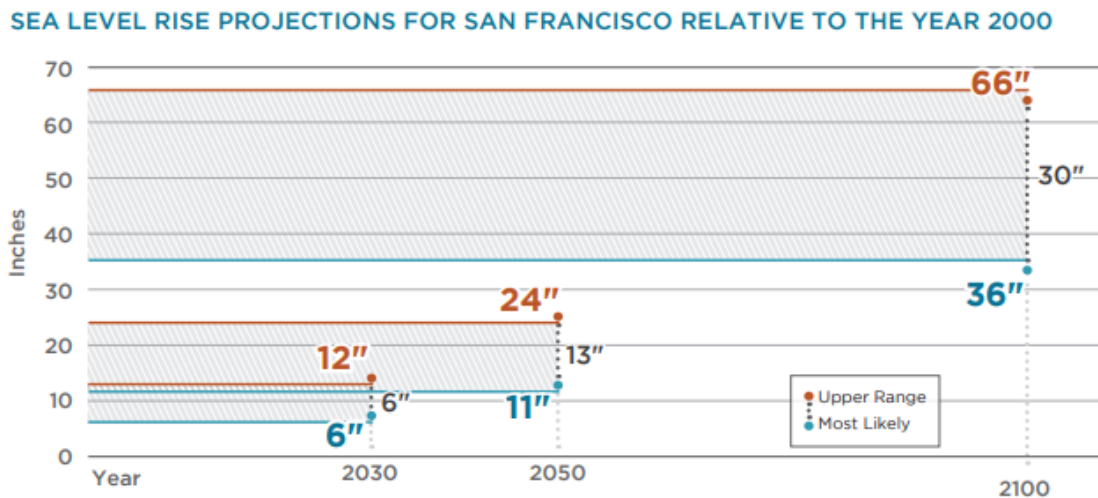


Figure 3. Sea level rise projections for San Francisco

The Vulnerability Assessment studies the following sectors:

- Water
- Wastewater
- Public Power
- Recreation and Open Space
- Mobility
- Public Safety
- Port
- Waterfront development

Sea Level Rise Vulnerability is a function of exposure (which assets will flood and when), sensitivity (how will assets will be damaged by flooding) and adaptive capacity (how are assets or systems able to function during and after flooding). For each sector and their component assets, the assessment has mapped exposure to sea level rise and coastal flooding, used city information and consultant help to rate sensitivity and adaptive capacity, and confirmed draft vulnerability findings through workshops with agency staff. This process is illustrated in Figure 3.

