



DATE: June 22, 2021

CATEGORY: New Business

DEPT.: Public Works

TITLE: **2021 Shoreline Sea Level Rise Study Update, Project 21-54**

RECOMMENDATION

1. Direct staff to use the high sea level rise risk level for the City's sea level rise planning, Capital Improvement Program, and funding efforts.
2. Direct staff to proceed with the next steps presented in this Council report.

BACKGROUND

The City of Mountain View lies on the alluvial plain of Santa Clara Valley with the ground surface descending from the hills south of the City to the San Francisco Bay (Bay). The area north of U.S. 101, including the North Bayshore Area, is a low-lying area and is subject to flooding due to stormwater runoff and high tides and is, therefore, sensitive to sea level rise impacts (Figure 1).

Even without sea level rise, some properties in the area are within the Federal Emergency Management Agency's (FEMA's) 100-year special flood hazard zone and subject to special construction and insurance requirements.



Figure 1: North Bayshore Area Map

North Bayshore Area – Existing Flood Risk

Flood risk for the area north of U.S. 101 is presented from three water bodies: the Bay from the north, Permanente Creek from the west, and Stevens Creek from the east. Each is discussed briefly below.

San Francisco Bay

North of Shoreline at Mountain View Regional Park, the City is bounded by three ponds that were constructed for salt production. One pond (Charleston Slough) was purchased by the City for wetland restoration. The other two ponds (Pond A1 and Pond A2W) are owned by the United States Fish and Wildlife Service (USFWS) and are part of the South Bay Salt Pond Restoration Project (Salt Pond Project) that is being managed by the California State Coastal Conservancy. Limited coastal flood and sea level rise protection are provided by the levees that surround these ponds, which are not constructed to the standards required for certification by FEMA.

The outer (Bay-side) levees will be breached as part of the Salt Pond Project, increasing wave action and potential erosion along the City's Bay front. The Salt Pond Project will also bolster the levees along Ponds A1 and A2W with installation of a gently sloped upland Habitat Transition Zone from the City's landfill towards the Bay. The Habitat Transition Zone will provide habitat for marsh wildlife as well as wave energy attenuation that will protect the levees.

Charleston Slough lies between Pond A1 and the Palo Alto Flood Basin (PAFB) and is protected from the Bay by an outboard levee, with tide gates regulating the flow of Bay water to the slough. The City has the following three management objectives at Charleston Slough:

1. **Tidal Marsh Restoration**: When the City acquired Charleston Slough from the Leslie Salt Company in 1980, the City inherited a mitigation requirement from the San Francisco Bay Conservation and Development Commission (BCDC) to restore 53 acres of tidal marsh within the parcel. The restoration effort has been challenging, and the City is working with BCDC on the effort.
2. **Water Supply for the Sailing Lake**: The Sailing Lake intake pump station, located at the southern limit of the slough, provides water supply to the Sailing Lake to maintain the lake water quality.

3. **Flood Management:** The levees along the southern edge of Charleston Slough and along the western edge of Charleston Slough are low and, therefore, provide limited protection. The tide gates and levees around Charleston Slough provide some level of flood protection but are not sufficient under anticipated sea level rise conditions. The existing floodplain in North Bayshore is connected to the floodplain of the City of Palo Alto and the PAFB. Therefore, any coastal flood risk management measures will need to connect and be coordinated with improvements along PAFB in order to provide continuous protection along the shared shoreline between the two cities.

Permanente Creek

The Permanente Creek levees are not accredited by FEMA, and some areas within North Bayshore are subject to flooding from Permanente Creek. In recent years, Valley Water's (formerly Santa Clara Valley Water District) Permanente Creek Flood Protection Project improved sections of floodwalls and levees along Permanente Creek between U.S. 101 and Shoreline at Mountain View, but additional levee improvements are needed for anticipated sea level rise conditions.

