# ALKI COASTAL EROSION CONTROL PROJECT

*SECTION 103 COASTAL STORM DAMAGE REDUCTION*

SEATTLE, WA

Integrated Detailed Project Report and Environmental Assessment

January 2014

U.S. Army Corps of Engineers, Seattle District

In Partnership with:
The City of Seattle, Washington
Parks and Recreation Department

**U.S. Army Corps
of Engineers
Seattle District**

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# EXECUTIVE SUMMARY

The U.S Army Corps of Engineers, Seattle District, has partnered with the City of Seattle Parks and Recreation Department to design and implement a coastal storm damage reduction project under Section 103 of the Rivers and Harbors Act of 1962, as amended. The recommended plan would provide protection that addresses damages caused by coastal storm events occurring in Puget Sound. Coastal storms and erosion continue to threaten public infrastructure located in and around the project footprint, including a 54 inch King County sewer main, a main public arterial, City park property, and other underground utilities. In 1998, the City of Seattle was prompted to take emergency action to stabilize the shoreline to the north of the proposed federal project when storm waves resulted in the failure of a similar section of existing seawall and subsequent erosion of shoreline protection that threatened utilities, roadways, and public lands. The City completed permanent emergency repairs on this adjacent site which is not included in the scope of the proposed Federal project.

The recommended plan was chosen because it has the least environmental impacts, was the least cost alternative and meets the project purpose. The recommended plan includes construction of a soldier pile wall parallel to the shoreline through the study area. Preliminary coordination with resource agencies and federal tribes resulted in general concurrence with the project, though discussions regarding the slight waterward change in footprint will require environmental mitigation to offset permanent impacts. A preliminary analysis of the real estate interests in the area identified all lands needed for the project to be controlled by the City of Seattle.

The implementation cost of the recommended plan is estimated to be $1.7 million and will be cost-shared 65% Federal ($1,100,000) and 35% non-Federal ($595,000). The non-Federal sponsor is responsible for all lands, easements, right-of-ways, relocations, and/or disposal areas which is currently valued at $50,000. Economic analysis suggests the project could prevent millions of dollars of physical and non-physical damages, with resulting benefit-cost ratio of approximately 3 to 1.

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# 1. INTRODUCTION

The United States (U.S.) Army Corps of Engineers (Corps) proposes to construct a 475 linear foot seawall to provide coastal erosion protection for public utilities, roadways, and public lands. The project will involve construction of a new seawall immediately adjacent to and seaward of an existing deteriorated wall. The proposed work would occur in the summer of 2015. In accordance with the National Environmental Policy Act (NEPA), this integrated document examines the potential impacts of the proposed coastal storm damage reduction project.

# 2. STUDY AUTHORITY

Section 103 of the 1962 River and Harbor Act authorizes the Corps to study, design, and construct small coastal storm damage reduction projects in partnership with non-Federal government agencies, such as cities, counties, special authorities, or units of state government. Projects are planned and designed under this authority to protect public infrastructure from damages resulting from storm driven waves and current and to provide the same complete storm damage reduction project that would be provided under specific congressional authorizations. The maximum Federal cost for planning, design, and construction of any one project is $5,000,000. Each project must be economically justified, environmentally sound, and technically feasible.

# 3. STUDY INFORMATION

## 3.1. Study Sponsorship

The study was requested by the City of Seattle Parks and Recreation Department (City). As a part of the implementation of the project, the non-Federal sponsor of the study, the City, would be obligated to contribute 35% of the design and implementation costs including all lands, easements, right-of-ways, relocations, and disposal areas (LERRD). Refer to Appendix A for the City of Seattle Letter of Intent to sponsor the project.

