Attachment 14.A

REPORT
Produced For West Bay Yards
November 2025

WEST BAY YARDS

Shoreline Restoration Design

Document Verification

Client	City of Olympia
Project name	West Bay Yards Development
Document title	Shoreline Restoration Design – Response to City Comments
Status	Report
Date	November 2025
Project number	201839

Revision	Description	Issued by	Date	Checked
00	Draft Report for Owner Review	YN/SP/ SM/JAB /CM	12/6/2022	SP
01	Revised to Incorporate Client Comments	NM	6/27/2023	YN
02	Revised to Incorporate City Comments	VC	9/19/2024	YN/SP
03	Revised to Incorporate Client Comments	YN	11/18/2024	SP
04	Revised to Incorporate Ecology's Shoreline Reviewer Comments	YN	3/27/2025	SP
05	Revised to Incorporate Ecology/City Reviewer Comments	JD	7/3/2025	YN
06	Revised to Incorporate Ecology/City Reviewer Comments	JD	11/14/2025	YN, SP

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Glossary

City	City of Olympia
Ecology	Washington State Department of Ecology
FEMA	Federal Emergency Management Agency
LWD	Large woody debris
M&N	Moffatt & Nichol
MLLW	Mean lower low water
MSL	Mean sea level
OHWM	Ordinary high water mark
Owner	West Bay Developers LLC
PAH	Polycyclic aromatic hydrocarbons
Site	West Bay Yards Project Area
SAV	Submerged aquatic vegetation
SLR	Sea level rise
SMP	Shoreline Master Program
USACE	U.S. Army Corps of Engineers
VCP	Voluntary Cleanup Program
WBY	West Bay Yards

Coastal Zone Definitions

The U.S. Army Corps of Engineers (USACE) provides the following definitions for the coastal zone in the Coastal Engineering Manual (USACE 2008) and depicts the typical beach profile as Figure 1-1 below.

Backshore: That part of the beach that is usually dry, being reached only by the highest tides, and by extension, a narrow strip of relatively flat coast bordering the sea[1]. For this project we are measuring the backshore starting from mean high water (MHHW).

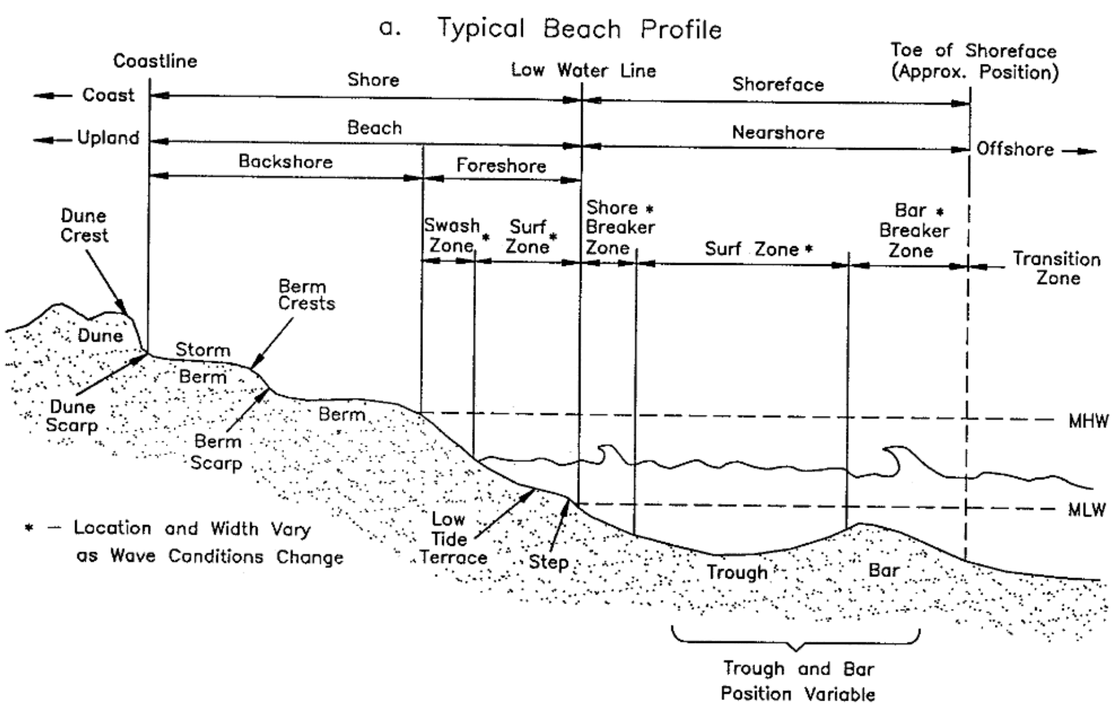
Berm (or Beach Berm): Nearly horizontal portion of the beach or backshore formed by the deposit of material by wave action. Some beaches have no berms; others have one or several.

Foreshore (or Beach Face): That part of shore which lies between high and low water mark at ordinary tide.

Upland: Land above mean high water mark and subject to private ownership, as distinguished from tidelands, ownership of which is prima facie in the state but also subject to divestment under state statutes.

Marine Riparian[2]: The transitional zone between the uplands and aquatic environments adjacent to marine waters, where marine riparian vegetation is often located.

FIGURE 1-1: COASTAL ZONE DEFINITION SKETCH



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[1] Alternatively, backshore has been defined as follows by the Washington Department of Fish and Wildlife (WDFW) in the Marine Shoreline Design Guidelines (WDFW 2014): "The upper zone of a beach beyond the reach of normal waves and tides, landward of the beachface. The backshore is subject to periodic flooding by storms and extreme tides, and is often the site of dunes and back-barrier wetlands. Width is measured cross-shore from the waterward extent of the backshore to the waterward extent of upland vegetation or anthropogenic modifications. Backshore areas tend to be highly modified or nonexistent on developed properties."

[2] Definition of "Marine Riparian" is provided by the Marine Shoreline Design Guidelines (Johannessen et al 2014).

1. Introduction

The West Bay Yards (WBY) Development project is proposing to reuse the site of the former industrial Hardel Plywood facility to construct a vibrant waterfront community at 1210 West Bay Drive, Olympia. The proposed community includes a mix of uses including 478 residential units, approximately 20,966 square feet of commercial/retail/restaurant area, and 823 parking stalls. Additionally, the project proposes to restore the existing biologically degraded shoreline and to enhance public access to the shoreline by providing direct access points in addition to an elevated public plaza and a waterfront esplanade.

WBY has submitted the project proposal with an application for a Shoreline Substantial Development Permit to the City of Olympia (City). The shoreline design proposed for WBY includes the placement of granular fill over the existing shoreline to create a naturally functioning, sloped beach. The fill material would be placed over the existing riprap revetment to ensure the new beach has sufficient space to remain resilient under future sea level rise. Additionally, by not removing the existing revetment, the proposed design limits the potential for the release of contaminants. This report has been developed to provide the necessary background information, purpose and need, design approach, and comparison of alternatives.

This report has been prepared by the multi-disciplinary shoreline design team in response to review comments. This multi-disciplinary team includes Moffatt & Nichol (M&N) for coastal and waterfront engineering and design, Farallon Consulting | Grette Associates (Farallon | Grette) for aquatic habitat/biology, J.A. Brennan (JAB) for landscape architecture design, and Sage Geotechnical[3] for geotechnical engineering design.

2. Site Characterization

2.1. History and Archaeology

The Hardel Mutual Plywood site is on the western shore of Budd Inlet, see Figure 2-1. Before European-American settlement in the vicinity of the project site, the Deschutes River meandered across extensive tide flats in Budd Inlet. The shallow waters of Budd Inlet precluded low tide access to Olympia's waterfront, so the U.S. Army Corps of Engineers (USACE) undertook a sustained dredging effort from 1893-1894 and again from 1909-1911. Spoils from dredging were used to extend the land into Budd Inlet, including within the current project boundary.

From 1924 to 1996 the site was used for logging, lumber, and plywood businesses. Hardel operated at the facility from 1951 through 1996, when a fire severely damaged several buildings and forced them to stop working at the site.

[3] The geotechnical engineers currently with SAGE Geotechnical began this work while employed at Landau Associates and have remained on the project team throughout.

