

Vegetated Terraces

Flood Adaptation Measure



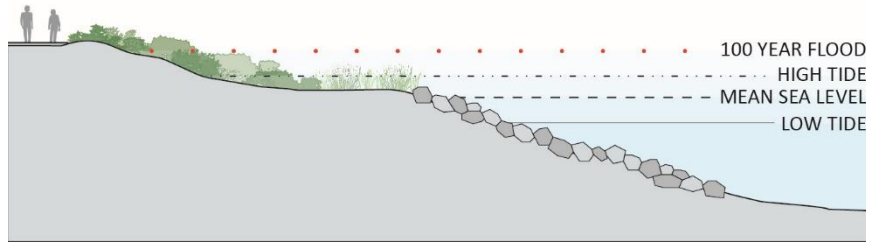
ECOLOGICAL INFRASTRUCTURE



WATER LEVEL RANGE:

Intertidal to supratidal

SHORELINE LOCATION:

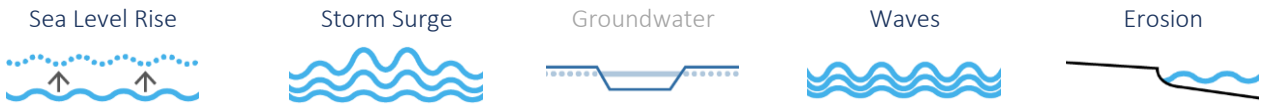


Section diagram of vegetated terrace. ©CMG

DESIGN LIFE 50+ years	ADAPTABILITY Medium	IMPACT ON THE WATERFRONT Minor Intervention	CONSTRUCTION COST TBD
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COASTAL FLOOD HAZARDS MITIGATED:

Enhancements can provide flood protection when combined with other physical infrastructure



MEASURES COMPATIBILITY:		ECOSYSTEM SERVICES: Measure may affect these shoreline values			
Flood	Seismic	↑	↑	—	—
Seawalls, Levees, Revetments	All	Aquatic Habitat	Terrestrial Habitat	Water Quality	Carbon Storage
		—	—	—	—

DESCRIPTION:

Vegetated terraces are the modification of existing slopes, or construction of new stepped slopes, to include vegetated surfaces. The slopes can be stepped back or stepped forward, and species can be planted or allowed to develop spontaneously on the terraces. Vegetated terraces can provide a reduction in wave runoff and overtopping, thereby mitigating flooding and erosion.

CONSIDERATIONS:	ADVANTAGES:	DISADVANTAGES:
<ul style="list-style-type: none"> Vegetated terraces can be built to a height to protect against storm surge, wave hazards, and sea level rise, depending on water level and wave conditions. They cannot tolerate high wave energy. These factors, as well as 	<ul style="list-style-type: none"> Habitat creation by vegetation growth. Vegetation type can adapt over time to long-term changes in water elevations. Mitigates erosion Flexible design 	<ul style="list-style-type: none"> Requires large horizontal extent and potential encroachment into water Difficult to adapt to higher water levels once constructed Can collect floating debris

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the tidal range, must be considered to design suitable habitat for plant growth and mitigate flooding.

- Lifetime of structures 50+ years
- Can be designed to accommodate a range of water levels and wave conditions
- Compatible with structural and nature-based flood mitigation measures

- Not suitable for high wave energy environments
- Lifetime of vegetation will depend on species selected, climate, and water quality
- Seismic performance depends on foundation and construction

CONSTRUCTION IMPACTS TO THE PUBLIC:

- Landside access necessary. Access to the shoreline will be constricted due to construction, and may impact parts of the Promenade.

SEA LEVEL RISE ADAPTATION OPPORTUNITIES:

- Can be designed to accommodate a range of water levels and wave conditions, but once built, significant modification would be required to accommodate higher water levels or wave conditions.

CASE STUDIES:

- None cited

DESIGN OPPORTUNITIES:

Ecological Enhancements

- Measure is compatible with nature-based flood mitigation measures and increases biodiversity and marine habitat

Urban Design

- Design of terraces can integrate with structural measure opportunities, and provide new ways of experiencing the waterfront and shoreline ecology.

Form

- Stepped form is adaptable to structural modifications and urban design goals.

DESIGN CONSIDERATIONS:

- Need to be developed on a site-specific basis, constructed with ecological materials, and planted with native species. Ideally suited for sheltered areas with relatively low wave action, otherwise vegetation may not survive and terraces can be eroded.
- Wave conditions, tidal range, and sea level rise need to be considered to ensure the survival of planted species as well as their adaptation to future sea levels.
- Wind and waves may cause floating debris to collect on terraces.

HISTORICAL RESOURCE CONSIDERATIONS:

- Siting needs to consider impacts to historical sites or and should consider access.

SITE-SPECIFIC CONSIDERATIONS:

- Geotechnical conditions must be considered.

URBAN DESIGN CONSIDERATIONS:

- Can include pedestrian walkways and bike trails.
- Depending on the height of the structure required to address wave hazards, may provide opportunity for Bay views and Bay access

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INSTALLATION AND CONSTRUCTABILITY CONSIDERATIONS:

- Land-based equipment and delivery of materials will require landside access. New terraces may require significant grading/soil preparation.

OPERATIONS AND MAINTENANCE CONSIDERATIONS:

- Periodic inspections and maintenance, as necessary, would be required to maintain flood protection capacity.