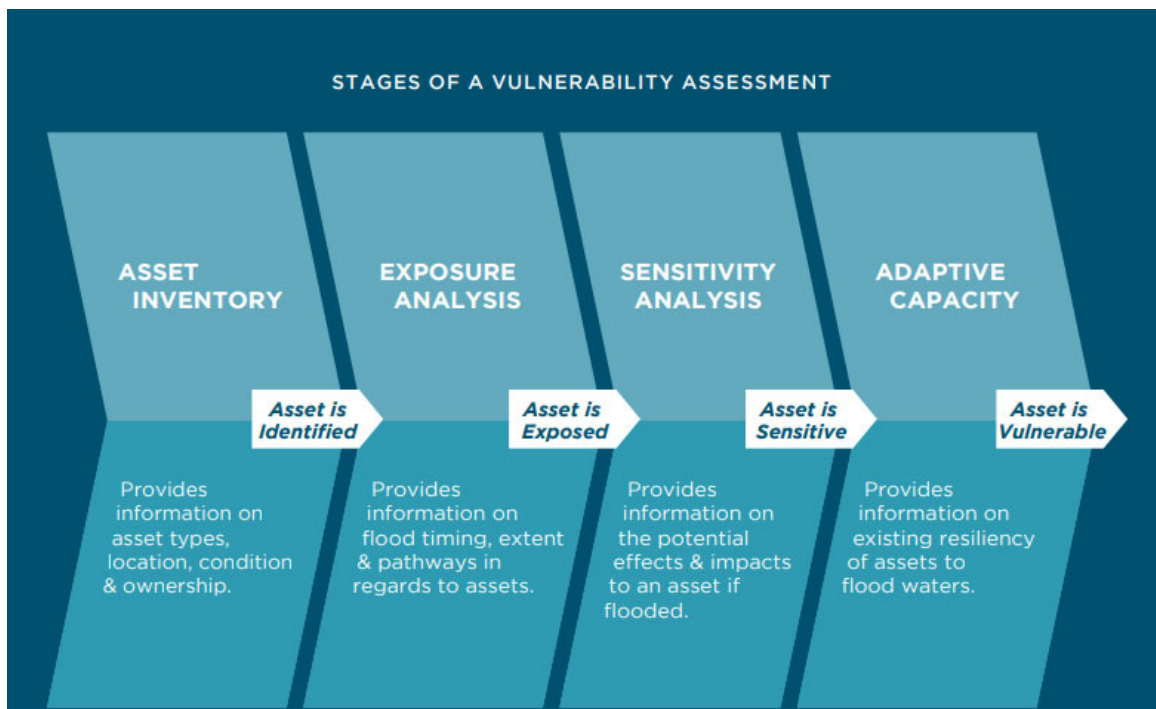


Figure 4. Vulnerability Assessment Process

The consequence assessment studies flooding in areas within the City and County of San Francisco that could result in severe consequences for people, public infrastructure, private property, and the natural environment, using a framework developed by the Bay Conservation and Development Commission for their Adapting to Rising Tides program. The assessment relies on four categories of consequences:

- **Society and Equity** includes effects on people, communities, and community services, with a focus on disproportionate impacts due to existing inequalities

- **Economy** includes direct and indirect costs of flooding such as infrastructure repair, property damage, recovery costs and lost productivity due to temporary disruptions
- **Environment** includes impacts on the natural environment as measured by water quality, species biodiversity and habitat area, air quality, soil contamination, and/or other metrics
- **Governance** includes both government and private actions that may be necessary for flood response including public participation in adaptation and resilience efforts and governmental approvals and financing mechanisms for adaptation strategies

The consequence assessment identifies vulnerable and high-consequence areas along the shoreline where adaptation efforts could be focused, especially in the near term. These areas may include vulnerabilities that affect multiple infrastructure systems, multiple facilities, and large numbers of people. The consequences assessment also identifies where additional analysis is necessary to support efforts to prioritize funding for capital improvements and future adaptation planning. See below for a brief description of key findings. Appendix A includes the full Executive Summary.

## KEY FINDINGS

The consequences assessment began by mapping potential flood impacts on current housing and businesses; those results and key public sector infrastructure findings are summarized in Table 1. Sea level rise and coastal flood risk will worsen over time without adaptation action, so the 2100 numbers reflect significant citywide risk to multiple sectors if no action is taken. These counts reflect current infrastructure, land use patterns, and shoreline protection and therefore may underestimate or overestimate assets at risk over time.

	2030 SCENARIO	2050 SCENARIO	2100 SCENARIO
Residents	5,044	15,471	31,121
Jobs	10,243	49,287	168,058
Streets	20 miles	50 miles	91 miles
Open Space	232 acres	550 acres	684 acres
Public Land	442 acres	887 acres	1,490 acres
Schools	2	9	19

**Table 1. Sea Level Rise exposure overview based on high end estimates of sea level rise plus coastal storm events. These counts reflect sea level rise and coastal flooding risk with no adaptation action based on current land use and public facilities.**

In addition to mapping housing and commercial land use in the Sea Level Rise Vulnerability Zone, the consequences assessment identified five key issues that cross agency boundaries and neighborhoods. These issues could cause severe citywide impacts and their solutions will require coordinated action.

- **Combined Precipitation and Coastal Flooding Risk:** Portions of Mission Bay and Islais Creek are vulnerable to flooding from both precipitation and coastal overtopping because they are at the bottom of large watersheds and include historic creeks and marshes. Their current elevations are low and rain from large watersheds collects in these basins, causing temporary flooding.

Higher Bay water levels will slow or impede gravity drainage of stormwater, which could result in severe and unprecedented flooding in these areas.