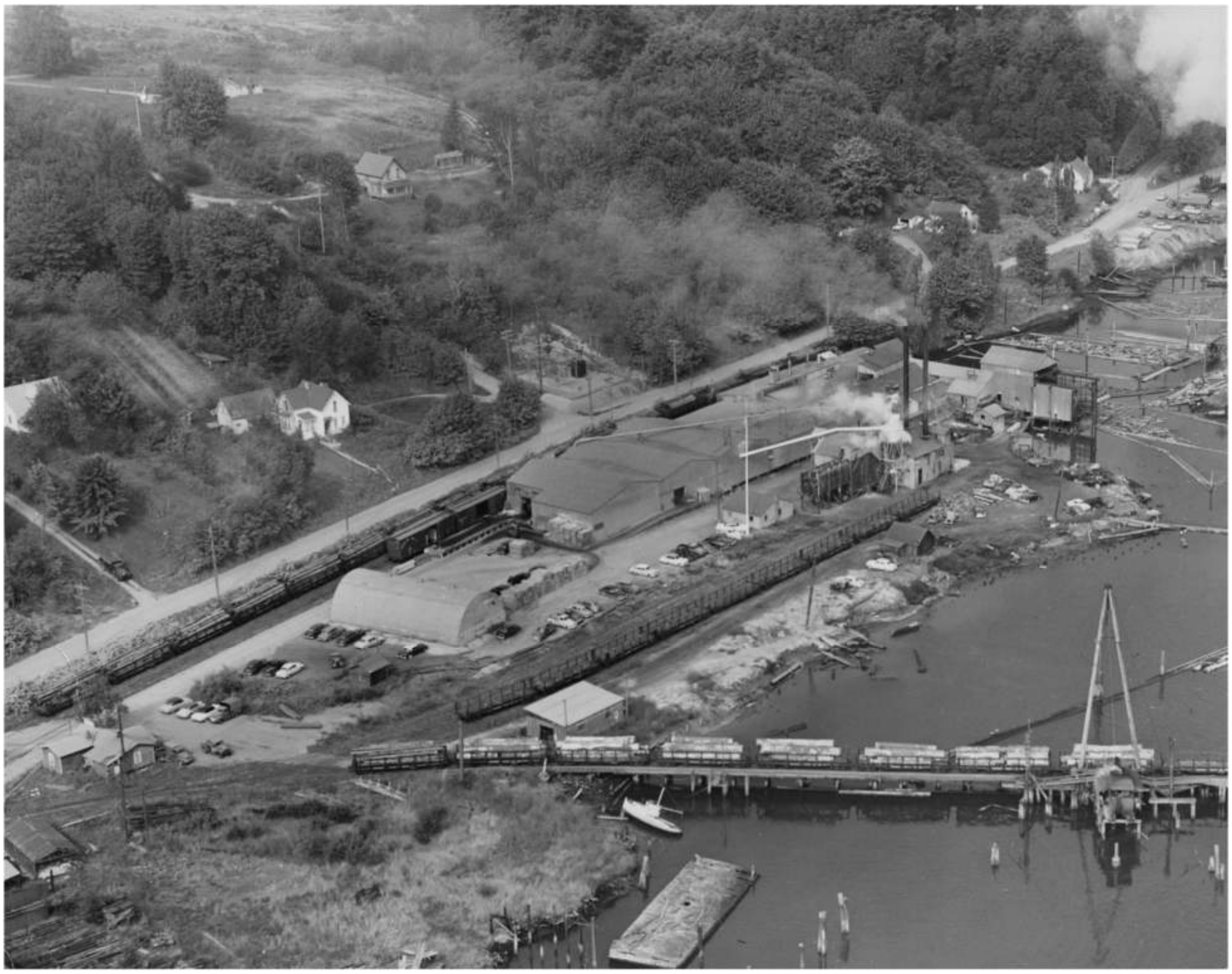
FIGURE 2-1: PROJECT SITE ALONG THE WESTERN SHORE OF WEST BAY, OLYMPIA

Past business activities contaminated the soil and groundwater at the site. Contaminants included heavy oil and diesel petroleum hydrocarbons and polycyclic aromatic hydrocarbons (PAHs), see Figure 2-2. This site was listed as cleaned in 2012 but re-opened in 2021 after the current owner found additional contamination.

West Bay Development Group LLC (Owner) purchased the property from Hardel in 2021. The Owner conducted due diligence investigation work and identified additional Model Toxics Control Act (MTCA) cleanup level exceedances in upland soil and groundwater that were not identified or addressed prior to the Washington State Department of Ecology (Ecology) issuing a No Further Action determination to Hardel in 2012. The Owner entered the site into Ecology's Voluntary Cleanup Program (VCP) in 2021 and was conducting a supplemental MTCA remedial investigation (RI) for the uplands under the VCP until Ecology determined that additional sampling of site sediment was necessary. Since the VCP is designed to issue opinions for upland sites only, the Owner terminated the VCP agreement in March 2023 (in coordination with Ecology) and reached an agreement on the terms of a MTCA Agreed Order with Ecology in early 2025. Following completion of the required public engagement process, the Agreed Order was finalized on July 23, 2025.

The Agreed Order scope of work will entail completing the supplemental RI, a Feasibility Study, and a Cleanup Action Plan for the uplands and the sediment at the site. Although it is premature to determine the final MTCA remedy for this site, the remedy will likely include: (1) the cleanup actions previously completed by Hardel (e.g., source area soil removal); (2) additional focused soil removal near a suspected former storage tank; (3) installation of a soil cap/cover across the entire uplands; (4) installation of a sediment cap; (5) vapor mitigation for future on-site buildings; (6) monitoring and maintenance; (7) engineering controls; and (8) institutional controls. The sediment remedy (e.g., sediment cap) is anticipated to dovetail with the shoreline restoration design.

FIGURE 2-2: HISTORIC USE OF SHORELINE



2.2. Geomorphology

The project shoreline includes a greatly altered shoreline with artificial fill that has resulted in separating the nearshore from natural longshore sediment processes. The altered condition will not naturally restore or recover by itself as there is a very limited to no granular sediment input for longshore transport. The morphology is the so-called foundation without which the restoration cannot occur.

The project shoreline as well as adjacent stretches of shoreline are armored and there are no sources of sediment (such as feeder bluffs) within this stretch of shoreline (Grette 2009, Ecology 2022b). The net-shore drift is aligned with the direction of longest fetch (horizontal distance over which a wind generates waves) and dominant wave energy sector from North. Ecology categorized the shoreline along the Project Site as “No appreciable drift” (Ecology 2022a).

2.3. Beaches of Puget Sound

Beaches of the Puget Sound typically have a ‘dynamic’ berm in the backshore area up to several feet higher than mean higher water. The berm is the zone of concentrated wave action and adequate berm width is critical to protection of upland infrastructure, as depicted in Figure 2-3 and Figure 2-4, see (Finlayson 2006) for further details.

FIGURE 2-3: BEACH PROFILE RESPONSE ON MACRO-TIDAL, LOW-ENERGY BEACHES
Model Shown for Both Natural and Modified Beaches as Observed at Cama Beach, Camano Island (Finlayson 2008)

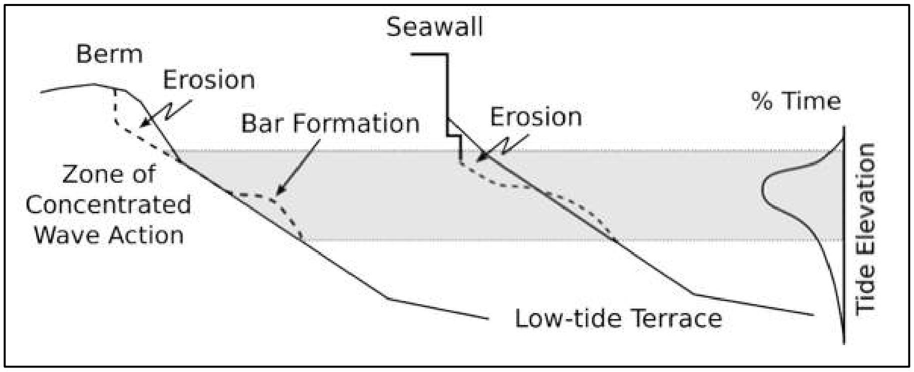


FIGURE 2-4: EXAMPLE OF HIGH TIDE WINDSTORM CAUSING SIGNIFICANT BEACH AND BACKSHORE CHANGE AT ROSARIO-RESORT IN SAN JUAN COUNTY (JOHANNESSEN AND MACLENNAN 2007)

2.4. Coastal Processes

In Puget Sound, the major source of coastal zone sediment is from the erosion and reworking of coastal bluff exposures of till, outwash sediments, and glacial marine deposits (Finlayson 2006). These deposits often exhibit a variety of sediment types simultaneously including clay, silt, sand, and gravel. Consequently, the beach sediments derived from these sources are similarly complex with heterogeneous mixtures of pebble gravels and coarse-grained sands being the most prevalent.

Project shoreline is exposed to fluctuating tides, tidal currents, wind waves (waves generated locally), and vessel wakes. Tides in Puget Sound have a mixed (semidiurnal) pattern characterized by two highs and two lows of unequal heights during each day. Average tidal range is 14.5 ft at Budd Inlet, Olympia, WA. Wind waves are typically the main driver for shoreline instability in Puget Sound. Based simply on the distribution of tidal elevations in the Puget Sound, the majority of storm waves occur at higher tides (above mean sea level or MSL). As such, the wave energy is concentrated near high tide and sediment transport is most active in the upper foreshore. Site-specific characterization of coastal processes was conducted to inform the shoreline restoration design (M&N 2022).

2.5. Ecology

The existing ecological conditions of the WBY Project Area ("site") consist of a highly developed and degraded shoreline that is low in habitat quality. The riparian corridor along the shoreline of the site is flat with sparse vegetation that is restricted to growing up through areas of asphalt and crushed concrete. A sparse variety of native and non-native shrubs, occasional trees, low grasses, and forbs are present on site.

The existing shoreline consists of a steep, armored, existing revetment that quickly transitions to gently sloped intertidal mudflats and deeper intertidal zones, see Figure 2-5. The existing revetment supports the entirety of the shoreline, and is completely unvegetated, see Figure 2-6. The site is also void of macroalgae and submerged aquatic vegetation (SAV). Substrates are fairly consistent across the site, with a mix of gravel and shell hash directly beneath the riprap slope, which transitions to softer substrates consisting of unconsolidated silt, sand, and mud.

FIGURE 2-5: STEEP, IMPACTED SHORELINE

FIGURE 2-6: LACK OF RIPARIAN VEGETATION ALONG THE SHORELINE

Species living within the intertidal mudflat primarily include shellfish (hardshell clams) and barnacles attached to existing debris, rubble, and larger rocks. Artificial, anthropogenic debris is found in large quantities scattered across the site, varying in size and type. Supplementary information on existing shoreline biological conditions can be found in *West Bay Yards Project: Critical Areas Report* (Grette 2022a), and *West Bay Yards Project: Important Habitats and Species – Habitat Management Plan* (Grette 2022b), and *West Bay Yards Shoreline Restoration Project: Restoration Plan* (Farallon | Grette 2024).

2.5.1. Riparian Condition

As described in the *West Bay Yards Project: Critical Areas Report* (Grette 2022a), and *West Bay Yards Project: Important Habitats and Species – Habitat Management Plan* (Grette 2022b), the current site conditions reveal a low-quality marine riparian habitat. Overall, very few trees and shrubs are present on site. Vegetation close to shore appears restricted by the steep riprap slope and the highly developed upland area dominated by derelict asphalt, filling material, and crushed concrete. Sparsely vegetated, non-native, and invasive shrubs are the primary species growing between areas of asphalt, fill material, and riprap on top of the slope. The primary shrub species are Himalayan blackberry (*Rubus bifrons*) and Scotch broom (*Cytiscus scoparius*), with occasional occurrences of red elderberry (*Sambucus racemosa*), Butterfly bush (*Buddleja davidii*), and Birch saplings. A few small trees are present including Pacific madrone (*Arbutus menziesii*) and big leaf maple (*Acer macrophyllum*). Assorted grasses and herbaceous vegetation are also scattered across the site, along with invasive and non-native forbs.

While the site does have some scattered small shrubs and trees, they are mostly non-native or invasive, small, and few in number, which limits the potential for large woody debris (LWD) to be recruited from the riparian zone and provides no significant amounts of shade or organic detrital input to the shoreline area.

2.5.2. Aquatic Habitat

The aquatic habitat on site is heavily degraded and disturbed, providing no meaningful function to aquatic species utilizing the shoreline. The primary structural features of the intertidal zone include the steep and bare riprap slope and artificial debris, including wood waste, concrete rubble, pile stubs and caps, metals, sawdust, and timber decking remnants. Additionally, remnants of an overwater pier, multiple large, derelict concrete structures, and a dense area of wood pile mixed with concrete rubble are present on site. Species living in the intertidal mudflat primarily include shellfish (hardshell clams) and barnacles attached to existing debris, rubble, and larger rocks. Besides rare occurrences of *Ulva* spp. or drift algae, no significant macroalgae or SAV are present on site.