## 3.2. Study Stakeholders

The following parties represent the project stakeholders:

- U.S. Fish and Wildlife Service (USFWS)
- National Marine Fisheries Service (NMFS)
- Muckleshoot Indian Tribe
- Suquamish Tribe
- Sauk-Suiattle Indian Tribe
- Snoqualmie Indian Tribe
- Tulalip Tribes
- Yakama Nation
- Duwamish Tribe
- Washington Department of Fish and Wildlife (WDFW)
- Washington Department of Natural Resources (DNR)
- Washington Department of Ecology (WDOE)
- Washington State Department of Archaeology and Historic Preservation (DAHP)

- Members of the general public

### 3.3. Study Area

The study area is located in West Seattle, Washington along the shores of Puget Sound and runs parallel to Beach Drive Southwest near Alki Point (Figure 1). The study footprint encompasses approximately 475 linear feet of shoreline and is about 75 feet wide, extending from the beach area to the easterly most edge (far side) of the existing roadway. All lands within the vicinity are owned by the City of Seattle, including the beach area extending waterward of the study footprint. There is an existing seawall that runs continuously through the study area that provides the current storm and erosion protection for public infrastructure. The existing seawall structure is approximately 14 feet high and has degraded since its construction in 1927. The degraded condition of the existing structure is not due to a lack of regular routine maintenance as the City of Seattle performs annual inspection and maintenance on the current structure. The infrastructure at risk behind the seawall includes a King County owned 54 inch sewer main running throughout the entire study area, as well as Beach Drive itself. In addition, there is a Puget Sound Energy gas line and a Seattle Public Utilities water line located beneath the centerline of Beach Drive that are also at risk of damages or failure caused by coastal storms.

The project is located two miles north of Lincoln Park, the site of a prior Section 103 project originally constructed in 1988 by the Corps and sponsored by the City of Seattle (Figure 1).

## 4. PURPOSE AND NEED

### 4.1. Overview

This Integrated draft Detailed Project Report and Environmental Assessment (DPR/EA) identifies the problems, objectives, and constraints of the project and documents the analysis of environmental impacts completed to date. Additionally, this report documents the process and screening developed to select the recommended plan. Storm waves in Puget Sound threaten public and private infrastructure around the Puget Sound, including West Seattle. The project area is exposed to a relatively long fetch. Fetch is the length of water over which wind can travel and it determines the size of waves produced. The project area is exposed to a fetch length of over 11 miles for winds from the south which is capable of producing wave heights greater than 7 feet during storm events. Many utilities and arterials are located near the water and often run parallel to the shoreline making them more vulnerable to impacts from storm waves and storm-induced erosion. In 1955, King County installed a 54 inch sewer main parallel to the shoreline that services over 20,000 customers with a capacity of up to 8 million gallons of flow daily; refer to Figure 2. The existing seawall runs throughout the project area and protects utility and transportation infrastructure, as well as park lands from wave damages and erosion caused by storm events. The existing seawall, built in 1927 by the Seattle Street Department, has significantly deteriorated over time as a result of storm-induced damages from Puget Sound.