Stevens Creek

Levees exist on both sides of Stevens Creek from U.S. 101 to Crittenden Lane, protecting Mountain View to the west and Moffett Field/Sunnyvale to the east. These levees were accredited by FEMA as providing protection from the 100-year flood event under existing conditions. Additional improvements are needed for the levees north of Crittenden Lane that were not accredited by FEMA to protect against existing and anticipated sea level rise conditions.

2012 Sea Level Rise Study

In 2012, in response to the existing flood risk for the North Bayshore Area and the anticipated sea level rise risk, the City developed the Shoreline Regional Park Community Sea Level Rise Study Feasibility report and Capital Improvement Program report (2012 Study). The 2012 Study proposed a sea level rise planning horizon of Year 2067, projected the future water surface elevations at the Bay with both high and low sea level rise projections under a 100-year event, estimated the coastal flood vulnerabilities in North Bayshore, and developed a Sea Level Rise Capital Improvement Program (CIP) to address the existing and the projected Year 2067 coastal flood risk.

Recognizing that there is some uncertainty regarding how much the sea level will rise, the 2012 Study adopted the following two scenarios to bracket the low and high ends of the range.

- Low Sea Level Rise. Eight inches (8") of sea level rise between 2000 and 2067 (1% still water level = 11.3' North American Vertical Datum (NAVD)).
- High Sea Level Rise. Thirty-one inches (31") of sea level rise between 2000 and 2067 (1% still water level = 13.2' NAVD).

The 2012 Study recommended, and Council approved, project implementation based on a "Low-Plus" planning scenario under which Sea Level Rise CIP projects will be designed to provide protection from the Low projection (8" of sea level rise) with simple adaptability to meet the High scenario. For instance, levees would be constructed with a wider base that can accommodate a future increase in height. Each scenario is shown diagrammatically in Figure 2.