The absence of significant riparian and aquatic vegetation limits sediment stabilization, nutrient cycling, protection from erosion, and primary production. In addition, with no significant shade from the riparian zone or aquatic plants and algae, the aquatic microclimate along the shoreline is degraded, minimizing site functionality for use by aquatic species (Brennan 2007). The absence of LWD also limits the opportunity for foraging and refuge for a variety of species, including salmonids (Brennan 2007), and further decreases the habitat quality.

2.5.2.1. Substrate Condition

The substrate immediately below the armored slope is generally a mix of gravel, sand, and shell hash. Below approximately +4 ft mean lower low water (MLLW), the sediments transition to finer materials like unconsolidated silt and mud. In some areas, gravel, shell hash, or sandy substrates are found intermixed with the finer sediments. As mentioned, large amounts of debris exist on site, which negatively impacts the quality of sediments, limiting habitat function. Areas of the site also have large amounts of debris and sawdust intermixed with the surface sediment, likely from when the site was previously used as a sawmill and plywood manufacturing facility.

As documented by Ecology, the water and sediments on site have concentrations of contaminants of concern and are listed on the 303(d) list according to the Water Quality Atlas Map. The presence of these contaminants negatively affects the habitat of the invertebrates living in and on the substrates, which in turn negatively affects species such salmonids which feed on these invertebrates.

2.5.2.2. Lack of Large Woody Debris

Though artificial debris is present, the distinct lack of LWD and other natural structural features limits the functionality of this site. LWD plays a role in aquatic and riparian habitats in providing bank stabilization, sediment and material deposition, substrate for algal attachment, and potential use by wildlife, fish, and invertebrates for foraging, refuge, roosting, nesting, and spawning (Brennan 2007). The current riparian habitat is degraded and sparsely vegetated, providing little opportunity for recruitment of LWD.

2.6. Geotechnical Investigation

Geotechnical investigations have been completed and are documented in a set of geotechnical engineering reports (Landau 2014, 2020 and 2021). These investigations include the assimilation of data from nearby projects and test pits on the project site. From this information it was determined that the foreshore sediment is made up of very soft, plastic, fine-grained material consistent with mudflats. Test pit explorations indicate that the mudflat soils extend below the project site, which is consistent with the fact that the project site was built up by filling over historic mudflats. The material overlaying the mudflat soils is composed of undocumented fill and large amounts of wood debris. Explorations also found a high water table at or near the ground surface (Landau 2020).

Based on the 2020 Geotechnical Engineering Report and subsequent recommendations prepared by Landau Associates completed for the project/site (Landau 2020 and 2021 and Sage 2024, 2025a, 2025b), the geotechnical engineer recommends leaving the existing riprap in place so as not to destabilize the shoreline slope. The proposal to place gravel fill over the existing riprap and then sand and gravel beach fill to create the 8:1 sloping beach will result in the highest factor of safety for the beach slope, also marginally increasing the seismic stability of the slope.

3. Purpose & Need for Shoreline Restoration

3.1. Consistency with City Restoration Plan (2012)

The WBY shoreline restoration project is designed to meet the objectives and priorities of the City's adopted Restoration Plan dated June 12, 2012. Historical ecological processes and habitat functions will serve as the basis for the restoration, which will be done in continuity of a larger scale restoration, not parcel by parcel. Restoration of the degraded intertidal areas will reconnect riparian and intertidal habitat. A naturally functioning, sloped beach will also be created.

The project is intended to restore critical habitat functions that are currently impaired within many areas of Budd Inlet and West Bay. Importantly, restoration of this shoreline, with regard to the City's adopted Restoration Plan, is intended to restore and improve shoreline ecological processes and functions as they existed as of the City's adoption of the master program. By its terms, the Restoration Plan does not require returning the site shoreline to pre-European settlement or pre-industrial conditions (see Chapter 1, Olympia 2012).

The goals and objectives of this project design align with the overall goals of the City's Restoration Plan. The primary goal of this project, as with the City's Restoration Plan, is "to achieve no net loss and overall improvements in shoreline ecological functions over time" (Olympia 2012). As noted above, the baseline from which to evaluate no net loss is the condition of the site at the time of adoption of the master program. In Olympia, the earliest master program was adopted in 1976. By that point in time, the shoreline area at issue was already highly disturbed.

3.1.1. Budd Inlet Restoration Objectives

The Restoration Plan lists the specific objectives for restoring important habitat functions in Budd Inlet. Below are the restoration objectives identified in the Plan, as well as how the current project design addresses each objective.

3.1.1.1. Preserve and Restore Estuarine Habitat (Including Saltmarsh)

The project design includes the establishment of saltmarsh vegetation along with a dense canopy of riparian vegetation. These improvements will greatly enhance the estuarine habitat functions of the site, including juvenile salmonid foraging, organic material input, and LWD recruitment.

3.1.1.2. Enable Natural Wave Attenuation

Covering of the existing revetment with a gently-sloped sandy-gravel beach with berm and backshore features will reduce shoreline armoring in West Bay, eliminate reflected wave energy, and reduce beach scour. This reduction in energy will allow for the establishment of saltmarsh vegetation and promote colonization of the beach by invertebrates that provide prey to juvenile salmonids. The low-energy beach will also provide habitat for forage fish spawning.

3.1.1.3. Improve Sediment Generation and Transport

The placement of a gently sloped sandy-gravel beach with berm and backshore features will introduce natural sediment to the nearshore in West Bay.

3.1.1.4. Improve Water Quality

The densely-planted riparian corridor will provide protection for the beach from upland stormwater runoff. In addition to the institutional controls implemented by the upland project, the riparian corridor will help to filter out toxins or sediments from stormwater before it flows down to the beach and into Budd Inlet. Furthermore, removal of debris and concrete rubble from the intertidal shoreline and the covering of contaminated intertidal sediments with beach nourishment will greatly improve water quality at the site.

3.1.1.5. Preserve and Restore Wildlife Habitat

Wildlife habitat at the site will be restored by the establishment of the native riparian corridor. Densely-planted trees and shrubs will provide nesting and foraging for many native species of birds and small mammals. Trees will provide perching and resting opportunities for raptors.

3.1.1.6. Increase Sources and Delivery of Large Woody Debris

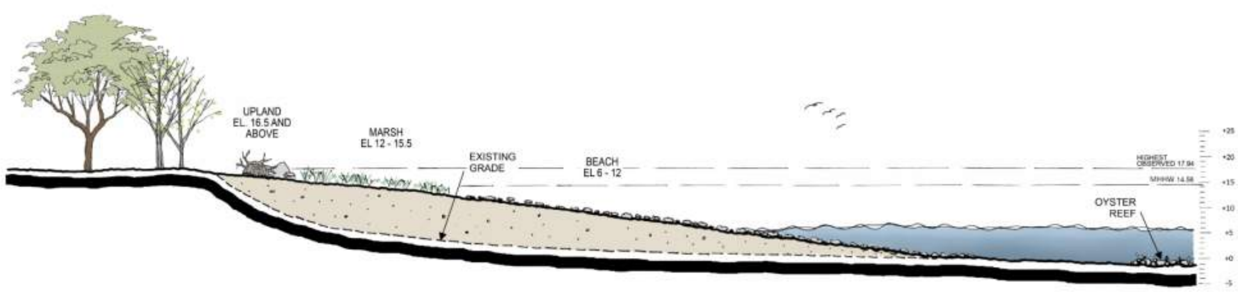
The removal of the existing rip rap, shoreline restoration, and the establishment of a dense riparian corridor with native trees will provide recruitment potential for LWD along the shoreline.

The purpose of the shoreline restoration project is to restore and enhance shoreline ecological processes and functions at the site. This will be accomplished by the placement of select beach materials at appropriate grades and slopes; installation of a dense, native riparian corridor; establishment of saltmarsh vegetation within the upper intertidal zone; and placement of LWD material. These habitat elements have been incorporated into the project design specifically to address each of the Budd Inlet restoration objectives identified in the City's Restoration Plan.

3.2. Following West Bay Environmental Restoration Assessment (2016)

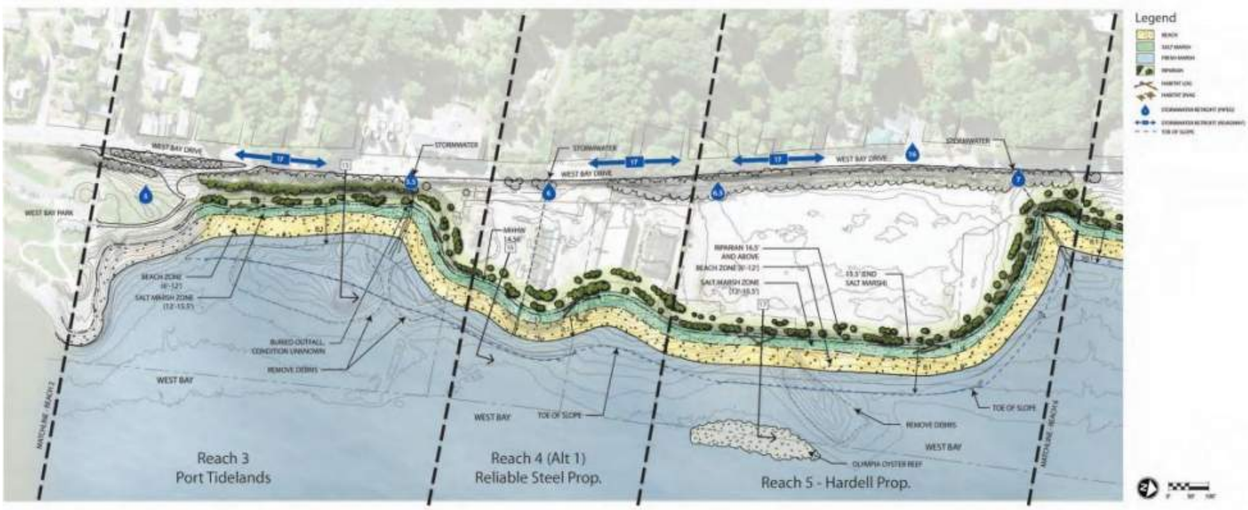
The purpose and need for restoration of shoreline along West Bay of Budd Inlet were established in the City of Olympia West Bay Environmental Restoration Assessment (Coast & Harbor Engineering 2016). The assessment was based on best available science for green shoreline development and was developed in coordination with key stakeholders, including the Squaxin Island Tribe, the Port of Olympia, and other interested parties. The restoration purpose and approach were and are supported by Tribe. The conceptual restoration design for the project site included creation of a naturally functioning, sloped beach to support salt marsh and riparian planting as well as placement of LWD (Figure 3-1).

