

Northeast Waterfront

Subarea 2-1



Subarea Description

Northeastern Waterfront (Subarea 2-1) stretches from the Cruise Terminal (Pier 27-29) down to the Waterfront Restaurant and Café (north of Pier 7). Port property in this subarea includes a series of historic buildings and finger piers, bulkhead wharves, and seawall lots, which house waterfront and tourist attractions, including the Exploratorium, multiple restaurants, and the James R. Herman Cruise Terminal. Critical infrastructure further includes maritime and disaster response assets, such as large staging areas and the Water Emergency Transportation Authority (WETA) berths at Pier 9, which can support regional emergency response efforts, tugboat operators, local and regional transportation assets, and important wastewater assets, such as the North Shore Force Main and North Point Main-Sansome Tunnel.

The primary flood pathways are from overtopping along the engineered shoreline. Flooding first occurs in this subarea due to floodwaters conveyed along the Embarcadero roadway that overtops the shoreline in Subarea 2-2. Higher Bay water levels eventually overtop the shoreline in this subarea, and floodwaters extend several streets inland.



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Assets and Landmarks



Maritime

- | | |
|---|--|
| 1. Pier 7.5 (Marginal Wharf) | 8. Beltline Railroad Complex (Seawall Lot 318) |
| 2. Pier 9 (WETA Layover Berth) | 9. Fog City Diner (Seawall Lot 319) |
| 3. Aboveground Storage Tank (Blue and Gold, Pier 9) | 10. Seawall Lot 320 |
| 4. Exploratorium (Pier 15/17) | 11. Seawall Lot 321 |
| 5. Pier 19 | 12. Seawall Lot 322-1 |
| 6. Pier 23 Café | 13. Seawall Lot 323 |
| 7. James R. Herman Cruise Terminal (Pier 27/29) | 14. Seawall Lot 324 |



Disaster Response

- | | |
|--|---|
| 15. EFWS Suction Connections (3) | 21. Large Vessel Berth (Pier 19) |
| 16. EFWS Cisterns (3) | 22. Large Vessel Berth (Pier 27) |
| 17. WETA Department Operations Center, Ferry Storage Terminal, Bar Pilot Headquarters (Pier 9) | 23. Staging Area (Pier 27) |
| 18. Water Taxi Dock (Pier 15) | 23. Staging Area (Pier 29) |
| 19. Bay-Delta Maritime Tugboat Dock (Pier 15/17) | 24. Staging Area (Seawall Lot 321) |
| 20. Large Vessel Berth (Pier 15/17) | 25. Assembly and Staging Area (Seawall Lot 322-1) |
| | 26. Staging Area (planned) (Seawall Lot 323, 324) |
| | 27. Embarcadero Roadway |



Transportation

- 27. Embarcadero Roadway
- 28. Muni E-Line, Muni F-Line



Utilities

Wastewater

- | | |
|-------------------------------------|---------------------------------------|
| 29. Jackson Transport / Storage Box | 31. North Point Main - Sansome Tunnel |
| 30. North Shore Force Main | |

Power

- 32. Shoreside Power Facility (Pier 27)



Assets and Landmarks



Open Space and Ecology

Open Space

- | | |
|---|--------------------------|
| 33. Embarcadero Promenade | 6. Pier 23 Café |
| 34. Telegraph Hill/Pioneer Park 22nd St. access (planned) | 36. Pier 7 (Public Pier) |
| 35. Northeast Wharf | 37. Bay Trail |