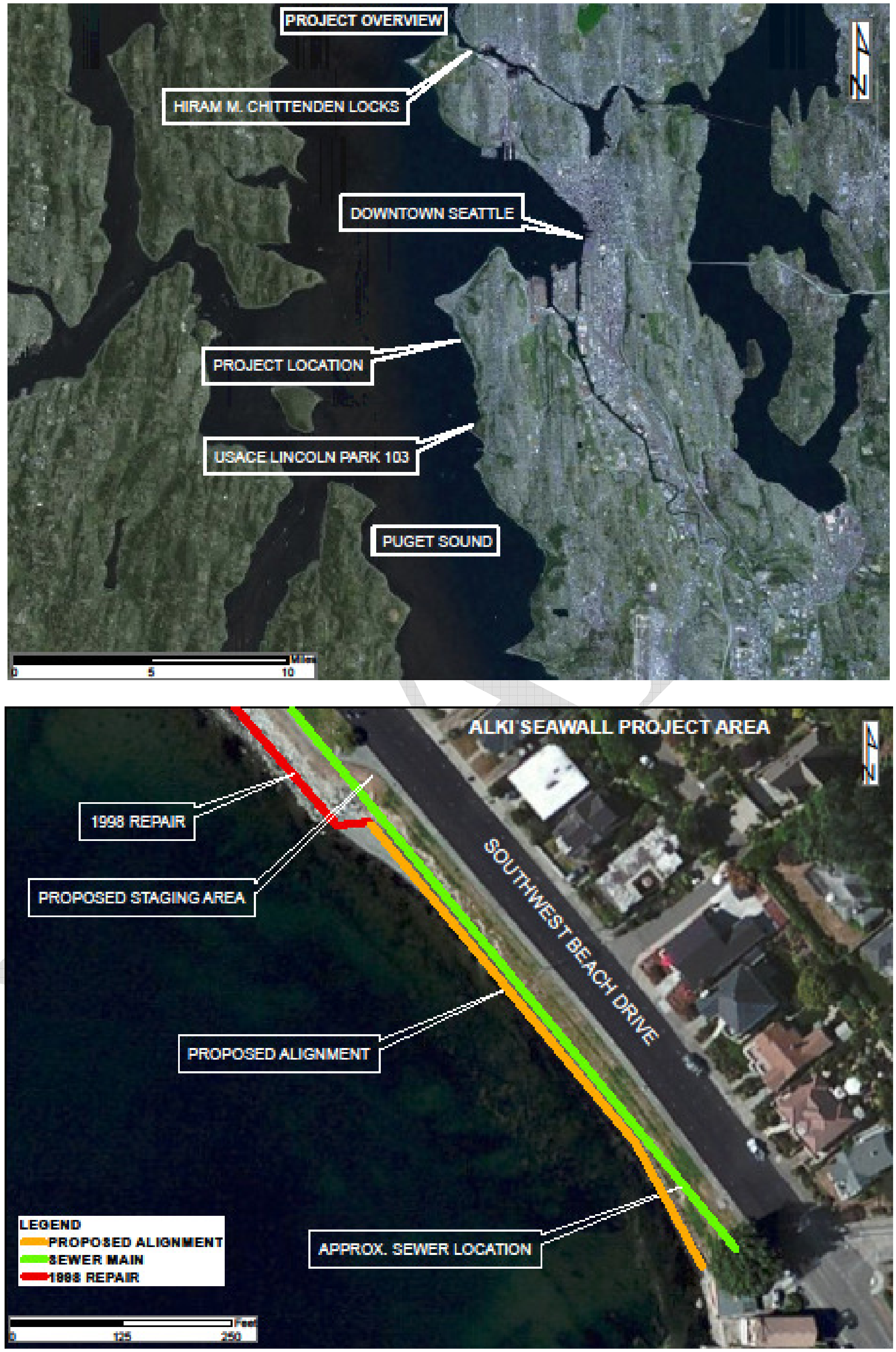


Figure 1. Project overview


Figure 2. King County Sewer Main

### 4.2. Problems and Opportunities

Coastal storm waves, storm surge, and storm-induced erosion continue to degrade the seawall and pose a significant risk to public infrastructure. A series of small winter storms in 1998 caused a 500 foot section of seawall to collapse just to the north of the project site, threatening infrastructure and the marine nearshore environment with potentially millions of gallons of raw waste-water discharging directly into Puget Sound. Emergency actions were taken by the City to stabilize the shoreline and prevent major utility damages. The failed section of seawall is located immediately to the north of the study area. Further action on the 1998 emergency repair area is not proposed as the work completed by the City is considered permanent and remains functional. The seawall and its components have been impacted by years of storm events and corrosion caused by salt water in Puget Sound, and further deterioration could result in failure of the structure, loss of infrastructure, contamination of the local marine environment, and erosion of public lands.