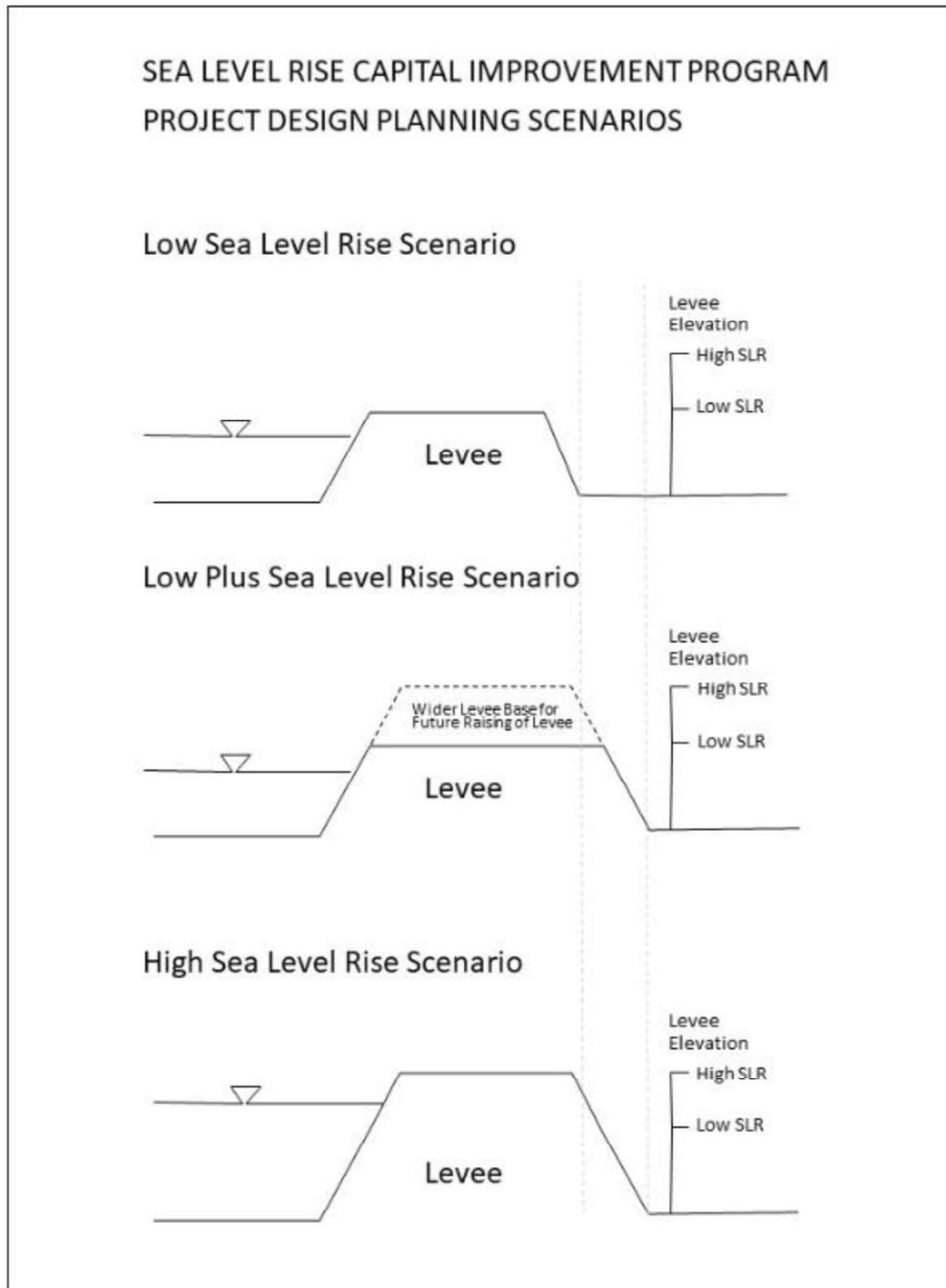


Figure 2: Sea Level Planning Scenarios

The Sea Level Rise CIP includes 12 projects to address impacts from sea level rise, primarily improvements to levees and pump stations (see Table 1). The 2012 estimate value of the 12 Sea Level Rise projects was \$45.7 million.

Table 1: Sea Level Rise CIP Projects from 2012 Study

2012 Study Project Number	Project	Coastal Flooding	Coastal Erosion	Fluvial Flooding	Infrastructure Reliability	Interior Drainage	Sea Level Rise Planning	Low Plus Sea Level Rise Scenario Estimated Cost (\$ in millions in 2012 value)
1	Charleston Slough and PAFB Levee Improvement	X						\$15.53
2	Coast-Casey North Levee Improvement	X	X					\$3.54
3	North Landfill Erosion Protection		X					\$9.61
4	Permanente Creek Levee and Floodwall Improvements			X				\$5.53
5	Golf Course Facilities High Ground Augmentation	X						\$3.63
6	Lower Stevens Creek Levee Improvements	X		X	X			\$1.49
7	Coast-Casey Pump Station Improvement					X		\$2.32
8	Lower Permanente Creek Storm Drain Improvements					X		\$2.61
9	Sailing Lake Access Road Improvement				X			\$0.17
10	Sailing Lake Intake Pump Station Modification				X			\$0.69
11	Charleston Slough Tide Gate Improvement	X			X			\$0.06
12	Sea Level Rise Assessment						X	\$0.50
TOTAL PLANNING LEVEL COST ESTIMATE								\$45.67

The North Bayshore Precise Plan incorporated the sea level rise considerations from the 2012 Study into land use planning design guidelines. It includes levee design, storm drainage improvements, and the minimum finished floor elevation in the low sea level rise inundation zone to account for sea level rise.

Regional Planning Efforts

Staff has been coordinating closely with members of other agencies working on regional efforts that affect the City's sea level rise mitigation efforts.

Phase II of the Salt Pond Project will restore Pond A1 and Pond A2W to tidal marshes and reestablish tidal flow connection with South San Francisco Bay by breaching segments of outboard levees. The proposed gently sloped Habitat Transition Zone will reduce erosion risk along the City shoreline, which is a vulnerability under anticipated sea level rise conditions. The design of the improvements to Pond A2W is 90% complete, and staff is working with the Salt Pond project team to complete design, project agreements, and logistics of hauling a significant amount of soil for construction of the Habitat Transition Zone. Construction is scheduled to start in summer 2021, with material hauling through Shoreline at Mountain View to stockpile soil in Pond A2W. The final design and the project agreements are anticipated to be complete before the end of 2021, which will be followed by full construction work at Pond A2W.