Timing of Exposure: Assets and Landmarks

Assets / Landmarks	Flood Scenario	Equivalent Events	Timing				
			USACE Low	USACE Inter.	OPC Most Likely	USACE High	OPC 1-in-200
<h3>Maritime</h3>							
<ul style="list-style-type: none"> Pier 23 Café 	36" (9.2 ft. NAVD)	High tide + 36" SLR	>2150	2144	2091	2074	2063
		50-YR + 0" SLR	Today	Today	Today	Today	Today
<ul style="list-style-type: none"> Pier 7.5 (Marginal Wharf) 	52" (10.5 ft. NAVD)	High tide + 52" SLR	>2150	>2150	2120	2092	2076
		100-YR + 11" SLR	2138	2066	2044	2035	2032
<ul style="list-style-type: none"> Beltline Railroad Complex (Seawall Lot 318) Fog City Diner (Seawall Lot 319) Seawall Lot 320 Seawall Lot 321 Seawall Lot 322-1 Seawall Lot 323 Seawall Lot 324 	66" (11.7 ft. NAVD)	High tide + 66" SLR	>2150	>2150	2143	2106	2086
		100-YR + 25" SLR	>2150	2115	2072	2060	2053
<ul style="list-style-type: none"> Pier 9 (WETA Layover Berth) Aboveground Storage Tank (Blue and Gold, Pier 9) Exploratorium (Pier 15/17) Pier 19 James R. Herman Cruise Terminal (Pier 27/29) 	77" (12.6 ft. NAVD)	High tide + 77" SLR	>2150	>2150	>2150	2116	2095
		100-YR + 36" SLR	>2150	2144	2091	2074	2063

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Timing of Exposure: Assets and Landmarks

Assets / Landmarks	Flood Scenario	Equivalent Events	Timing				
			USACE Low	USACE Inter.	OPC Most Likely	USACE High	OPC 1-in-200
 Disaster Response							
<ul style="list-style-type: none"> EFWS Suction Connections (3) 	24" (8.2 ft. NAVD)	High tide + 24" SLR	>2150	2112	2070	2059	2051
		5-YR + 0" SLR	Today	Today	Today	Today	Today
<ul style="list-style-type: none"> The Embarcadero 	48" (10.2 ft. NAVD)	High tide + 48" SLR	>2150	>2150	2113	2088	2073
		100-YR + 7" SLR	2088	2048	2032	2025	2023
<ul style="list-style-type: none"> Staging Area (Seawall Lot 321) Staging Area (planned) (Seawall Lot 323, 324) 	66" (11.7 ft. NAVD)	High tide + 66" SLR	>2150	>2150	2143	2106	2086
		100-YR + 25" SLR	>2150	2115	2072	2060	2053
<ul style="list-style-type: none"> WETA Department Operations Center, Ferry Storage Terminal, Bar Pilot Headquarters (Pier 9) Water Taxi Dock (Pier 15) Bay-Delta Maritime Tugboat Dock (Pier 15/17) 	77" (12.6 ft. NAVD)	High tide + 77" SLR	>2150	>2150	>2150	2116	2095
		100-YR + 36" SLR	>2150	2144	2091	2074	2063
<ul style="list-style-type: none"> Assembly and Staging Area (Seawall Lot 322) 	84" (13.2 ft. NAVD)	High tide + 84" SLR	>2150	>2150	>2150	2121	2100
		100-YR + 43" SLR	>2150	>2150	2104	2082	2069
<ul style="list-style-type: none"> Staging Area (Pier 27) Staging Area (Pier 29) 	96" (14.2 ft. NAVD)	High tide + 96" SLR	>2150	>2150	>2150	2131	2110
		100-YR + 55" SLR	>2150	>2150	2125	2096	2078
<ul style="list-style-type: none"> EFWS Cisterns (3) 	> 108"	--	--	--	--	--	--
<ul style="list-style-type: none"> Large Vessel Berth (Pier 15/17) Large Vessel Berth (Pier 19) Large Vessel Berth (Pier 27) 	--	--	--	--	--	--	--

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Timing of Exposure: Assets and Landmarks