FIGURE 3-1: 2016 CONCEPTUAL SHORELINE RESTORATION DESIGN FOR PROJECT SITE (COAST & HARBOR ENGINEERING 2016)



It should be noted that the West Bay Environmental Restoration Assessment developed a plan for preserving continuity of a larger scale restoration rather than a parcel-by-parcel approach (Figure 3-2). This study was based on restoration of ecological processes and habitat functions by restoring degraded intertidal areas for reconnection of riparian and intertidal habitats and restoration of impacted intertidal zone.

FIGURE 3-2: 2016 CONCEPTUAL SHORELINE RESTORATION FOR PROJECT VICINITY (COAST & HARBOR ENGINEERING 2016)



3.3. Consistency with City's Climate Response Plan

City of Olympia Sea Level Response Plan (2019) states that "Naturally sloped, vegetated shorelines help moderate upland flooding by reducing wave energy as waves approach the shoreline. Green shorelines can reduce the risk of high waves overtopping the shoreline." The proposed more natural beach fill (mixed sand and gravel) helps to mimic natural stretches of shoreline and reference sites within Puget Sound. The proposed design includes a naturally sloping beach face which is consistent with the City of Olympia Sea Level Response Plan.

3.4. Consistency with Marine Shoreline Design Guidelines

Project site characteristics that contribute to design of a naturally functioning beach include wave energy and available backshore in addition to project length, cumulative risk, alignment, and shore type. Adequate backshore area (including a sufficient width berm) not only protects the upland infrastructure against coastal hazards but also provides the space for the riparian zone with drift logs, dune grass and other salt-tolerant herbaceous vegetation present. Additionally, adequate berm width (within the backshore zone) allows adaptability to Sea Level Rise (SLR). Based on prior experience and prototypes in Puget Sound, the backshore and berm widths are critical design features.

The WDFW Marine Shoreline Design Guidelines (WDFW 2014) provides guidance for backshore width required to support a naturally functioning beach based on project site's wave energy.

TABLE 3-1: BACKSHORE WIDTH CATEGORIES IN FEET

(Measured from MHHW landward) to assist with selection of appropriate design alternatives for the site conditions from WDFW Marine Shoreline Design Guidelines (WDFW 2014).

Backshore width (ft)	Wave Energy Category		
	Low	Moderate	High and Very High
Low (ft)	<5	5-15	15+
Medium (ft)	5-10	15-25	25+
High (ft)	10-15	25-35	35+

During the site-specific characterization of coastal process, we determined that the 2% annual exceedance wave event was estimated to have a height of 1.5 feet and a period of 3.1 seconds (M&N 2022). Per the WDFW Marine Shoreline Design Guidelines (WDFW 2014) the WBY project is in a 'High' wave energy category[4] based on the greatest fetch distance at the project site. The recommended backshore width (measured landward from MHHW) is 25+ ft for a medium case or 35+ ft for high case, as listed in Table 3-1. For the WBY project selecting a backshore width near the high end of this range is appropriate in order to provide adequate space for the "managed realignment" of the shoreline under future SLR (WDFW 2014) and to incorporate a sea level rise backshore buffer.

3.5. Consistency with City's SMP

The proposed shoreline design must also comply with the City's Shoreline Master Program (SMP) (Olympia 2021). Creation of a naturally functioning beach for shoreline restoration includes the creation of backshore, berm, and foreshore. The backshore width must be sufficient to provide the vegetation conservation area (VCA) required per OMC 18.36. The VCA will be a 30-foot wide area measured landward of the ordinary high water mark (OHWM).

Constructing a nearshore beach restoration without creating a non-developable backshore and beach berm feature would reduce functionality, increase risks for performance and require a greater level of maintenance.

The proposed restoration design for WBY includes placement of fill to restore the existing ecologically degraded shoreline and to enhance public access to the shoreline. The proposed shoreline restoration design by WBY in our opinion does not create new or additional developable[5] upland areas and conforms to the provisions of the City's SMP Section 2.32.F. because:

1. Creation of adequate backshore/berm conforms to provisions of the City's SMP Section 2.32.C and Section 3.63, OMC 18.20.837, and the guidelines of Ecology's SMP Handbook Appendix A.; and
2. The proposed restoration design creates the minimum necessary backshore and this backshore and berm is a critical functional element of the beach restoration that provides the following functions:
    - The protection of upland infrastructure;
    - Providing space for the marine riparian zone; and
    - Building adaptability against sea level rise.

3.6. Engineering with Nature

Nearshore improvements such as a habitat beach, soft shore stabilization and dynamic revetments are all examples of *engineering with nature*. Engineering With Nature® (EWN), developed by US Army Corps of Engineers (USACE), is the intentional alignment of natural and engineering processes to efficiently and sustainably deliver economic, environmental, and social benefits through collaboration (EWN, 2024). The guiding principles for engineering with nature shoreline improvement systems include the following:

- Holistic (ecosystem approach),
- A Systems Approach (consideration that projects exist in a complex physical system, i.e., Geomorphologic system),
- Sustainable (consideration for resiliency for Sea Level Rise (SLR) and Climate Change relative to beach adjustment over time),

[4] It should be noted that this is not an industry-wide classification
[5] Note: The upland project design retains the existing, pre-restoration OHWM for purposes of determining building setbacks and required vegetation conservation areas under the City's SMP.

- Innovative (embracing continuous learning and prior experience),
- Adaptive (demonstrating ability to provide sustainable designs within the natural environment),
- Collaborative (Tribal, City and Regulatory input),
- Socially Responsible (aligned with values of City West Bay Restoration Plan and Tribal Restoration Interests for Budd Inlet Nearshore Enhancements),
- Efficient and Cost Effective (reducing rework and maintenance requirements),
- Science Based (being intentional to work within natural processes).

The proposed WBY shoreline and beach design alternatives have been developed based on the EWN guiding principles, as detailed in research documentation and guidance documents rather than a prescriptive code. A number of these references are used in the development of the proposed beach fill design, that have been used extensively in prior successfully constructed projects. Prior experience and post-construction monitoring are validation of those prior designs and increase confidence in subsequent future design recommendations. In summary, following these principles represent the standard of care and best available science for coastal engineering design of shoreline beach fill restoration and soft shore stabilization systems for Puget Sound beaches.

4. Restoration Design Approach and Considerations

Building on the conceptual design developed by the West Bay Environmental Restoration Assessment, shoreline restoration design for WBY was further advanced by applying coastal geomorphology and investigated with process-based morpho-dynamic models and applied geomorphology using reference sites and regional guidance documents. Design considerations included the following disciplines.

4.1. Ecological/Habitat

Ecological and habitat design considerations establish the purpose and need for restoration, which was described in detail in Section 3. The ecological and habitat design approach is based on the proposed design in the West Bay Environmental Restoration Plan (Coast & Harbor Engineering 2016).

4.2. Beaches of Puget Sound and Reference Sites

The primary parameters taken into consideration were the prevailing coastal processes, wave exposure, tide climate, sediment grain size, and associated beach geometry (specifically, slope, berm elevation, and berm width). The resulting beach profile was a modification of a natural profile adapted to the constraints of the project site.

The project will introduce new beach sediment material to the littoral system. The new beach material will be similar to the existing material and placed at slopes and grades that will promote natural beach cross-shore processes and backshore ecological function.

4.2.1. Reference Sites

M&N identified natural and artificial reference sites and elements that contribute to success of shoreline restoration, see Figure 4-1. In addition, reference sites with eroding shoreline were identified to highlight the elements that result in loss of beach sediments, see Figure 4-2. M&N evaluated the geometry and the beach profiles located in West and East Bays of Budd Inlet as well as other reference sites on the Puget Sound.

FIGURE 4-1: (A) PERCIVAL LANDING, OLYMPIA; (B) CORNET BAY

FIGURE 4-2: (A) STEEP/ERODED SHORELINE AT EAST BAY, OLYMPIA; (B) ERODED SCARP AT WEST BAY PARK, OLYMPIA

4.3. Resilience against Sea Level Rise and Coastal Flooding

The Washington State Department of Ecology (Ecology) has addressed the role of inland areas in resilience against sea level rise in Appendix A to the Shoreline Master Program (SMP) Handbook as follows:

"… sea level rise predictions should be factored into restoration planning, perhaps including larger inland areas in restoration or habitat protection efforts to accommodate increasing inundation and to allow the shoreline to shift farther inland."

As outlined in the City of Olympia Sea Level Response Plan (Olympia 2019), a moderate level scenario of SLR is estimated to be 18 to 24 inches. Higher water levels will result in faster rates of erosion on beaches and coastal bluffs (Shipman, 2009). Accommodating shoreline translation because of SLR can enable salt marshes, sand dunes and beaches to transgress (move landwards while maintaining their overall form). This concept is commonly referred to as "managed retreat" or "managed realignment" (WDFW 2014). A SLR buffer (see Sections 5.2, 5.3, and 5.4) is proposed to provide the space for the "managed realignment" of the shoreline. This approach provides capacity for adaptation and resiliency under future sea level rise.