Staff has also been coordinating with the United States Army Corps of Engineers (USACE), Valley Water, the City of Palo Alto, and other agencies on the South San Francisco Bay Shoreline Project (Shoreline Project) at the PAFB. Led by USACE, the project team is currently working on environmental clearance and studying the feasibility of various options. The option chosen will affect the City's plans for protection in this area, so close coordination is warranted.

Table 2 provides the status of the City's 2012 Sea Level Rise CIP projects, and how they relate to the Salt Pond Project and Shoreline Project.

Table 2: 2012 Sea Level Rise CIP Project Status

Project		Status
Projects that are City-led and independent of Salt Pond Project and Shoreline Project		
4	Permanente Creek Levee and Floodwall Improvements	Pending, future project.
5	Golf Course Facilities High Ground Augmentation	Pending, future project.
6	Lower Stevens Creek Levee Improvements	In design, estimated construction start in 2024.
8	Lower Permanente Creek Storm Drain Improvements	Pending, future project.

Project		Status
9	Sailing Lake Access Road Improvement	Design is completed. Construction scheduled to start in fall 2021 and complete early 2022.
12	Sea Level Rise Assessment	In progress.
Projects coordinated with Salt Pond Project		
2	Coast-Casey North Levee Improvement	In design, estimated construction start with Pond A1.
3	North Landfill Erosion Protection	In analysis, coordinating with Salt Pond team on project timing and phasing.
10	Sailing Lake Intake Pump Station Modification	In design, estimated construction to start with Project 2 – Coast-Casey Levee Improvement.
Projects to be coordinated with Shoreline Project		
1	Charleston Slough and PAFB Levee Improvement	Pending, project need and project scope depend on PAFB improvement plan.
7	Coast-Casey Pump Station Improvement	Pending, project scope depends on PAFB improvement plan
11	Charleston Slough Tide Gate Improvement	Tide gate repair proceed in Fiscal Year 2021-22, long-term improvements depend on PAFB improvement plan and Charleston Slough mitigation project.

ANALYSIS

Since 2012, projections for sea level rise have been updated and regional planning efforts have progressed.

Updated Sea Level Rise Scenarios

The latest update by the California Ocean Protection Council's State of California Sea-Level Rise Guidance 2018 Update (OPC 2018 Guidance) provides new estimates and planning resources for coastal communities to develop strategies to address sea level rise adaptation.

The OPC 2018 Guidance projected a 66% probability that the sea level rise in Year 2070 will be at or below 23" and considered this to be a low risk aversion scenario. It also projected a 0.5% probability that the sea level rise in 2070 will be at or above 42" and considered this to be a medium-to-high risk aversion scenario. The increased sea level rise projection is a reflection of the increasing rate of ice loss from Greenland and the Antarctic ice sheets, improved scientific understanding and modeling of sea level rise, and change in sea level rise with consideration of different greenhouse gas emissions scenarios.

Based on the updated sea level rise projections and their estimated exceedance probabilities, the low and high ends of the sea level rise scenarios are updated as follows:

- Low Sea Level Rise. Twenty-three inches (23") of sea level rise between 2000 and 2070 (1% still water level = 12.5' NAVD).

2012 Study: Eight inches (8") of sea level rise between 2000 and 2067 (1% still water level = 11.3' NAVD).

- High Sea Level Rise. Forty-two inches (42") of sea level rise between 2000 and 2070 (1% still water level = 14.1' NAVD).

2012 Study: Thirty-one inches (31") of sea level rise between 2000 and 2067 (1% still water level = 13.2' NAVD).

With the latest projections, the planning year has been updated from 2067 to 2070, which equates to an approximately 50-year planning horizon and is in line with the sea level rise projection time steps presented in the OPC 2018 Guidance.

