27. BEACH BOULEVARD SEAWALL

City of Pacifica

VULNERABILITY SUMMARY

The Beach Boulevard seawall (Seawall) is **highly vulnerable** to the impacts of sea level rise. Exposure of both northern and southern sections of the Seawall is high. The northern section is more vulnerable and currently undergoing repairs from a recent breach. The functions it protects (recreation, including the CCT, transportation, utilities, and housing) are highly sensitive to a breach as none can tolerate flooding or erosion. There are no redundant measures or alternatives to provide the same levels of service, making near- and long-term adaptive capacity low. Consequences from the loss of the asset would likely be locally focused in Pacifica, and could be high.

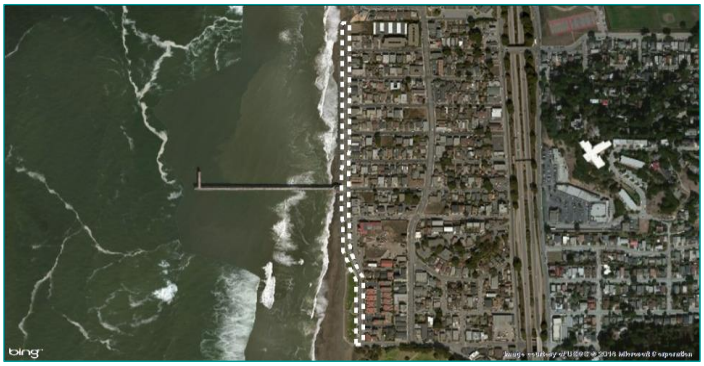
SENSITIVITY	*EXPOSURE*	*ADAPTIVE CAPACITY*	*CONSEQUENCES*
High	*High*	*Low*	*High*

ASSET CHARACTERISTICS

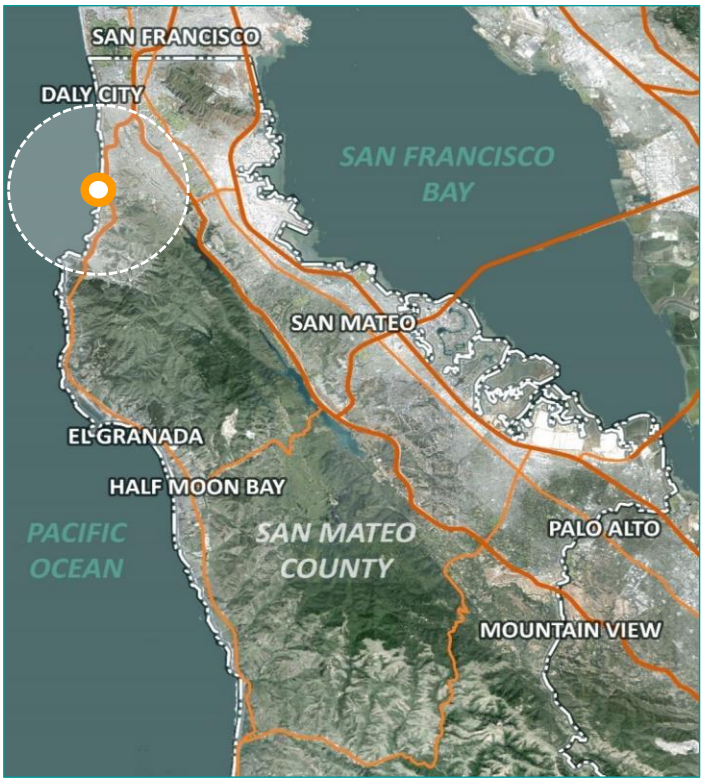
2100 Beach Blvd | Pacifica

Asset Description and Function:

The Seawall runs along Beach Boulevard from Paloma Avenue to Clarendon Road in Pacifica. It protects the boulevard and the roughly 2,000 people who live in the West Sharp Park District, which includes Pacifica City Hall, Council Chambers, a wastewater pump station, and other community assets. A popular promenade on top of the Seawall provides access to the beach and Pacifica Pier. The Seawall protects various utilities located under the boulevard, including sewer, stormwater, water, gas and electrical service.