Assets / Landmarks	Flood Scenario	Equivalent Events	Timing				
			USACE Low	USACE Inter.	OPC Most Likely	USACE High	OPC 1-in-200
 Utilities							
<ul style="list-style-type: none"> Shoreside Power Facility (Pier 27) 	96" (14.2 ft. NAVD)	High tide + 96" SLR	>2150	>2150	>2150	2131	2110
		100-YR + 55" SLR	>2150	>2150	2125	2096	2078
<ul style="list-style-type: none"> Jackson Transport / Storage Box North Shore Force Main North Point Main - Sansome Tunnel 	--	--	--	--	--	--	--
 Transportation							
<ul style="list-style-type: none"> The Embarcadero Muni E-Line, Muni F-Line 	48" (10.2 ft. NAVD)	High tide + 48" SLR	>2150	>2150	2113	2088	2073
		100-YR + 7" SLR	2088	2048	2032	2025	2023
 Open Space and Ecology							
<ul style="list-style-type: none"> Pier 23 Cafe 	36" (9.2 ft. NAVD)	High tide + 36" SLR	>2150	2144	2091	2074	2063
		50-YR + 0" SLR	Today	Today	Today	Today	Today
<ul style="list-style-type: none"> Embarcadero Promenade 	48" (10.2 ft. NAVD)	High tide + 48" SLR	>2150	>2150	2113	2088	2073
		100-YR + 7" SLR	2088	2048	2032	2025	2023
<ul style="list-style-type: none"> Northeast Wharf Pier 7 (Public Pier) 	66" (11.7 ft. NAVD)	High tide + 66" SLR	>2150	>2150	2143	2106	2086
		100-YR + 25" SLR	>2150	2115	2072	2060	2053
<ul style="list-style-type: none"> Telegraph Hill/Pioneer Park 	> 108"	--	--	--	--	--	--



Timing of Exposure: Subarea

Adaptation Focus	Shoreline Type	Flood Scenario	Timing					
			Return	USACE Low	USACE Inter.	OPC Most Likely	USACE High	OPC 1-in-200
Immediate	Engineered	52" (10.5 ft. NAVD)	High tide + 52" SLR	>2150	>2150	2120	2092	2076
			100-YR + 11" SLR	2138	2066	2044	2035	2032
Tipping Point	Engineered	66" (11.7 ft. NAVD)	High tide + 66" SLR	>2150	>2150	2143	2106	2086
			100-YR + 25" SLR	>2150	2115	2072	2060	2053
Long Term >2050	Engineered	77" (12.6 ft. NAVD)	High tide + 77" SLR	>2150	>2150	>2150	2116	2095
			100-YR + 36" SLR	>2150	2144	2091	2074	2063

Flood Progression

Immediate Flood Risk



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Substantial Flood Risk (Tipping Point)



Long-Term Flood Risk (>2050)



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The following describes the progression of potential extreme tide and sea level rise flooding, along with a brief discussion of the assets that will be impacted within Subarea 2-1.

Flood Scenario	Assets	Consequences				
		USACE Low	USACE Int.	OPC Most Likely	USACE High	OPC 1:200
High tide + 12" SLR	1-YR + 0" SLR	Today	Today	Today	Today	Today
Water Level Elevation: 7.2 ft. NAVD88	--	--	--	--	--	--
High tide + 24" SLR	5-YR + 0" SLR	Today	Today	Today	Today	Today
Water Level Elevation: 8.2 ft. NAVD88		Disaster Response Two fire suction connections (part of the emergency firefighting water system) that allows fire engines to draw water from the Bay for fire suppression are inundated. Suction connections become unusable if they are inundated, primarily due to limitations related to fire truck access				
		Utilities The higher Bay water levels may reduce the gravity-driven flow of excess combined wastewater and stormwater from the transport / storage boxes to the Bay. This impact is only of concern during intense and prolonged rainfall events that exceed the capacity of the large underground transport / storage boxes that ring the city. This could result in an increase in localized flooding in low-lying areas.				
High tide + 36" SLR	50-YR + 0" SLR	Today	Today	Today	Today	Today
Water Level Elevation: 9.2 ft. NAVD88		Maritime The Pier 23 Cafe (paved plaza) begins to experience minor inundation as water levels reach the top of the hardened shoreline where this asset is located. This is also an Open Space asset.				
		Open Space and Ecology The Pier 23 Cafe (paved plaza) begins to experience minor inundation.				