Updated Sea Level Rise Study

With new sea level rise projections, information available from the City's 2019 Storm Drain Master Plan and progress on the City's and regional efforts, staff updated the 2012 Study by reanalyzing sea level rise impacts to the City and updating the CIP project list.

In this sea level rise study update, it is assumed the Salt Pond Project will proceed as planned, but the analysis did not include implementation of the regional Shoreline Project (unless noted) due to the uncertainties related to that project's scope, timing, and funding.

The sea level rise study update mapped the 100-year coastal floodplain under existing conditions and the two projected sea level rise scenarios (Figure 3). Based on this new

analysis, the scope and cost estimate of each project in the 2012 Study are updated under two scenarios:

- Low-Plus Sea Level Rise Scenario: Improvements to provide 100-year flood protection with 23" of sea level rise by Year 2070, but with a wider levee base sized for the high sea level rise scenario so additional fill can be more easily added at a later time.
- High Sea Level Rise Scenario: Improvements to provide 100-year flood protection with 42" of sea level rise by Year 2070.



Figure 3: Year 2070 Projected Sea Level Rise Inundation Map

The updated 2021 Sea Level Rise CIP projects are shown in Figure 4 and Table 3. In general, the updated Sea Level Rise CIP has a similar list of projects, but the scope of work has increased for most projects due to the higher sea level rise projections and design elevations. Construction cost estimates have increased accordingly. Two new projects have been added, and additional modifications to the scopes of some projects are made, as described below.

- Project 11: Charleston Slough Tide Gate Improvement is updated, and the scope of work will be expanded to include the mitigation requirements to meet the BCDC tidal marsh vegetation requirements in Charleston Slough. Project 11 will be renamed “Charleston Slough Mitigation Project.”
- Project 12: Sea Level Rise Assessment and Monitoring is updated to include an important element to monitor sea level rise impacts to the North Bayshore Area and City infrastructure and will develop a series of performance-based criteria to plan and schedule the implementation of specific Sea Level Rise CIP projects.
- A new Project 13: Crittenden Pump Station Improvement is added. Based on recommendations from the 2019 Storm Drain Master Plan, this project will decommission the Charleston Pump Station and route stormwater flow from the Charleston Detention Basin to Crittenden Pump Station. This project will improve the interior drainage system and provide a single discharge to Stevens Creek.
- A new Project 14: As-needed Storm Drain Improvements is added. This project provides as-needed interior drainage improvements, such as backflow prevention at the creek outfalls to address potential sea level rise impacts.

The updated 2021 Sea Level Rise CIP planning level program cost estimate in 2021 dollars is as follows:

- Low-Plus Sea Level Rise Scenario = \$86.7 million
- High Sea Level Rise Scenario = \$96.6 million



Figure 4: 2021 Sea Level Rise Capital Improvement Program Projects

Staff recommends updating the City's sea level rise planning guidance to the new High Sea Level Rise scenario, with 42" of sea level rise by Year 2070 for the following reasons:

- Considering that this is a regional challenge, using design parameters that are consistent with other local projects is recommended. Both the Salt Pond Project and Shoreline Project use this scenario for project planning and design. The California Ocean Protection Council Strategic Plan to Protect California's Coast and Ocean 2020-2025 outlined a target to ensure California's coast is resilient to at least 3.5' (42") of sea level rise by 2050.
- The sea level rise projection has been trending up with each revision. Research in this field will continue, and staff does not anticipate that estimates will be reduced.

Table 3 provides the updated Sea Level Rise CIP projects with planning level cost estimates for the High Sea Level Rise Scenario. Also provided are estimated time frames for project implementation.