Asset Type	Flood Control Infrastructure
Asset Risk Class	4
Size	2,500 linear feet
Year of Construction	1984 (N), 1987(S)
Elevation	18-22 feet, MLLW
Protection Provided	2,000 residents
Annual O&M Cost	Unknown
Special Flood Hazard Area	N/A
Physical Condition	Poor to Fair
Landowner	City of Pacifica



Underground Facilities

Sewer, water, gas, and electrical lines and conduits are below the adjacent street, not directly associated with this asset.

Environmental Considerations

Special status plants, animals, and natural communities may be present in the project area; a more detailed analysis will be needed before implementing adaptation strategies.

BEACH BOULEVARD SEAWALL

ASSET SENSITIVITY

The Seawall functions, particularly the northern section, are very sensitive to seawall breaching, as the Seawall is the only line of defense for this area. The northern section was built in 1984 as a retaining wall rather than an engineered seawall. It is built on loose fill and is particularly vulnerable to wave action and erosion. In 2016, a breach caused a portion of northern Beach Boulevard and the pedestrian promenade to be closed for roughly six months. The southern section, built in 1987 using a more robust method, has never experienced a breach.

Under high water conditions, access to the site would be restricted. If high water occurred during or after a breach, it could flood the houses and other structures behind it. The utilities under the adjacent road could be exposed and are highly sensitive to the seawall breaching as well as overtopping; for example, if waves overtopped the Seawall, water could flow into the storm drains.
In the West Sharp Park neighborhood behind the Seawall, many houses are sensitive as they are low lying and built at-grade. Note: The Seawall was constructed in two phases—Phase I, north of Pier was built in 1984 ("tile"), and Phase 2, south of Pier was built in 1987 ("concrete panel").

Beach Boulevard seawall from the beach, looking north.

SHORELINE VULNERABILITY

Erosion Analysis

The Seawall is located within the area identified in the Pacific Institute study (2012) as susceptible to erosion (eastern extent by 2100 in yellow). The area of erosion concern, as illustrated, could occur by 2100 if the Seawall were breached, if the northern section is not upgraded, and if all shore line protections were not adequately maintained. The City of Pacifica is repairing the recent damage and pursuing grant opportunities to replace the entire northern section of the Seawall.

Cross-Cutting Vulnerabilities

If the Seawall were to breach and expose utility lines under Beach Boulevard, these could be damaged by high water and could interrupt service in surrounding communities. Due to the uncertainty of future erosion events, a geophysical survey would be useful to better understand the full extent of the risk.

Erosion Analysis: Site is entirely in future erosion area.