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Flood Scenario	Assets	Consequences				
		USACE Low	USACE Int.	OPC Most Likely	USACE High	OPC 1:200
High tide + 48" SLR	100-YR + 7" SLR	2088	2048	2032	2025	2023

Water Level Elevation: 10.2 ft. NAVD88



Disaster Response

The Embarcadero roadway emergency priority route from Chestnut Street to Broadway begins to experience inundation. The portion of the roadway near the Subarea boundary adjacent to Subarea SA2-2 is impacted due to flooding originating from Subarea 2-2.



Transportation

Impacts to the Embarcadero roadway causes cascading impacts to local and through traffic, bike routes, truck traffic, bus routes, pedestrian access to the shoreline, tourism, and the historic streetcar Muni E- / F-Line service. The Muni E- / F-Line route is directly impacted by flooding.



Open Space and Ecology

A portion of the Bay Trail near Broadway and Pier 7 becomes inundated, resulting in disruption to mobility and recreation. The Embarcadero Promenade is also inundated.

Flood Scenario	Assets	Consequences				
		USACE Low	USACE Int.	OPC Most Likely	USACE High	OPC 1:200
High tide + 52" SLR	100-YR + 11" SLR	2138	2066	2044	2035	2032

Water Level Elevation: 10.5 ft. NAVD88



Maritime

Pier 7½ (Marginal Wharf) is inundated. Overtopping at this Pier allows flooding to reach the Embarcadero roadway.

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Flood Scenario	Assets	Consequences				
		USACE Low	USACE Int.	OPC Most Likely	USACE High	OPC 1:200
High tide + 66" SLR	100-YR + 25" SLR	>2150	2115	2072	2060	2053
Water Level Elevation: 11.7 ft. NAVD88		<p>Maritime</p> <p>Seawall Lots 318 (Beltline Railroad Complex), 319 (Fog City Diner), 320, 321,321-1, 322, 323, and 324 are inundated.</p> <p>Additional inundation of the Embarcadero roadway will block all landside access to the piers in this subarea.</p>				
		<p>Disaster Response</p> <p>Staging Areas on Seawall Lots 321, 323, and 324 are inundated.</p> <p>Due to inundation of the Embarcadero roadway at this scenario, landside access to disaster response assets on the piers will be impacted.</p>				
		<p>Open Space and Ecology</p> <p>The Northeast Wharf and Pier 7 are inundated.</p> <p>Most of the Bay Trail and Embarcadero Promenade are inundated, resulting in disruption to mobility and recreation.</p>				

Flood Scenario	Assets	Consequences				
		USACE Low	USACE Int.	OPC Most Likely	USACE High	OPC 1:200
High tide + 77" SLR	100-YR + 36" SLR	>2150	2144	2091	2074	2063

Water Level Elevation: 12.6 ft. NAVD88



Maritime

Many piers will experience shoreline overtopping and significant inundation, including Pier 9 (WETA Layover Berth), Pier 15/17, Pier 19, Pier 23, and Pier 27/29 (James R. Herman Cruise Terminal). Pier 15/17 is part of the Historic District and home to the Exploratorium, which is a local destination for science-based educational entertainment and learning opportunities for children. Impacts to these piers creates cascading impacts to ferry traffic and container ship traffic to the Ports of Oakland and Stockton.

One aboveground storage tank for the Blue and Gold fleet at Pier 9 will also be inundated.

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Flood Scenario	Assets	Consequences				
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Disaster Response

Several Disaster Response assets are impacted, including: the WETA Department Operations Center, Ferry Storage Terminal, Bar Pilot Headquarters on Pier 9; the Water Taxi Dock on Pier 15; and the Bay-Delta Marine Tugboat Dock on Pier 15/17. Impacts to these piers creates cascading impacts to water-based response to regional emergencies.



Open Space and Ecology

The Pier 23 Cafe (paved plaza) is fully inundated.