- **Joint Impacts of Contamination and Liquefaction in Bay Fill Areas:** Along San Francisco's Bay shoreline, historical fill and military and industrial land uses mean many neighborhoods are at risk of flooding, soil liquefaction and settlement during earthquakes, and environmental contamination. These concurrent hazards may exacerbate one another, such as when contaminated materials are mobilized during a flood event or when rising groundwater expands liquefaction areas. These physical hazards have significant public health and safety consequences. Neighborhoods like Bayview and Hunters Point, where many of these factors exist, already experience disproportionate contamination burdens among other health disparities.
- **Risks and Requirements for New Development in Waterfront Neighborhoods:** Multiple areas of the shoreline are in various stages of planning and design, permitting, and construction. These shoreline developments will revitalize former military and industrial areas, provide significant amounts of new housing, and accommodate commercial growth, but their location makes them potentially vulnerable to future flooding and sea level rise impacts. New developments are incorporating sea level rise adaptation strategies into their design based on the best available science at the time of their approvals.
- **Loss of Shoreline Open Space Through Flooding and Adaptation Efforts:** Shoreline parks and open space add to San Francisco's quality of life and generate economic activity through tourism. Ocean Beach, Crissy Field, Marina Green, and the Embarcadero Promenade are iconic San Francisco destinations that are vulnerable to current flooding and future sea level rise impacts. Shoreline open space provides unique recreation such as swimming, small boat access, and wildlife viewing that cannot be replaced at other city open spaces.
- **Regional Transportation Impacts:** San Francisco relies on regional transportation infrastructure to bring workers and tourists into the city and to connect San Francisco with the rest of the Bay Area. Caltrain, BART, and freeways are vulnerable to current and future flooding within and beyond San Francisco's boundaries and they will not function well in the future without regional action.

## NEXT STEPS

This Assessment is a first step towards successful sea level rise adaptation. City agencies, decision makers, and the public will need to use this information to plan, fund, and implement appropriate strategies across our shoreline.

San Francisco's efforts to adapt to sea level rise, coastal flooding, and other climate impacts will continue for decades. Major adaptation projects that involve significant changes to the city's shoreline infrastructure will take many years to plan, fund, and build. These projects will involve phasing plans that identify near-term, high-priority actions that address the most imminent flooding concerns. Smaller fixes to individual buildings or other infrastructure may be built into ongoing capital improvement plans and built quickly.

The city already experiences coastal flooding. Sea level rise will exacerbate flooding in very low-lying areas in the near term. To that end, the City is already pursuing projects, plans, and policies at the asset, neighborhood, and citywide scales to adapt San Francisco to coastal flooding, including:

- **The Hazard and Climate Resilience Plan** assesses citywide vulnerability to a variety of climate and other hazards, such as earthquakes, heat, poor air quality, drought, and sea level rise, and develops strategies to mitigate risk and make the city more resilient to these hazards.
- **The Embarcadero Seawall Program** is a citywide effort, led by the Port, to seismically strengthen the Embarcadero Seawall, address current and future flood and sea level rise risk due to climate change.
- **The U.S. Army Corps/Port Flood Study** will study flood risk along San Francisco's Bayside shoreline from Aquatic Park to Heron's Head Park, identify areas that are vulnerable to shoreline flooding, and develop strategies to reduce current and future flood risk.
- **The Islais Creek Adaptation Strategy** will develop a long-range vision for the Islais Creek basin, with an emphasis on securing the area's critical transportation facilities
- **Ocean Beach Master Plan (OBMP)** was an interagency effort with participation from federal, state, and local agencies to develop a sustainable and resilient long-term vision for Ocean Beach. The Plan presents six key moves that are designed to be implemented incrementally over a period of decades. To date, City efforts have focused on South Ocean Beach which experiences chronic erosion related to sea level rise and include removal of the Great Highway between Sloat and Skyline Boulevard and introduction of a coastal protection, restoration, and access. Implementation of these moves is considered the City's first climate change adaptation project, which is being led by the SFPUC.
- The **SFO Shoreline Protection Project** will address potential flood risks at San Francisco International Airport.
- The City adopted **Sea Level Rise Capital Planning Guidance** in 2014 for infrastructure projects of \$5 million or more. This guidance is currently being revised to reflect updated State sea level rise projections.
- Requirements for new waterfront development to build sea level rise adaptation strategies into their proposed projects.