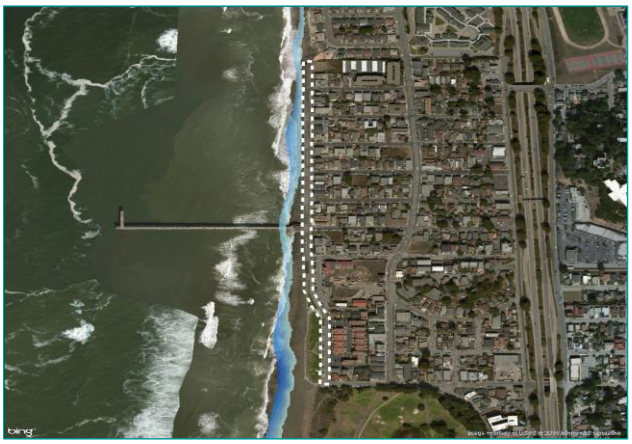
BEACH BOULEVARD SEAWALL

SEA LEVEL RISE EXPOSURE ANALYSIS

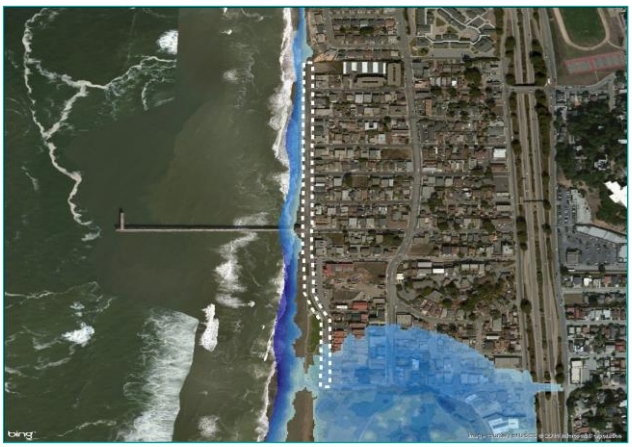
Exposure Discussion

The Seawall is highly exposed and is regularly subject to high tides and wave action under current conditions. The northern section of the Seawall has experienced breaches in 2002, 2006, and 2016 when exceptionally high tides combined with high swells and waves crashed into and over the Seawall. The rock revetment adjacent to the northern Seawall also regularly loses rocks due to wave action. The southern section has sustained no damage since construction in 1987. Sea level rise will increase the exposure of both Seawall sections, as higher mean water levels will lead to more frequent overflow, and deeper water will allow larger waves to reach and damage the Seawall. This combination will put the Seawall further at risk of overtopping and erosion damage and endanger city infrastructure, utilities, houses, and other properties it protects. Historical erosion data and projected future erosion (USGS, Pacific Institute) indicate that this asset, and the surrounding area, are particularly likely to experience severe erosion by 2100. For more detail on the Seawall construction and an overtopping analysis of the southern Seawall, refer to the *Coastal Hazards Study 2212 Beach Boulevard, Pacifica: Technical Report with Executive Summary* (City of Pacifica 2016).

Baseline Scenario: Asset not yet inundated.



Mid-Level Scenario: Asset under 0 to 5 feet of water.



High-End Scenario: Extensive flooding behind asset.

Exposure Analysis Results

Potential Inundation Depth (feet)		
Scenario	***Minimum***	***Maximum***
First Significant Impacts	***Area Not Included in Overtopping Analysis***	
Baseline *1% Flood*	***0***	***0***
Mid-Level *1% + 3.3 feet*	***0***	***5***
High-End *1% + 6.6 feet*	***0***	***6***

BEACH BOULEVARD SEAWALL

ADAPTIVE CAPACITY, CONSEQUENCES, AND POTENTIAL ADAPTATION

Adaptive Capacity

The adaptive capacity of the Seawall itself is low; however, regular monitoring, maintenance, and repairs such as slurry walls can prevent a near-term breach of the full Seawall, which the city is currently doing. Wave overtopping can create flooding if backup measures are not in place. At this time, there are no redundant protections for the utilities, the road, or the properties. To minimize the impacts of flooding, the City of Pacifica is working to upgrade the northern Seawall to "concrete panels" to match the the southern section. The city also engages in flood preparedness activities with residents in the West Sharp Park neighborhood, and some may have flood insurance. There is access to Sharp Park Beach by other means.

Consequences

A breach of the Seawall would directly affect recreational use of the area by preventing beach access and prohibiting use of the heavily used pedestrian promenade. Traffic would be rerouted until the Seawall could be repaired. Under a severe storm, there could be direct flood damages to the houses behind the Seawall, to the wastewater pump station, and to the utilities under the boulevard (if the wall were breached). Disruption of utilities, gas lines, sewer lines, and water lines could create contaminated or hazardous conditions for residents, rendering homes uninhabitable. Injuries or casualties are also possible with a Seawall breach. The area behind the Seawall is low-lying, so a flood could force up to 2,000 people out of their homes, creating a demand for temporary shelters in addition to utility repairs. Repair of the Seawall in 2016 is estimated to cost $450,000 for 40 feet. This could mean up to $28 million to replace the full 2,500 feet of the Seawall. The economic damage potential for property losses has not yet been quantified.

Additional Important Information

There is planned development in this area, which could increase the consequences of a breach. Raising the Seawall may be needed to reduce flood risk and prevent shoreline erosion. As mentioned above, the City of Pacifica has plans to upgrade the northern section of the Seawall.

Asset-Specific Adaptation

In the near-term, the Seawall height can be increased; houses may need to be elevated or floodproofed to provide a second line of defense. In the long-term, relocating the adjacent utilities to higher ground may be necessary.

Vulnerable Seawalls

This is the only Asset Vulnerability Profile on vulnerable seawalls in the County. The vulnerability assessment analysis shows that the Seawall (also called a floodwall in other locations) is part of the 25.9 total miles of levees and floodwalls in the project area.

Beach Boulevard Seawall, looking south.

Repairs being performed on the Seawall after the 2016 breach.