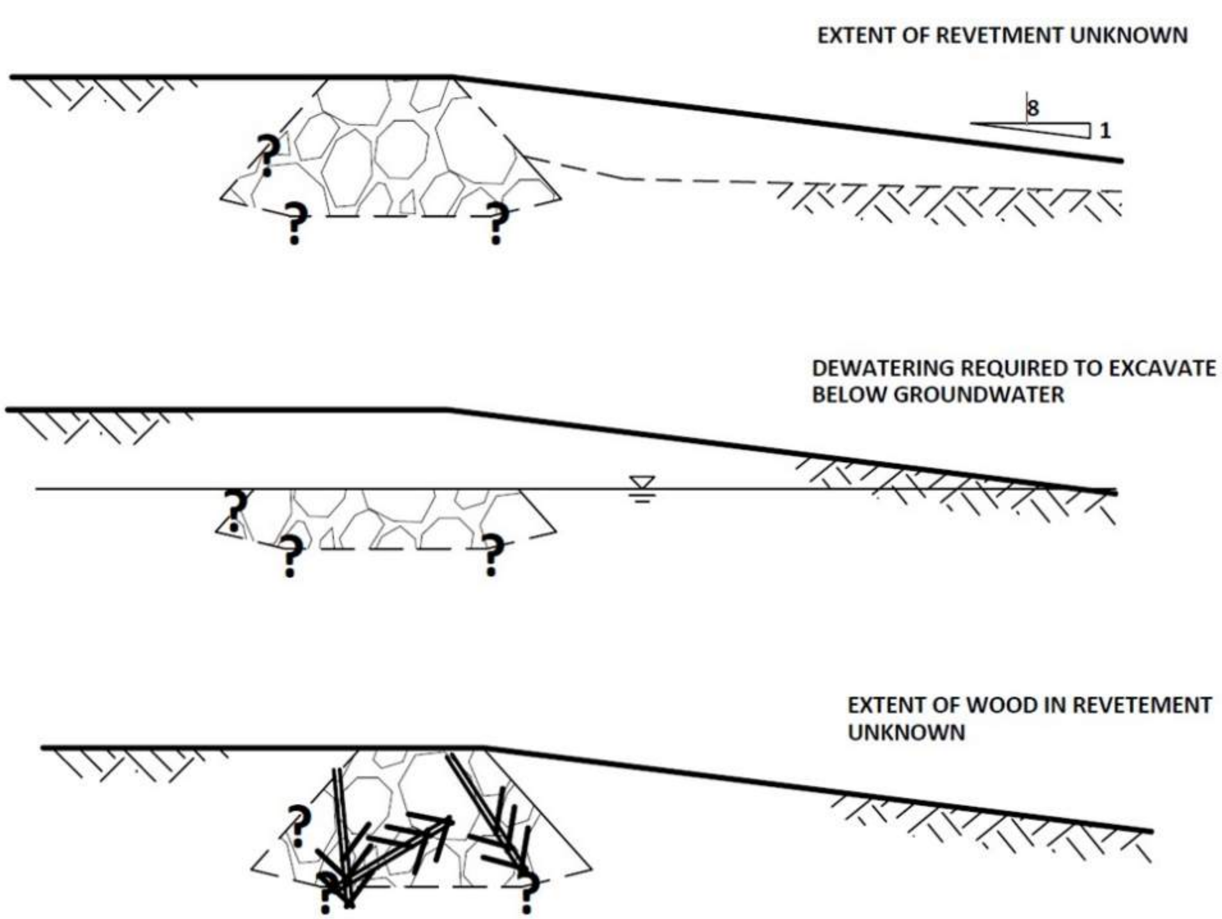
This project would revert the shoreline to a more natural state by restoring a natural morphology (geometry and sediments) with the capacity to adapt to waves and water levels, including higher sea levels. The project site has already experienced roughly 4 inches of sea level rise in the last 50 years, and we expect that sea level rise will accelerate. The restored beach will adapt to higher sea levels by aggrading vertically and migrating landward, while dissipating incident waves and limiting wave attack on landward features.

4.4. Geotechnical Engineering

Geotechnical considerations of the proposed shoreline geometry focus on slope stability, constructability, and risks related to unknown subsurface conditions. These considerations are depicted in order on Figure 4-3:

1) The extent of the existing revetment is unknown.
2) A significant portion of the existing revetment height becomes submerged during tidal cycles, resulting in the need for dewatering to remove the existing revetment.
3) The extent of wood waste and other obstructions or deleterious materials is unknown.

FIGURE 4-3: GEOTECHNICAL DESIGN CONSIDERATIONS – SITE CONSTRAINTS



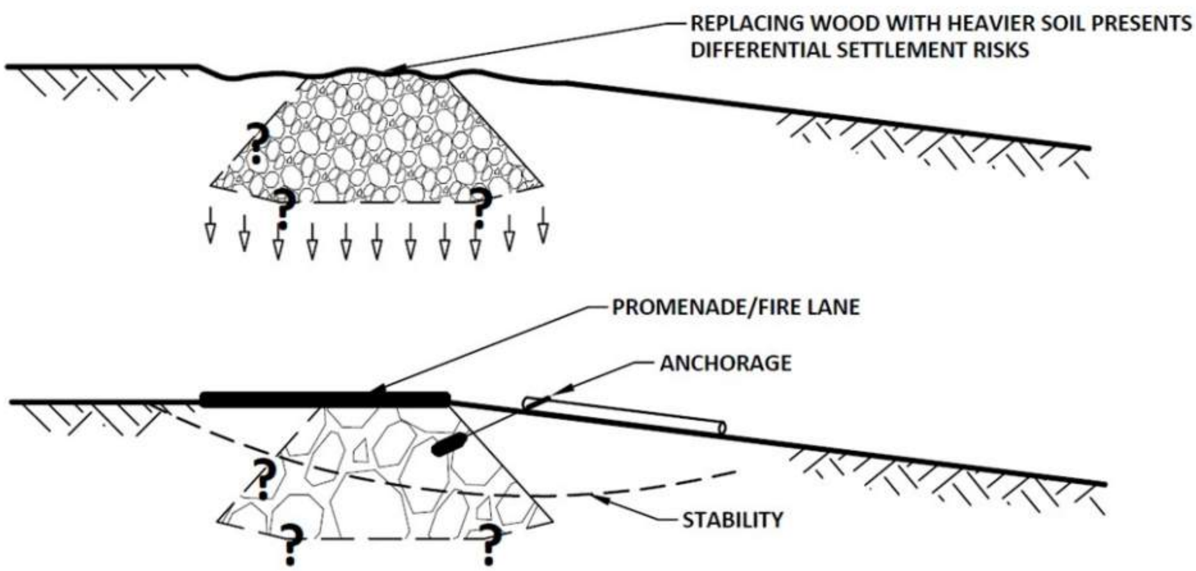
The geotechnical considerations discussed above were used to develop recommendations with respect to the removal of the existing revetment and the implementation of dewatering if the existing revetment were to be removed.

4.4.1. Existing Revetment Removal

The recommendation from the geotechnical engineer is that the existing revetment should be left in place (Landau 2020 and 2021, and Sage 2024, 2025a, and 2025b). The primary considerations guiding this recommendation are depicted in Figure 4-4. The existing revetment has been in place for several decades and, as such, primary settlement is likely complete. Portions of the existing revetment may include wood or debris (materials that weigh less than soil). Removing the existing revetment and replacing it with soil (heavy) may, therefore, create new settlement, which would present concerns for beach restoration and the promenade.

The existing revetment generally provides high shear strength compared to soils that would be used to replace it. Higher shear strength soils provide increased slope stability, particularly during small to moderate sized seismic events. The existing revetment also provides a solid foundation (settlement being complete) for the promenade and fire lane, and potentially good anchorage (non-erosive) for woody debris.

FIGURE 4-4: GEOTECHNICAL CONSIDERATIONS – EXISTING REVETMENT REMOVAL



4.4.2. Water Exclusion and Dewatering

The existing revetment lies within the area of daily tidal inundation, and its removal would necessitate dewatering to allow the removal to be completed in the dry. The recommendation from the geotechnical engineer is that water exclusion structures in the form of sheet pile cofferdams or Portadam® are high risk and have a potential for failure (Sage 2024, 2025a, and 2025b).

To complete dewatering a water exclusion structure would need to be built to separate the work area from West Bay. The successful installation and operation of the dewatering system is highly dependent on-site soil and groundwater conditions. It should be noted that the execution of dewatering is risky, and failure of the water exclusion and dewatering system could result in the release of contamination into West Bay creating a potential for impacts to aquatic habitat.

The water table was determined to be roughly equivalent to the ground surface during geotechnical explorations (Landau 2020). As a result, it should be expected that the volume of groundwater that would need to be regularly pumped away from the existing revetment removal area would be significant especially if the water exclusion structure does not provide groundwater cutoff.

To complete dewatering a temporary water exclusion structure would need to be built. One option for providing water exclusion is a sheet pile cofferdam. The installation of sheet piles could fail if obstructions in the subsurface prevent sheets from being advanced. Site investigations found evidence of layers of wood waste from a few feet thick to as much as 15 feet thick. Figure 4-5 exemplifies the nature of the wood waste encountered during geotechnical explorations (Landau 2020). These conditions indicate a high risk that sheet pile installation would be obstructed. Water exclusion work is inherently high-risk construction work and not a preferred construction method for the documented site conditions and proposed shoreline improvements. It is not recommended by the engineers of record due to the higher construction risks.

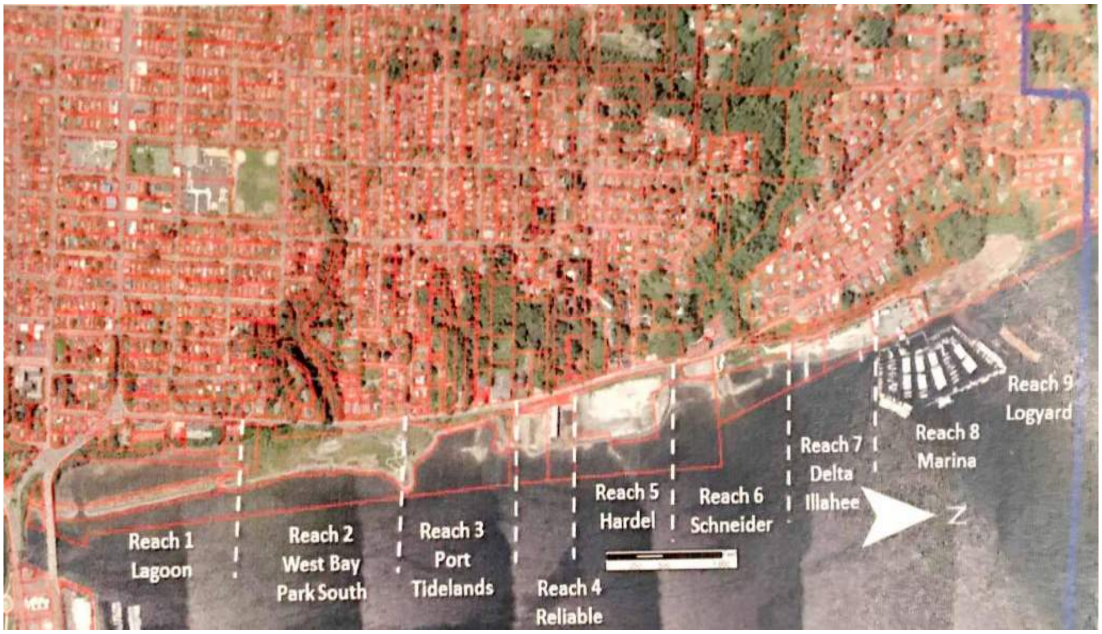
FIGURE 4-5: WOOD WASTE OBSTRUCTIONS IN TEST PIT 2 (LANDAU 2020)

Portadam® is a possible alternative to a sheet pile cofferdam. However, it is unlikely that the soft soils present at in the foreshore would be able to support the Portadam®. Instabilities from poor soil conditions could compromise the seal, require frequent adjustments or re-installation, and increase risk of overtopping. Furthermore, the Portadam® does not provide groundwater cutoff which greatly increases the pumping costs to maintain the dewatered condition due to the high water table at the project site. If the pumps were to fail water could overwhelm the Portadam® causing the system to fail.