These efforts are closely coordinated with the citywide Sea Level Rise planning work. Planning staff participate in the technical working groups and steering committees for these projects. Planning and partner agencies are working together to share data and information, coordinate and streamline public engagement, and identify cross-cutting issues that cannot be addressed by any single effort. Collectively, these efforts will develop strategies to adapt the City's critical infrastructure, facilities, and public and private lands and structures to rising sea levels.

In addition to these ongoing efforts, the City is scoping out next steps for climate resilience planning, considering not only sea level rise, but other climate-related hazards as well, such as extreme precipitation, drought, poor air quality, extreme heat, and wildfire.

Specific next steps are currently being developed, and may include:

- Comprehensive capital planning for climate adaptation, including shoreline strategies for sea level rise adaptation;
- Climate resilient codes and standards for new development that consider climate adaptation, including flood protection and weatherproofing, and climate mitigation such as Zero Net Energy and green roofs, considering overall development feasibility;
- General Plan policy updates to ensure the City's policy integrates and aligns with the need to address climate change and its impacts; and



- Funding, legislative, governance, and strategies to implement climate strategies – both reducing our climate emissions and adapting San Francisco to the impacts of climate change.

### **REQUIRED COMMISSION ACTION**

This item is being presented for informational purposes only. No formal action by the Planning Commission is required.

<b>RECOMMENDATION: None-Informational Item Only</b>
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Attachment:

Draft Sea Level Rise Vulnerability and Consequences Assessment Executive Summary



# **SAN FRANCISCO VULNERABILITY AND CONSEQUENCE ASSESSMENT**

## **EXECUTIVE SUMMARY**

Sea levels are rising globally. Recognizing this universal crisis cannot be halted with exemplary limited efforts, San Francisco is committed to understanding the local vulnerabilities and consequences of sea level rise and coastal flooding with the ultimate goal of implementing effective adaptation strategies.

Approximately 4 square miles of San Francisco are located within the city's Sea Level Rise Vulnerability Zone,<sup>1</sup> an area that was formally identified by the City in 2014.<sup>2</sup> By the end of the century, this area could be flooded by a 100-year coastal flood event coupled with 66 inches<sup>3</sup> of sea level rise, a probable worst-case scenario. These low-lying areas are home to approximately 80,000 residents,<sup>4</sup> approximately

30,000 businesses,<sup>5</sup> new development, and a host of vital infrastructure, including roadways, water and wastewater pipelines, emergency services, transit lines, recreational areas, the Port of San Francisco, and San Francisco International Airport.<sup>6</sup>

In 2016, San Francisco released the Sea Level Rise Action Plan,<sup>7</sup> defining an overarching vision and set of objectives for future sea level rise and coastal flooding planning and mitigation, and identifying the next steps toward developing a citywide Sea Level Rise Adaptation Plan.

This Sea Level Rise Vulnerability and Consequence Assessment (Assessment) fulfills the critical next steps required to advance the City forward toward reaching this goal.

1 4 square miles, not including Treasure Island or the San Francisco Airport SFO.

2 <http://onesanfrancisco.org/sea-level-rise-guidance/>

3 66 inches of SLR represents the upper-bound SLR projection for the end of the century (i.e., 2100) associated with the best available science (National Research Council, 2012) when the SLR Vulnerability Zone was adopted by the City in 2014. In 2017, three new reports were released that increased the upper-bound projections (USGCRP, 2017; Rising Seas, 2017; Sweet et al., 2017); however, a revised and expanded SLR Vulnerability Zone has not been adopted at this time.

4 Population count by 2010 census block

5 Business counts by Census Tract from 2017 Dun & Bradstreet data set

6 San Francisco International Airport (SFO) is located south of the main city of San Francisco, within San Mateo County and directly adjacent to San Francisco Bay. However, SFO is part of the jurisdiction of the City and County of San Francisco.