Table 3: Updated Sea Level Rise CIP Project Budget Timeline

Project		Estimated Cost (\$ in millions)*			
		Total	5 Year	10 Year	10+ Year
1	Charleston Slough and PAFB Levee Improvement	\$30.98			\$43.7
2	Coast-Casey North Levee Improvement	\$6.93	\$4.9	\$2.5	
3	North Landfill Erosion Protection	\$4.91	\$2.9	\$2.3	
4	Permanente Creek Levee and Floodwall Improvements	\$7.35			\$10.4
5	Golf Course Facilities High Ground Augmentation	\$4.05			\$5.7
6	Lower Stevens Creek Levee Improvements	\$9.01	\$7.2	\$2.1	
7	Coast-Casey Pump Station Improvement	\$6.39	\$1.3	\$6.1	
8	Lower Permanente Creek Storm Drain Improvements	\$6.72			\$9.5
9	Sailing Lake Access Road Improvement	\$2.68	\$2.7		
10	Sailing Lake Intake Pump Station Modification	\$2.40	\$0.5	\$2.3	
11	Charleston Slough Restoration	\$4.22	\$3.4	\$1.0	
12	Sea Level Rise Assessment and Monitoring	\$0.50		\$0.6	
13	Crittenden Pump Station Improvement	\$7.30	\$1.5	\$6.9	
14	As-needed Storm Drain Improvements	\$3.17			\$4.5
COST ESTIMATE AT EACH PLANNING TIME STEP		-	\$24.3	\$23.8	\$73.7
TOTAL COST ESTIMATE IN PRESENT VALUE		\$96.61	\$24.3	\$20.1	\$52.3

* The Total and 5-Year Estimated Costs are based on present value. The 10-Year and 10+ Year Estimated Costs are based on 2026 and 2031 future value, respectively, using a 3.5% annual rate.

Staff will continue to cooperate with other agencies that are studying or implementing projects associated with sea level rise to ensure common analysis and develop cost-effective solutions for the City and other agencies.

NEXT STEPS

Staff proposes the following next steps for sea level rise planning for the City:

- Update the design criteria of the existing Sea Level Rise CIP projects that are currently in progress based on the 2070 High Sea Level Rise planning scenarios, where feasible.
- For the pending and upcoming Sea Level Rise CIP projects, prepare feasibility analysis and develop performance-based criteria to prioritize the projects and develop an implementation plan and schedule.
- Assess potential changes in long-term groundwater impacts due to sea level rise, especially the need to revisit its potential effects to the closed landfill operation at Shoreline at Mountain View.
- Develop recommendations to update the City policy on sea level rise adaptation.
- Continue to participate and collaborate on regional planning efforts and projects.
- Identify additional funding sources for Sea Level Rise CIP implementation.
- Monitor sea level rise impacts to the City and update the Sea Level Rise CIP in five years.

FISCAL IMPACT

This study does not have an immediate financial impact. However, it is anticipated that over the ensuing years, it may be necessary to issue long-term debt to fund a number of significant capital projects. Individual projects are funded through the City's CIP.

The recommended updated list of Sea Level Rise CIP projects is estimated to cost \$121.8 million in year-of-construction dollars. Of this amount, \$11 million is currently funded in the CIP. Although staff will continue to seek outside funding sources and partnering opportunities, it is anticipated that the Shoreline Regional Park Community Fund will be the primary source for the remaining \$110.8 million required to complete the projects.

CONCLUSION

The 2021 Shoreline Sea Level Rise Study Update provides a framework to plan the projects required to manage the flood risk to the City due to projected sea level rise. Under the High Sea Level Rise scenario, the overall planning level program cost is estimated at \$96.6 million in present value (\$121.8 million in year of construction dollars). While there are opportunities to reduce the City's share via collaboration with regional projects, cost-sharing, and grant funding, there are uncertainties on these funding sources. There are also uncertainties associated with sea level rise planning, including the projection and timing of sea level rise, scope, funding, and timing of regional projects that would affect the City's planning efforts.

Coordination with other agencies is essential because the coastal floodplain in North Bayshore is connected across jurisdictional boundaries. Staff will continue to implement projects that are under way, prioritize and recommend projects for funding as appropriate, and continue to seek outside funding sources and partnering opportunities.

ALTERNATIVES

1. Direct staff to modify this report.
2. Provide other direction.

PUBLIC NOTICING – Agenda posting.

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931-06-22-21CR-1
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