4.5. Landscape Architecture

The submitted shoreline design creates diverse riparian habitat, overlooks, and touch points for ecological value and recreational shoreline use. The benefits outweigh the impact of fill on the site given the ecological lift achieved. The design is developed in the context of the greater West Bay ecosystem and the urban context. This portion of West Bay will provide a critical link for the West Bay Trail and the Greater Olympia Trail. This important connection of trails was highlighted in the West Bay Restoration Plan (Figure 4-6).

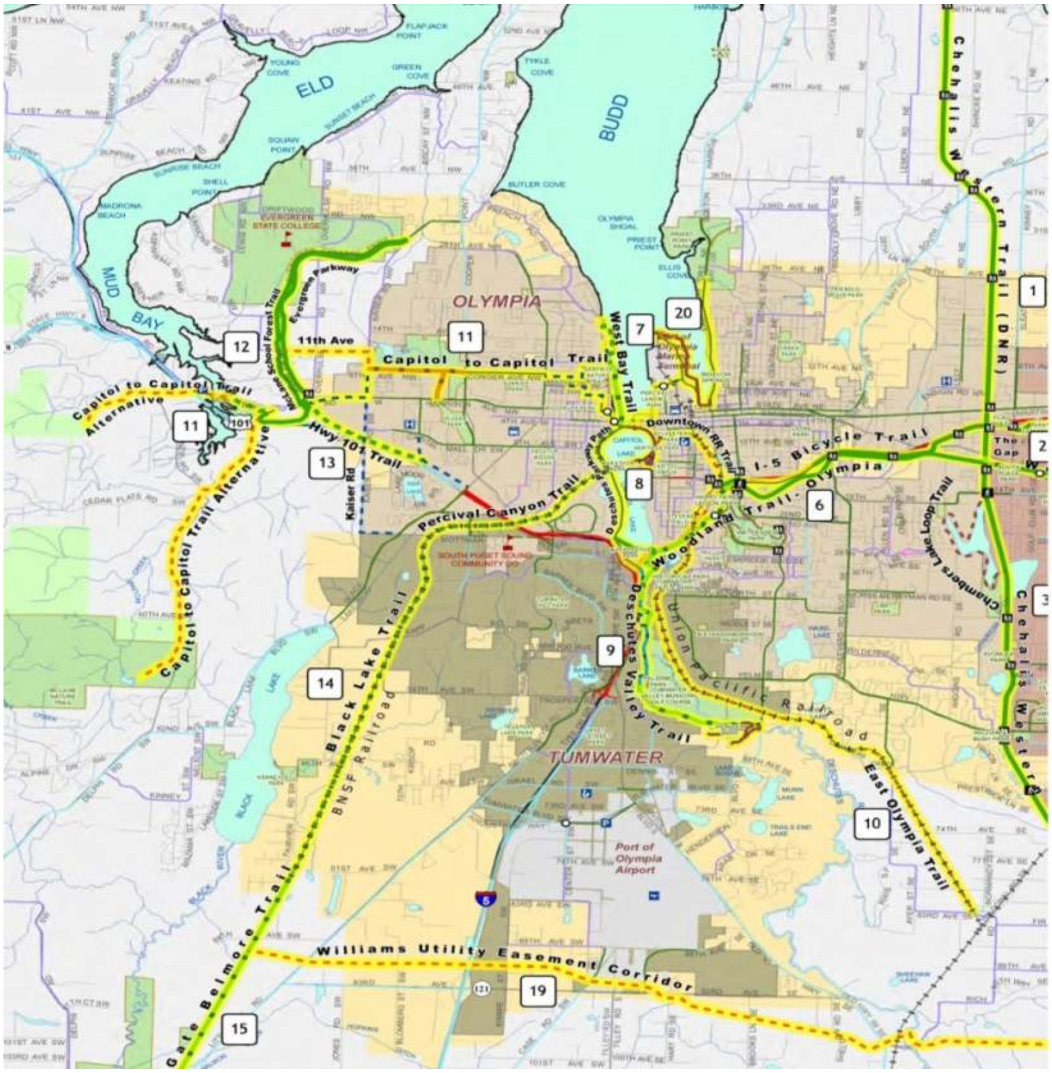
FIGURE 4-6: WEST BAY RESTORATION PLAN



The project involves fill, but there is a significant ecological benefit to the intertidal and riparian habitat as the design provides a naturalistic green shore approach. The design carefully targets specific elevations to create a diversity of habitat types, including upland riparian, transitional plantings, high brackish marsh and low brackish marsh, and intertidal beach with carefully graded mineral substrate. The beach will improve the habitat for forage fish and other aquatic, terrestrial, and avian species. These habitats are designed to maximize food sources, cover, nesting sites, etc. Logs and snags provide sites for cavity nesters and food sources. Tree groves are provided within the riparian zone to maximize biomass, overhanging vegetation, and structure along the shore. Topsoil will be mixed with the proposed mixed sand/gravel foreshore in depths adequate to support the health and growth of the large tree and shrub groves proposed in the plan. The groves are located to ensure opportunities for great views along the waterfront.

Recreation elements include paths leading to shoreline touch points interspersed with protected areas to maximize habitat value. Touch points also provide opportunities for hand carry boat launching and stand-up paddle board use. An esplanade provides a connection across the site that will eventually be extended to the north and south edges of the property which will enable the important West Bay Trail implementation (Figure 4-7).

FIGURE 4-7: WEST BAY TRAIL CONNECTING TO THE PEDESTRIAN NETWORK



The following goals/design principles were considered:

- Enhance Habitat & Ecological Function
- Balance Human Use and Ecological Value
- Create Strong Links to The Surrounding Community & Region
- Provide Recreational Opportunities
- Create a Beautiful Site Aesthetic with Design Simplicity
- Respect and Express Cultural, Archaeological, Ecological & Historic Site Significance
- Create an Implementable Design
- Enhance Public Health & Safety
- While fill is relatively expensive from a development cost standpoint, from a landscape and regional perspective the habitat and recreational enhancements outweigh any impact from the fill placed.

5. Comparison of Alternatives

The four alternatives discussed below were developed to assess the proposed design (Alternative 3) against the purpose and need established in Section 3. Alternative 1 is a No-Action/Status Quo option where no modification to the shoreline is proposed. The remaining three alternatives were developed to study how the proposed conceptual design (Coast & Harbor Engineering 2016) could be implemented while minimizing fill and the relocation of the OHWM.

5.1. Alternative 1: No-Action/Status Quo

Under the No-Action Alternative, the proposed redevelopment project would not implement any comprehensive action (or actions) to restore the shoreline. Under this alternative, the steep armored slope would remain in place. Furthermore, the existing armored slope would require repairs to protect the upland infrastructure in areas that have experienced erosion. The advantages and disadvantages of this alternative are listed in Table 5-1.

Under the No-Action Alternative, top of the shoreline is at an elevation varying between +16.0 and +19.0 ft, MLLW. The shoreline slope is approximately 1.5H:1V to 2H:1V from the top of shoreline to the elevation contours between +0 and 5 ft, MLLW.

FIGURE 5-1: ALTERNATIVE 1: STATUS QUO (W/O SHORELINE RESTORATION)

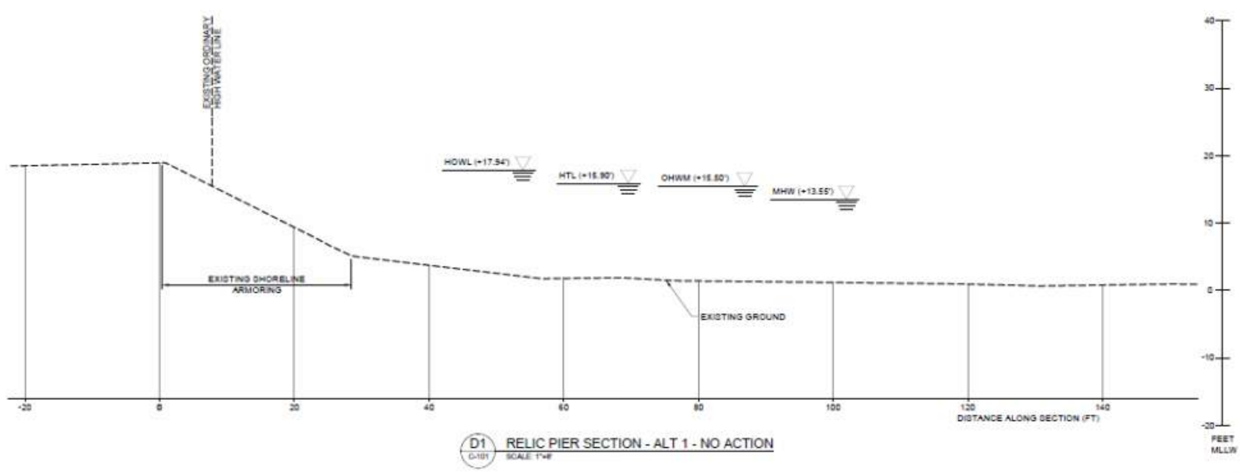


TABLE 5-1: ADVANTAGES AND DISADVANTAGES FOR ALTERNATIVE 1: STATUS QUO

Advantages	Disadvantages
No loss of aquatic area	Needs ongoing repair/maintenance
Less cost to owner	Does not support aquatic habitat
Less fill	Does not support public access to shoreline
Less regulatory permitting effort	Leaves existing debris along the shoreline
	Continued ecological function impairment
	Continued opportunity for substrate contaminant releases
	High-energy shoreline continues to impact nearby resources
	Increased environmental contaminant risk (sediment)

5.2. Alternative 2: Original Design Concept

Original Design Concept (Alternative 2) maintains the existing uplands and shoreline plan form but creates fronting intertidal beach and marsh areas primarily through placing beach substrates offshore of the existing revetment and contouring the upland areas to promote riparian vegetation (Figure 5-2). The design also includes an SLR backshore buffer that is included to ensure sufficient space for the managed realignment of the shoreline and that the beach fill is placed on a compatible substrate. These strategies could form part of a sea level rise adaptation strategy.