7 <http://sf-planning.org/sea-level-rise-action-plan>

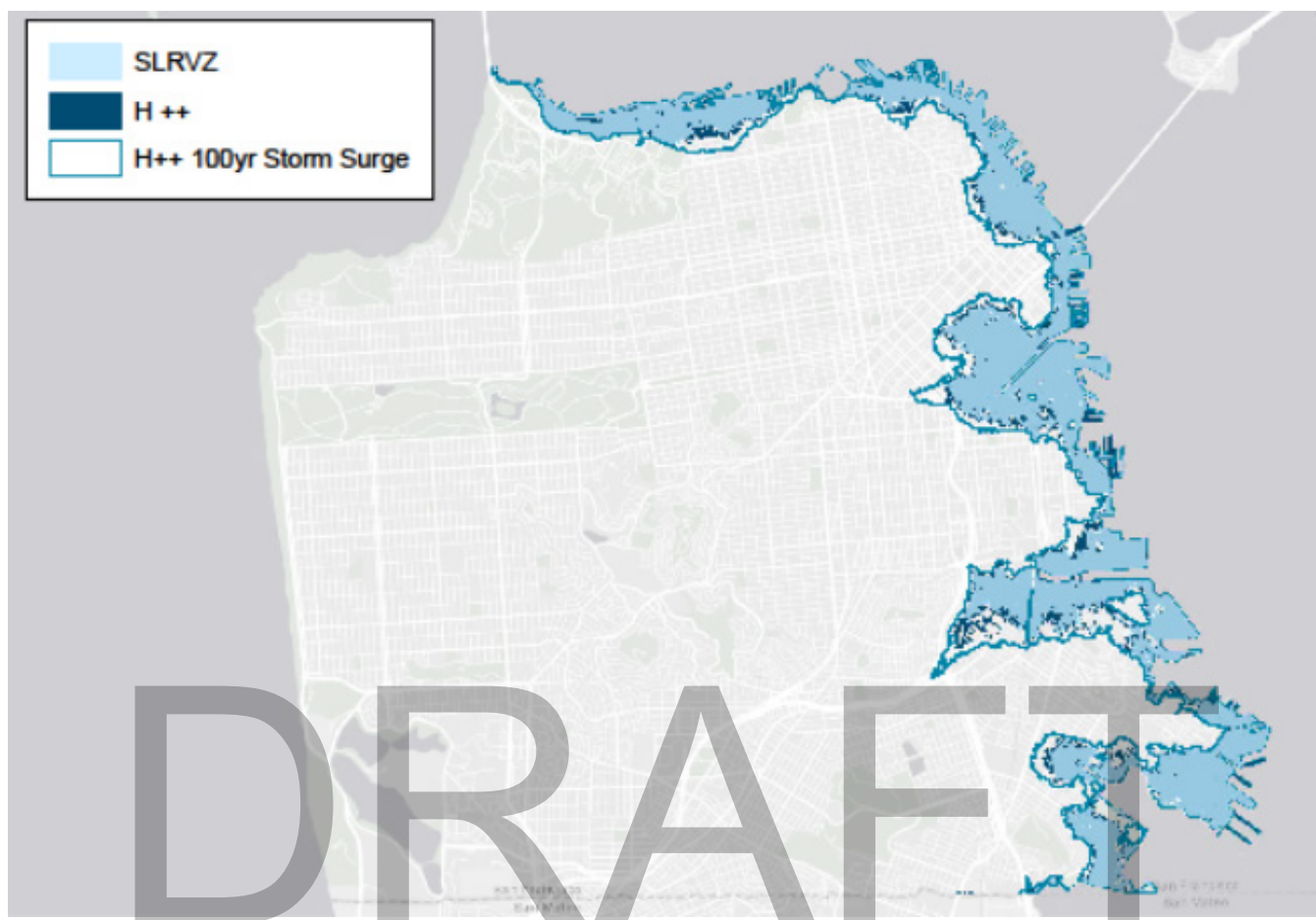
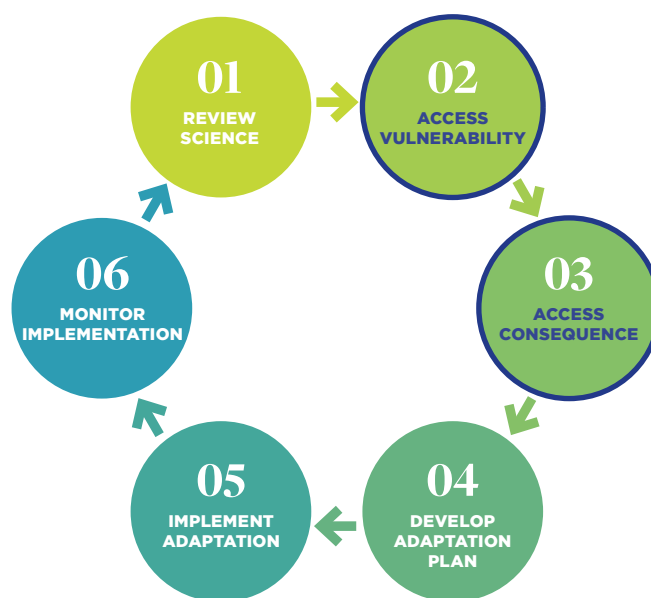