High tide + 84" SLR	100-YR + 43" SLR	USACE Low	USACE Int.	OPC Most Likely	USACE High	OPC 1:200
		>2150	>2150	2104	2082	2069

Water Level Elevation: 13.2 ft. NAVD88



Maritime

The Assembly and Staging Area at Seawall Lot 322-1 will be inundated.

High tide + 96" SLR	100-YR + 55" SLR	USACE Low	USACE Int.	OPC Most Likely	USACE High	OPC 1:200
		>2150	>2150	2125	2096	2078

Water Level Elevation: 14.2 ft. NAVD88



Disaster Response

The Staging Areas on Pier 27 and Pier 29 are inundated. One additional fire suction connection would be inundated.



Utilities

The Shoreside Power Facility for cruise ships on Pier 27 is impacted.

High tide + 108" SLR	100-YR + 67" SLR	USACE Low	USACE Int.	OPC Most Likely	USACE High	OPC 1:200
		>2150	>2150	2145	2107	2087

Water Level Elevation: 15.2 ft. NAVD88

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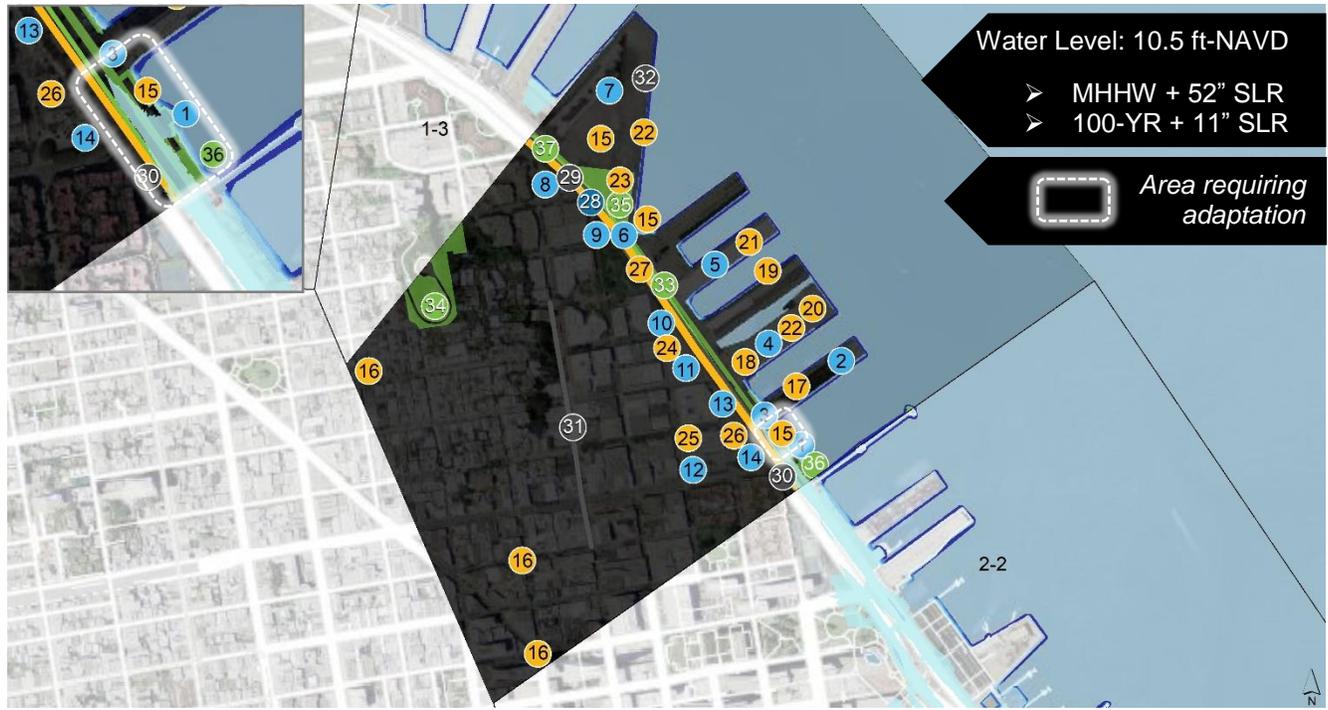
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Adaptation Focus: Immediate



