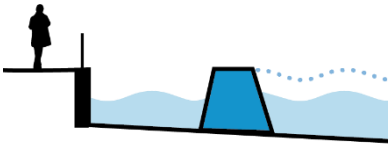
Measure Profile

Wave Barrier

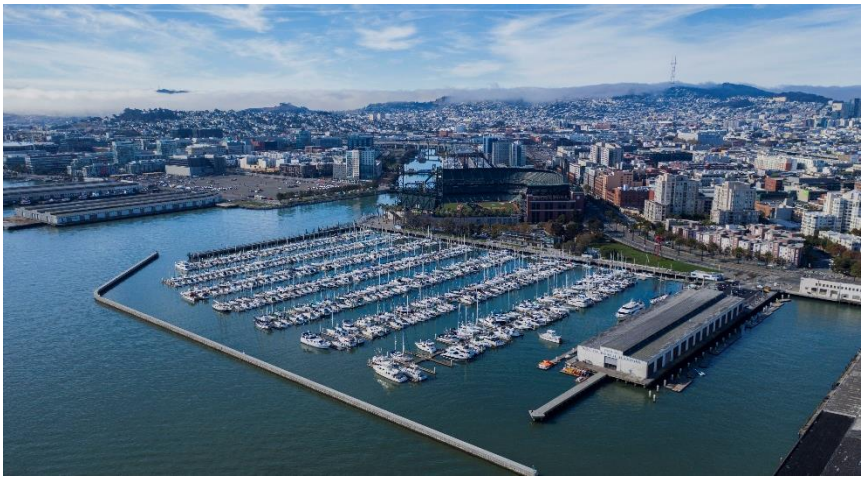
Flood Adaptation Measure

PHYSICAL INFRASTRUCTURE



SHORELINE LOCATION:

In Water



South Beach Harbor wave barrier ©Civic Edge Consulting

DESIGN LIFE	ADAPTABILITY	IMPACT ON THE WATERFRONT	CONSTRUCTION COST
50 - 100+ years	Low	Living with Water	TBD

COASTAL FLOOD HAZARDS MITIGATED:

Sea Level Rise

Storm Surge

Groundwater

Waves

Erosion

MEASURES COMPATIBILITY:

Flood	Seismic
All	All

ECOSYSTEM SERVICES: Measure may affect these shoreline values

Aquatic Habitat	Terrestrial Habitat	Water Quality	Carbon Storage
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DESCRIPTION:

Wave barriers are in common use around the San Francisco Bay for reducing wave energy in marinas or in some cases recreational or habitat areas. These structures extend above the waters surface at all tide levels and can be built of sheet piles or rubble mounds. Sheet Piles take up less space in the water and are typically supported by piles driven into the ground. Rubble mound wave barriers sit on the underwater surface, and beacuse of their sloping sides have a larger footprint than sheet pile wave barriers.

CONSIDERATIONS:

- Offshore construction presents a number of challenges with feasibility, cost, and impact.

ADVANTAGES:

- Reduces wave energy on the sheltered side of the structure reducing wave runup and overtopping.
- Can sustain damage or adjust to settlement without catastrophic

DISADVANTAGES:

- Expensive in deep water.
- Emergent structures can be unsightly.
- Can interfere with ship traffic.
- High wave reflection off the bay side of the structure, particularly

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	failure. • Rubble mound waver barrier can provide habitat for rock-dwelling flora and fauna, and fish.	for designs with solid walls. • Relatively costly due to offshore construction costs.
CONSTRUCTION IMPACTS TO THE PUBLIC: • Minimal impact to waterfront uses as construction occurs in the water.	**SEA LEVEL RISE ADAPTATION OPPORTUNITIES:** • Design height should consider extreme events and future sea level rise. After construction, modifications to extend the height of the structure would be costly.	**CASE STUDIES:** • South Beach Marina and Fisherman's Wharf in San Francisco

DESIGN OPPORTUNITIES:

Ecological Enhancements	Urban Design	Form
• Rubble mound barriers can be constructed to provide aquatic habitat by providing surfaces to promote growth of mollusks and aquatic vegetation	• TBD	• TBD

DESIGN CONSIDERATIONS:

- Must be designed to resist lateral wave loads.
- Appropriate materials should be selected for use in the marine environment.
- Could affect sediment transport patterns and surrounding shorelines.

SITE-SPECIFIC CONSIDERATIONS:

- Water levels, waves, currents and propeller wash from ship activity should be well defined.
- Geotechnical investigations should be performed to determine bottom characteristics, potential for settlement, and global stability failure.
- Sub-bottom profiling should be performed to identify buried debris or other features that could limit pile drivability.
- Sufficient water depth should be available to prevent the attenuators from bottoming out during low tides.
- Impacts to maritime uses should be considered in siting and design.

INSTALLATION AND CONSTRUCTABILITY CONSIDERATIONS:

- Offshore construction would be performed from a barge by a competent marine contractor.
- Noise issues with pile driving for sheet pile version have could impact aquatic and terrestrial wildlife as well as people near the site.
- Stone used for rubble mound structures would be delivered to the site either by truck or by barge.
- A relatively large staging area would be required for the quantities of stone required by the structure.
- Although the rubble mound structure would create habitat for marine life that would colonize the hard surfaces and voids, it would also cover a significant amount of seabed habitat.

HISTORICAL RESOURCE CONSIDERATIONS:

- In-Bay construction would need to consider potential buried archeological resources.