Figure 1 Sea Level Rise Vulnerability Zone

Figure 2  
Sea Level Rise Action  
Plan Framework





The 2016 Sea Level Rise Action Plan Vision is still applicable:

**Make San Francisco a more resilient city in the face of immediate and long-term threats of sea level rise by taking measures to protect and enhance public and private assets, the natural environment, and quality of life for all.**

The Assessment works toward this vision by providing information to decision makers, City agencies, and public stakeholders so the City (in collaboration with San Francisco's communities) can develop,

prioritize, and implement appropriate adaptation strategies to build San Francisco's resilience to sea level rise. This executive summary highlights key citywide sea level rise impacts that supersede individual agencies and considerations for successful future adaptation planning. For more detailed sector and neighborhood findings, see the full Assessment report. Sector chapters, including Mobility, Water, Wastewater, Public Safety, Open Space, and Port, identify publicly owned infrastructure within the Sea Level Rise Vulnerability Zone and assess the infrastructure's vulnerability to both temporary coastal flooding and long-term permanent inundation by sea level rise. The Assessment also includes neighborhood profiles that identify consequences to people, the economy, and the environment with a focus on low-income communities and vulnerable populations.



## KEY CITYWIDE IMPACTS

	2030	2050	2100
Population	5,044	15,471	31,121
Jobs	10,243	49,287	168,058
Streets	20 miles	50 miles	91 miles
Open Space	232 acres	550 acres	684 acres
Public Land	442 acres	887 acres	1,490 acres
Public Schools	0	1	4
Private Schools	2	8	15

## Sea Level Rise Exposure Overview



### **Combined Precipitation and Coastal Flooding Risk**

Portions of Mission Bay and Islais Creek are vulnerable to flooding from both precipitation and coastal overtopping because they are at the bottom of large watersheds and include historic creeks and marshes. Rain from large watersheds collects in these low basins, causing temporary flooding. Higher Bay water levels will slow or impede gravity drainage of stormwater, which could result in severe and unprecedented flooding in these areas.

Combined coastal and precipitation flood risk, particularly as sea levels rise and precipitation patterns change, is not fully understood. Modeling of future precipitation is underway by the San Francisco Public Utilities Commission and Lawrence Livermore National Laboratory. Areas with precipitation flood risk, coastal flood risk, and drainage issues will be among the first and most severely affected neighborhoods in the city. Strategies to address flooding in these areas will need to keep coastal flooding out while allowing or improving drainage so that solutions to one type of flood risk do not exacerbate others.

### **Joint Impacts of Contamination and Liquefaction in Bay Fill Areas**

Along San Francisco's Bay shoreline, historical fill (filling in former wetlands and areas of the Bay to create new land) and military and industrial land uses mean many neighborhoods are at risk of flooding, soil liquefaction and settlement during earthquakes, and environmental contamination. These concurrent hazards may exacerbate one another, such as when contaminated materials are mobilized during

a flood event or when rising groundwater expands liquefaction areas. These physical hazards have significant public health and safety consequences. Neighborhoods like Bayview and Hunters Point, where many of these factors exist, already experience disproportionate contamination burdens among other health disparities.