Shoreline Characteristics	Shoreline Overtopping					Timing of Impact (100-YR)				
	Classification	Avg. Elev.	Avg. Depth (ft)	Max Depth (ft)	Length (ft)	%	USACE Low	USACE Inter.	OPC Most Likely	USACE High
Engineered	10.5 ft. NAVD	0.1	0.1	271	2.2%	2138	2066	2044	2035	2032

Flood Pathways

- Overtopping of the shoreline at Pier 7½ results in inundation of the adjacent areas along the Embarcadero roadway. However, inundation of this area also occurs earlier (MHHW + 48-inch scenario; 10.2 ft-NAVD) because the Embarcadero roadway conveys floodwaters that originate from the adjacent Subarea 2-2.
- Inundation depths of just over 1-foot would occur in the Embarcadero roadway during this scenario.

Shoreline Focus

- Isolated adaptation measures are needed along the engineered shoreline at Pier 7½; however, adaptation measures in Subarea 2-2 are also required otherwise access to Subarea 2-1 via the Embarcadero roadway will be eliminated.

Adaptation Considerations

- Adaptation measures in Subarea 2-2 are required to mitigate flooding that is conveyed from Subarea 2-1 into this subarea along the Embarcadero roadway. Additional measures will also be required in this subarea. The adaptation measure should embed the ability to adapt to higher water levels, or to be integrated into a larger shoreline adaptation solution as Bay water levels rise further.



Adaptation Focus: Tipping Point



Shoreline Characteristics	Shoreline Overtopping					Timing of Impact (100-YR)				
	Classification	Avg. Elev.	Avg. Depth (ft)	Max Depth (ft)	Length (ft)	%	USACE Low	USACE Inter.	OPC Most Likely	USACE High
Engineered	11.0 ft. NAVD	0.6	1.3	1,046	8.7%	>2150	2115	2072	2060	2053

Flood Pathways

- Overtopping occurs at several locations along the engineered shoreline, resulting in flooding of the adjacent transit routes and Port seawall lots.
- The shoreline locations that are overtopped include a stretch of shoreline from Pier 7 to Pier 9, Pier 9 to Pier 15, and over Pier 23½.
- The Embarcadero roadway acts as a conduit to carry flooding across the entire span of the subarea
- Flooding in this subarea connects with the flooding in adjacent Subareas 1-3 and 2-2.

Shoreline Focus

- Several shoreline segments require adaptation measures. The overtopped shoreline segments are not adjacent; therefore, separate adaptation measures are required at each location.

Adaptation Considerations

- Adaptation measures to reduce flood risk will reduce flooding in adjacent Subareas 1-3 and 2-2. The adaptation measure should embed the ability to adapt to higher water levels, or to be integrated into a larger shoreline adaptation solution as Bay water levels rise further.

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Adaptation Focus: Long-Term >2050



Shoreline Characteristics		Shoreline Overtopping				Timing of Impact (100-YR)				
Classification	Avg. Elev.	Avg. Depth (ft)	Max Depth (ft)	Length (ft)	%	USACE Low	USACE Inter.	OPC Most Likely	USACE High	OPC 1-in-200
Engineered	12.2 ft. NAVD	0.4	2.2	10,059	83.4%	>2150	2144	2091	2074	2063

Flood Pathways

- Overtopping occurs over most of the Embarcadero shoreline, including most piers, resulting in flooding of the adjacent transit routes and the Financial District.
- The Embarcadero roadway acts as a conduit to carry flooding across the entire span of the subarea.
- Flooding within this subarea connects with flooding from adjacent Subareas 2-1 and 3-1.

Shoreline Focus

- Subarea wide shoreline adaptation measures are required.

Adaptation Considerations

- Adaptation measures to reduce flood risk are required along most of the shoreline, including the shoreline in adjacent Subareas 1-3 and 2-2.