This alternative includes expanding the intertidal areas to cover the existing armored shoreline with more natural sand and gravel substrate fill, which will improve intertidal habitat function as well as waterfront access and provide hand-carry launch access for the public. The advantages and disadvantages of this alternative are listed in Table 5-2.

FIGURE 5-2: ALTERNATIVE 2: ORIGINAL DESIGN CONCEPT

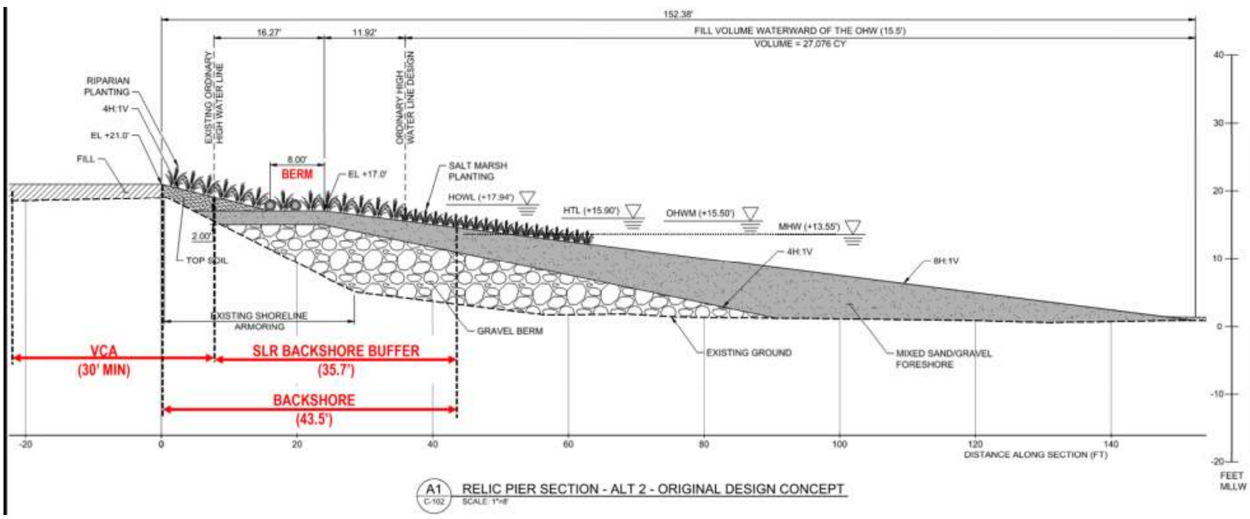


TABLE 5-2: ADVANTAGES AND DISADVANTAGES FOR ALTERNATIVE 2: ORIGINAL DESIGN CONCEPT

Advantages	Disadvantages
Sea level rise/Climate change resiliency	Costs
Does not create disturbance of existing slope (compared to Alt #3 or Alt #4)	Loss of aquatic area despite the fact that the habitat area is ecologically degraded
Meets all City Restoration Plan goals	
Introduces new beach sediment material to the littoral system	
Significant ecological function improvement	
Larger area of enhanced aquatic habitat value compared to Alt #3	
Improves public access to the shore	
Provides useable planting substrate	
Finer substrate	
Fill covers potentially contaminated sediment	
No excavation into bay bottom (compared to Alt #4)	

5.3. Alternative 3: Modified Design Concept – Partial Cutback

A Modified Design - Partial Cutback (Alternative 3) was developed to reduce the amount of fill below the OHWM, see Figure 5-3. The disadvantages associated with the alternative design concept include a reduced SLR backshore buffer width, which reduces long-term resiliency, and the need for additional excavation to create the riparian zone, requires more linear open space, and condensed open space, which is less attractive and usable. The advantages and disadvantages of this alternative are listed in Table 5-3.

FIGURE 5-3: ALTERNATIVE 3: MODIFIED DESIGN CONCEPT – PARTIAL CUTBACK

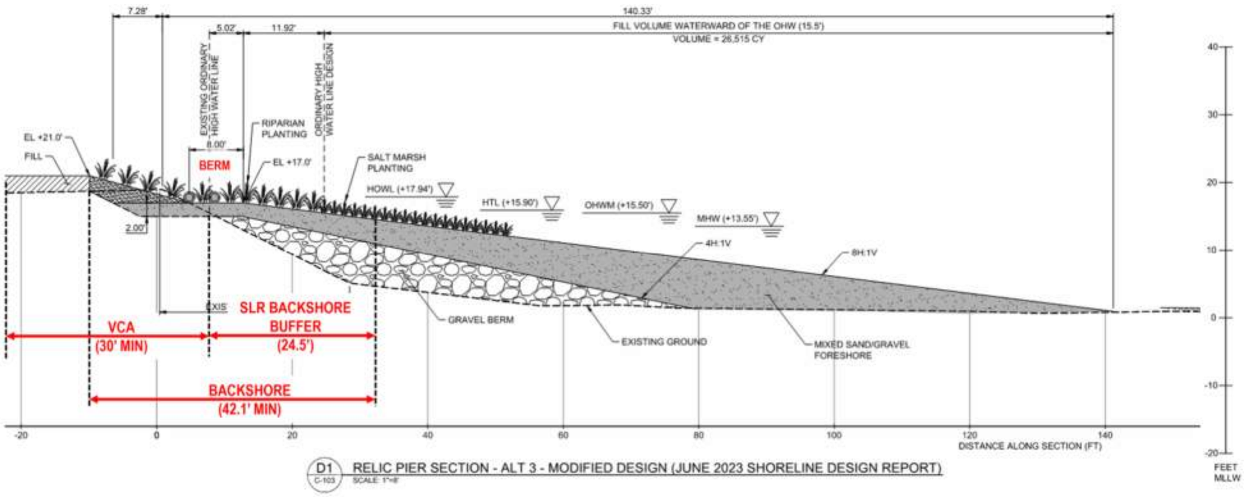


TABLE 5-3: ADVANTAGES AND DISADVANTAGES FOR ALTERNATIVE 3: MODIFIED DESIGN CONCEPT – PARTIAL CUTBACK

Advantages	Disadvantages
Reduced fill below OHWM compared to Alt #2	Smaller SLR backshore (relative to Alt #2) buffer resulting in reduced resilience
Significant ecological function improvement	Need for additional excavation to create riparian zone
Meets all City Restoration Plan goals	Loss of degraded aquatic area, though less than Alt #2
Introduces new beach sediment material to the littoral system	Less planting substrate over existing rip rap
Fill covers potentially contaminated sediment	
No excavation required into bay bottom (compared to Alt #4)	
Improves public access to the shore	
Provides useable planting substrate	
Finer substrate	

5.4. Alternative 4: Modified Design Concept - Full Cutback

A Modified Design – Full Cutback (Alternative 4) was developed to evaluate further reduction of the amount of fill below the ordinary high water mark (OHWM), see Figure 5-4. However, the disadvantages associated with this alternative include an even greater reduction in the SLR backshore buffer, which reduces long-term resiliency, and requires significant additional excavation into the bay bottom to create the riparian zone. The advantages and disadvantages of this alternative are listed in Table 5-4.

FIGURE 5-4: ALTERNATIVE 4: MODIFIED DESIGN CONCEPT – FULL CUTBACK

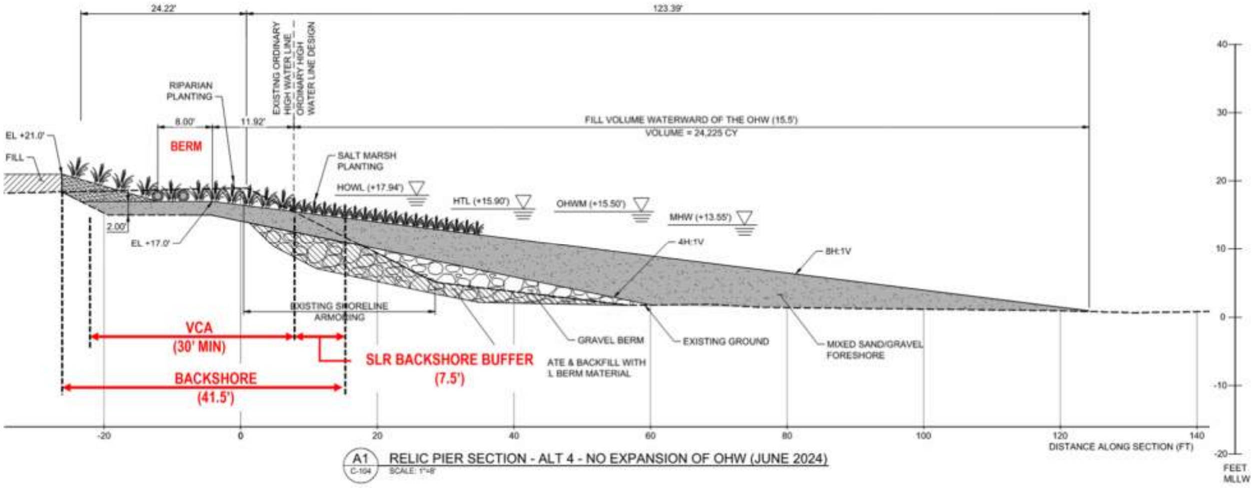


TABLE 5-4: ADVANTAGES AND DISADVANTAGES FOR ALTERNATIVE 4: MODIFIED DESIGN CONCEPT – FULL CUTBACK

Advantages	Disadvantages
Reduced fill below OHWM compared to Alt #2	Smallest SLR backshore buffer resulting in the least resilient design
Significant ecological function improvement	Need for additional excavation to create riparian zone makes construction infeasible and disturbs contaminated sediments
Meets all City Restoration Plans	Loss of degraded aquatic area, though less than Alt #2
	Less planting substrate over existing rip rap

5.5. Summary of Alternatives Analysis

Quantitative comparison of alternatives in terms of required fill in addition to permitting considerations associated with each alternative is listed in Table 5-5. Although Alternative 2 (Original Design Concept) is most consistent with design restoration objectives, it does not minimize fill to the extent envisioned by the City's shoreline code. Conversely, Alternative 3 (Modified Design – Partial Cutback) satisfies both the design objectives and the City's shoreline code requirements. Alternative 4 (Full Cutback) was analyzed as an alternative to further minimize required fill; however, the corresponding excavation into the bay bottom required to create a functional riparian zone is not feasible to permit or construct with the project.

After considering various factors, the recommended alternative is the Modified Design Concept – Partial Cutback (Alternative 3). While the Original Design Concept (Alternative 2) may be preferred for its alignment with design objectives, Alternative 3 is recommended to minimize fill consistent with the City's restoration objectives.