It is in the interest of public health and safety to effectively and efficiently remediate contaminated land sites. Many sites undergoing remediation have plans for new housing development and there is a limited amount of undeveloped land to meet housing needs. Effective remediation and reuse of these sites will need to account for future flooding and groundwater changes due to sea level rise. Modeling and monitoring may be required to fully understand interactions between sea level, groundwater, contamination, and soil stability.

### **Risks and Requirements for New Development in Waterfront Neighborhoods**

Many of San Francisco's large developable areas exist along the Southeastern Shoreline. Multiple areas of the shoreline are in various stages of planning and design, permitting, and construction. These shoreline developments will revitalize former military and industrial areas, provide significant amounts of new housing, and accommodate commercial growth, but their location makes them potentially vulnerable to future flooding and sea level rise impacts.

Current development plans account for expected sea level rise and identify adaptation measures like elevating building pads and designing open spaces



to accommodate flooding. These strategies require developments to commit to a future water level elevation, but if sea level rises faster or higher than anticipated, these neighborhoods will need to pursue additional measures.

This effect is exacerbated by the long lead time for development approvals and construction. For example, the Treasure Island Redevelopment Authority secured its project approvals in 2011-2015 but buildout will not be complete until after 2035 and the housing and commercial buildings will persist past 2100. Sea level rise science will continue to evolve and more protective measures may be necessary. In addition to physical flood risks, these sites rely on existing transportation and utility networks that are not fully resilient to sea level rise and coastal flooding. A residential and commercial development that becomes an island during flood events will still suffer from these impacts even if its own buildings stay dry. Site-specific adaptation strategies cannot fully protect the function and value of these new developments; they will need to engage in community adaptation planning to protect neighborhoods and the city.

### **Loss of Shoreline Open Space Through Flooding and Adaptation Efforts**

Shoreline parks and open space add to San Francisco's quality of life and generate economic activity through tourism. Public access to the shoreline has been expanded and improved through the removal of the Embarcadero Freeway and shoreline redevelopment, but sea level rise may damage and eventually destroy these recreational facilities. Ocean Beach, Crissy Field, Marina Green, and the

Embarcadero Promenade are iconic San Francisco destinations that are vulnerable to current flooding and future sea level rise impacts. Shoreline open space provides unique recreation such as swimming, small boat access, and wildlife viewing that cannot be replaced at other city open spaces.

In addition to publicly owned recreation sites, many shoreline developments have identified shoreline open spaces as part of their adaptation strategies. This approach may protect buildings and infrastructure, but the open space will narrow and eventually disappear. These shrinking open spaces will limit recreation opportunities for residents and workers in those developments and for the city as a whole. This effect would be most severe in the Central and Southeastern Waterfront areas, where private developments have agreed to provide extensive open space for a rapidly growing population as part of their development agreements.

### **Regional Transportation Impacts**

San Francisco relies on regional transportation infrastructure to bring workers and tourists into the city and to connect San Francisco with the rest of the Bay Area. Caltrain, BART, and freeways are vulnerable to current and future flooding within and beyond San Francisco's boundaries and they will not function well in the future without regional action. For example, the Embarcadero BART and Muni station are vulnerable to near-term flood impacts, which the City is studying in partnership with the Port, BART, and the U.S. Army Corps of Engineers. Even if San Francisco implements adaptation measures for Embarcadero station, the station cannot function if the Transbay Tube is out





of service or BART is unable to adapt other vulnerable stations. Similarly, flooding on U.S. Highway 101 in San Mateo County has severe impacts for San Francisco International Airport, although the flooding is outside of San Francisco's jurisdiction.

In addition to planning for current infrastructure, the Bay Area is planning and implementing major transportation investments like High Speed Rail, a potential second Bay BART crossing, and ferry network extensions. All of these projects will need to consider sea level rise and coastal flooding in their designs and coordinate with San Francisco shoreline projects like the Embarcadero Seawall Program. San Francisco cannot plan and implement effective regional transportation adaptation alone and will need to work with regional, state, and federal partners to protect and enhance transportation networks.

### Considerations for Sea Level Rise Adaptation Planning

This Assessment is a first step towards successful sea level rise adaptation. City agencies, decision makers, and the public will need to use this information to plan, fund, and implement appropriate strategies

across our shoreline. As the City enters that planning process, it has identified key considerations to ensure future adaptation is effective, efficient, equitable, and environmentally appropriate.

Successful adaptation planning should:

- Begin with robust community engagement to ensure strategies will meet local needs and build public and political support for action
- Prioritize and include vulnerable neighborhoods that already bear disproportionate environmental contamination burdens and will be most impacted by future flooding
- Include natural solutions where possible to improve the city's environment and provide open space recreation opportunities
- Create a decision-making framework for when and where to implement facility-specific floodproofing versus neighborhood-scale shoreline strategies
- Identify strategies that could be implemented by multiple actors, including individual agencies, private landowners, and the city as a whole
- Adopt adaptation policies for private development and public investment in addition to implementing physical strategies
- Identify potential funding sources and appropriate lead agencies for adaptation projects that cross agency jurisdictions
- Balance uncertainty in long-term climate projections with the need for urgent action
- Integrate sea level rise and coastal flooding programs with other City resilience efforts

San Francisco will continue to adapt to sea level rise, coastal flooding, and other climate impacts for decades and centuries to come. This Assessment is a first step towards protecting the shoreline and the social, economic, and environmental benefits it provides.

## NEXT STEPS

San Francisco's efforts to adapt to sea level rise, coastal flooding, and other climate impacts will continue for decades. Major adaptation projects that involve significant changes to the city's shoreline infrastructure will take many years to plan, fund, and build. These projects will involve phasing plans that identify near-term, high-priority actions that address the most imminent flooding concerns. Smaller fixes to individual buildings or other infrastructure may be built into ongoing capital improvement plans and built quickly.

The city already experiences coastal flooding. Sea level rise will exacerbate flooding in very low-lying areas in the near term. To that end, the City is already pursuing projects, plans, and policies at the asset, neighborhood, and citywide scales to adapt San Francisco to coastal flooding, closely coordinated with the citywide Sea Level Rise planning work, including:

- **The Hazard and Climate Resilience Plan** assesses citywide vulnerability to a variety of climate and other hazards, such as earthquakes, heat, poor air quality, drought, and sea level rise, and develops strategies to mitigate risk and make the city more resilient to these hazards.
- **The Embarcadero Seawall Program** is a citywide effort, led by the Port, to seismically strengthen the Embarcadero Seawall, address current and future flood and sea level rise risk due to climate change.
- **The U.S. Army Corps/Port Flood Study** will study flood risk along San Francisco's Bayside shoreline from Aquatic Park to Heron's Head Park, identify areas that are vulnerable to shoreline flooding, and develop strategies to reduce current and future flood risk.
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- **Ocean Beach Master Plan (OBMP)** was an interagency effort with participation from federal, state and local agencies to develop a sustainable and resilient long-term vision for Ocean Beach.

The Plan presents six key moves that are designed to be implemented incrementally over a period of decades. To date, City efforts have focused on South Ocean Beach which experiences chronic erosion related to sea level rise and include removal of the Great Highway between Sloat and Skyline Boulevard and introduction of a coastal protection, restoration, and access. Implementation of these moves, led by the SFPUC, is considered the City's first climate change adaptation project.

- The SFO Shoreline Protection Project will address potential flood risks at SFO.
- The City adopted Sea Level Rise Capital Planning Guidance in 2014 for infrastructure projects of \$5 million or more. This guidance is currently being revised to reflect updated State sea level rise projections.
- Requirements for new waterfront development to build sea level rise adaptation strategies into their proposed projects.

In addition to these ongoing efforts, the City is scoping out next steps for climate resilience planning, considering not only sea level rise, but other climate-related hazards as well, such as extreme precipitation, drought, poor air quality, extreme heat, and wildfire. Specific next steps are currently being developed, and may include:

- Comprehensive capital planning for climate adaptation, including shoreline strategies for sea level rise adaptation;
- Climate resilient codes and standards for new development that consider climate adaptation, including flood protection and weatherproofing, and climate mitigation such as Zero Net Energy and green roofs, considering overall development feasibility;
- General Plan policy updates to ensure the City's policy integrates and aligns with the need to address climate change and its impacts; and
- Funding, legislative, governance, and strategies to implement climate strategies – both reducing our climate emissions and adapting San Francisco to the impacts of climate change.