TABLE 5-5: QUANTITATIVE COMPARISON OF ALTERNATIVES IN TERMS OF REQUIRED FILL IN ADDITION TO PERMITTING CONSIDERATIONS

Alternatives	Existing OHWL to Proposed OHWL (ft)	Fill Below OHWL (CY)	Fill Footprint Below OHWL (ft)	Meets Design Standard & Best Available Science	Excavation Below OHWL Required?	Corps Permitting Considerations	Geotechnical Considerations	Climate Change Resilience	Estimated Construction Cost (w/out planting, design, or other soft costs)	Design Team Comments
Original Design Concept (Alternative #2)	28.2	27,060	144.5	Yes - ideal.	No	Requires the most fill/loss of aquatic area. Results in highest lift of habitat function. As with other alternatives, likely to be formal consultation with the Services due to volume of fill/loss of aquatic area, but functional benefits should outweigh impacts. Initial runs of conservation calculator result in large number of credits.	Provides most robust slope protection/stability by leaving armor rock in place.	High. Best for climate change resiliency because of the large SLR backshore buffer and keeps the shoreline farthest away from the development and infrastructure.	$4M to $5M	Aligns with design standards and prototypes that have demonstrated biological and physical processes success within Puget Sound.
Modified Design - Partial Cutback (Alternative #3)	16.9	26,515	133.5	Yes - ideal; minimized footprint but meets purpose and need of restoration action.	No	Balances aquatic fill and habitat function. Less function than Alt. 2, but less fill as well. Does not require sheet pile/excavation of bay bottom. Conservation calculator results will be similar to Alt. 2, though less credits generated. Minimizes fill/loss of aquatic area for Corps permitting, while achieving purpose and need.	Provides less slope protection than Alt. 2, but still feasible without heavy marine construction equipment (derrick barge, pile hammers, etc.) required for Alt. 4.	Good. Provides a SLR backshore buffer width to mitigate SLR and climate change but is a reduced width.	$3.6M to $4.6M	Reduced aquatic habitat footprint that has a small deviation from design standard and prototype geometries but can still be functional without significant added risk of performance.
Modified Design -Full Cutback (Alternative #4)	0	24,225	116.5	No - does not meet design standard unless excavation and backfill below OHWM is conducted.	Yes	Installation and removal of cofferdams several times over will introduce noise and other impacts and spread the impacts out over more than one fish window. Even if the Federal Services agree to allow work within the fish closure to get it all done in one year (unlikely for a restoration project), impacts to fish/aquatic life would likely be unreasonable. Where cofferdams are constructed outside the fish window it is usually only for cleanup projects where the material had to be removed due to contamination, not for restoration purposes. Formal consultation with the Services would be extensive. Excavation of the bay bottom may require coordination with the Dredge Material Management Office at the USACE (even with sheet pile), adding time and complexity to the project. Excavated material would have to be disposed of upland and area behind sheet pile would need to be dewatered, adding significant costs.	Construction of this alternative without a cofferdam would be reckless. It could not be completed in the dry (groundwater) and excavations would get flooded by tides daily.	Reduced; least resilient of alternatives because of the smaller beach and the sea level rise buffer is closest to development and infrastructure. See Ecology's January 2023 "Sustainable Remediation: Climate Change Resiliency and Green Remediation" (Publication 17-09-052).	$8M to $15M	The impacts from construction are likely to make this alternative infeasible for Corps permitting, both in terms of impacts to ESA species and critical habitat and work window timing. Without excavation below OHWM, would not meet the standard of care or best available science for function, performance and longevity. Requires substantial excavation of bay bottom to create a beach that could function properly, significant added cost for greater risk on performance.

6. Summary and Conclusions

Shoreline restoration design for the project site was developed incorporating the following factors and considerations:

- The proposed natural beach fill (mixed sand and gravel) has been engineered to remain stable against local site coastal processes (wind waves, tides and currents, and vessel wakes) using analytical engineering calculation methods laid out in the Coastal Engineering Manual (USACE 2011), industry guidance, and prior similar project experience. Fill placement will simulate similar Puget Sound beaches (Toft et al 2009) with similar site conditions. Various elements of the beach configuration (slopes, grades, and the bench) are critical for achieving the desired restoration goals and ensuring a resilient habitat.
- The substrate for the natural beach fill (mixed sand and gravel) has been designed to be stable during design storm events and, at the same time, support the creation of shoreline marsh and riparian habitat. Ecological value/restoration design needs require certain elements, most notably the right size of substrate at the right elevation. The original design mimics reference shorelines to support habitat restoration.
- Adding resilience against coastal flooding and sea level rise (in-line with recommendations of the City of Olympia Sea Level Rise Response Plan 2019): according to this plan, "Naturally sloped, vegetated shorelines help moderate upland flooding by reducing wave energy as waves approach the shoreline. Green shorelines can reduce the risk of high waves overtopping the shoreline."
- Following recommendations in the City's science-based assessment developed in conjunction with the City, the Port, and the Tribe (West Bay Environmental Assessment, Coast & Harbor Engineering 2016).
- Seaward offset of the proposed OHWM will provide a sea level rise buffer to allow for greater resilience to future conditions as outlined in the City SLR guidance.
- In addition, a beach fill is required to meet the restoration goals. Natural recovery is not feasible at this location to achieve a properly functioning intertidal habitat at this location due to its location and the large fill distance into the bay. Adhering to the slopes, grades, and bench width for the beach fill is critical for achieving the desired restoration goals and ensuring a resilient habitat and shoreline for changes related to sea level rise and climate change.

Four alternatives shoreline configurations were evaluated, and an alternatives analysis was conducted, see Section 5. In conclusion, the preferred alternative is the Partial Cut-back (Alternative 3) based on the overall engineering and environmental impacts analyses and compliance with City's shoreline code considerations. Based on best shoreline restoration practices and extensive regional design, construction, and monitoring experience as well as incorporating City's input, we conclude that the Partial Cut-back (Alternative 3) is the most appropriate choice for this site.

7. References

Brennan, J.S. 2007. Marine Riparian Vegetation Communities of Puget Sound. Puget Sound Nearshore Partnership Report No. 2007-02. Published by Seattle District, U.S. Army Corps of Engineers, Seattle, Washington. URL: https://wdfw.wa.gov/publications/02192.

Coast & Harbor Engineering. 2011. City of Olympia Engineered Response to Sea Level Rise. Prepared for the City of Olympia. December 30, 2011.

Coast & Harbor Engineering, a Division of Hatch Mott MacDonald. 2016. West Bay Environmental Restoration Assessment. Final Report. Prepared for the City of Olympia. February 26, 2016.

City of Olympia (Olympia). 2012. City Of Olympia Engineered Response to Sea Level Rise. Technical report prepared by Coast Harbor Engineering for the City of Olympia, Public Works Department, Planning and Engineering.

City of Olympia (Olympia). 2019. "Olympia Sea Level Rise Response Plan". March 2019. Prepared by AECOM.

City of Olympia (Olympia). 2021. "City of Olympia Shoreline Master Program"

EWN. Engineering With Nature, Website. About EWN - Engineering With Nature (dren.mil). 2024.

Finlayson, D. 2006. The Geomorphology of Puget Sound Beaches. Puget Sound Nearshore Partnership Report No. 2006-02. Published by Washington Sea Grant Program, University of Washington, Seattle, Washington. Available at http://pugetsoundnearshore.org

Grette Associates, LLC (Grette). 2022a. West Bay Yards Project: Critical Areas Report. February 2022.

Grette Associates, LLC (Grette). 2022b. West Bay Yards Project: Important Habitat and Species – Habitat Management Plan. February 2022.

Farallon Consulting | Grette Associates (Farallon|Grette). 2024. West Bay Yards Shoreline Restoration Project: Restoration Plan. February 2022.

Johannessen, Jim; Maclennan, Andrea. 2007. Technical Report 2007-04. Beaches and Bluffs of Puget Sound

Johannessen et. Al.. 2014. Marine Shoreline Design Guidelines. Washington Department of Fish & Wildlife (WDFW). WA State aquatic Habitat Guidelines Program. https://wdfw.wa.gov/sites/default/files/publications/01583/wdfw01583.pdf

Landau Associates Inc. (LAI). 2014. Geotechnical Report: West Bay Drive Northwest Sidewalks Project, Olympia, Washington.

Landau Associates Inc. (LAI). 2020. Technical Memorandum: Preliminary Geotechnical Engineering Recommendations, West Bay Yards, Olympia, Washington.

Landau Associates Inc. (LAI). 2021. Geologic Hazard Assessment for the West Bay Mixed-Use Development. Prepared for Milestone Companies West Bay Development Group.

Moffatt & Nichol (M&N). 2022. West Bay Yards Shoreline Restoration Design, Preliminary (30%) Engineering Design Report. March 2, 2022.

Toft, J., S. Heerhartz, J. Cordell, E. Armbrust, A. Ogston and E. Flemer. 2009. Olympic Sculpture Park: Year 2 Fish, Epibenthos, and Physical Modeling, Including Additional Beaches. Prepared for Seattle Public Utilities, City of Seattle. University of Washington School of Aquatic and Fishery Sciences, Report SAFS-UW-0902.

Sage Geotechnical, LLC (Sage). 2024. Response to Third Round Review Comments, West Bay Yards Mixed-Use Development, Olympia, Washington. November 22.

Sage Geotechnical, LLC (Sage). 2025a. Portadam Feasibility Assessment, West Bay Yards Shoreline Restoration, Olympia, Washington. June 2, 2025.

Sage Geotechnical, LLC (Sage). 2025b. Response to Review Comments, West Bay Yards Shoreline Restoration, Olympia, Washington. October 31, 2025.

Shipman, H., 2009 (in press), The Response of the Salish Sea to Rising Sea Level: A Geomorphic Perspective, Puget Sound Georgia Basin Ecosystem Conference, February 8-11, 2009, Seattle, WA, 8pp

U.S. Army Corps of Engineers (USACE). 2011. Coastal Engineering Manual. Engineer Manual 1110-2-1100, U.S. Army Corps of Engineers, Washington D.C.

Washington Department of Ecology (Ecology). 2018. SMP Handbook, Appendix A. Addressing Sea Level Rise in Shoreline Master Programs.

Washington State Department of Ecology (Ecology). 2022a. Coastal Atlas Map. Accessed November 16, 2022. URL: https://apps.ecology.wa.gov/coastalatlas/tools/Map.aspx.

Washington State Department of Ecology (Ecology). 2022b. Water Quality Atlas Map (online mapper). Accessed November 16, 2022. URL: https://apps.ecology.wa.gov/waterqualityatlas/wqa/map.