The seawall at the project site was originally constructed in 1927. The design of the original seawall included horizontal tiebacks which attached the top waler of the seawall to concrete anchors embedded in the soil landward of the structure. These anchors were intended to provide structural support to the system, but over the years the tiebacks have detached and no longer serve their intended function. Additionally, steel trolley rails were originally embedded into the concrete foundation to support the vertical concrete slabs. These rails have corroded such that the majority are now unstable. The failed vertical rails can be found along the beach during a low tide (Figure 3). Also sediments scour has occurred adjacent to concrete footing causing further destabilization of the structure. Insufficient maintenance is not attributable to the degraded condition of the existing seawall. Annual routine maintenance has been performed by the City throughout the life of the existing structure, including inspections and minor repairs as needed. However, the seawall and its components have been impacted by years of storm events and corrosion caused by salt water in Puget Sound, and further deterioration could result in failure of the structure, loss of infrastructure, contamination of the local marine environment, and erosion of public lands.

The opportunity exists to reduce the risk of damages to public infrastructure, including the potential loss of critical utilities and transportation corridors, from coastal storm waves, storm surge, and storm-induced erosion that continue to threaten the project area. In addition, there is an opportunity to reduce the risk of potential environmental impacts that may result from collapse of the sewer main that could result in raw sewage discharging into Puget Sound.

Figure 3. Corroded steel rails and failed top waler which historically held tie back anchors. Also note scour of sediments adjacent to concrete footing.

### 4.3. Goals

The goal of the study is to reduce damages to public utilities and infrastructure resulting from failure of the seawall due to coastal storm events, storm surge, and storm-induced erosion.

### 4.4. Objectives

The study objectives within the bounds of the defined study area, evaluated over the planning period of analysis include:

- Reduce the risk of physical damages to public utilities and transportation infrastructure resulting from coastal storm events, storm surge, and storm-induced waves.
- Reduce the risk of erosion and loss of public lands due to storm damages.
- Reduce the risk of environmental impacts resulting from a sewer main failure.
- Reduce the risk of potential transportation delays and other emergency costs to residences, businesses and government entities resulting from coastal storm damages.

### 4.5. Constraints

The study constraints include:

- The recommended plan will not adversely affect existing infrastructure and utilities in the project area.
- The recommended plan, at a minimum, must provide an equivalent level of storm protection or greater than what is currently provided for utilities and infrastructure.

## 5. EXISTING CONDITIONS

The project site is located on City of Seattle Parks and Recreation lands and provides recreation, including viewing and walking/biking paths, for local residents. The existing seawall was originally constructed by the City of Seattle in 1927 and runs parallel to Beach Drive Southwest. The seawall provides storm damage protection for public utility and transportation infrastructure located immediately behind the seawall. Further, the seawall prevents loss of public lands associated with the erosive storm and tidal forces in Puget Sound. The crest of the existing seawall is 20.3 feet above mean lower low water (MLLW)[1]. The vertical wall is comprised of 7 inch thick by 5 foot 8 inch high by 4 foot 8 inch wide[2] precast concrete slabs imbedded vertically in a concrete footing that is embedded to 5.7 feet above MLLW[3]. The precast concrete slabs are held in place by vertical steel trolley rails. Horizontal tiebacks (concrete deadman and wire rope anchoring) were installed to the top waler in order to provide lateral support to the structure, but these connections have completely eroded.



[1] Emma Schmitz Memorial Overlook. City of Seattle Department of Parks and Recreation. General Map. March 1987
[2] Emma Schmitz Seawall Feasibility Study. PND Engineers. 2008.
[3] Beach Drive Concrete Sea Wall. City of Seattle Department of Streets & Sewers. 1922

Beach Drive Southwest is a main arterial that connects the west side of West Seattle to Alki Point with average daily traffic of over 5,000 vehicles. A 54 inch sewer main that services 20,000 residents and commercial businesses in the area with a capacity of up to 8 million gallons a day runs parallel to the shoreline and Beach Drive, adjacent to the existing seawall structure. The sewer main is owned and maintained by King County and is buried beneath the surface at a depth of approximately 10 feet below the roadway surface and as close as 2 feet landward from the face of the existing seawall. In addition to the sewer and roadway, there is a Puget Sound Energy gas line and a Seattle Public Utilities water line located beneath the centerline of Beach Drive Southwest. It is expected that as a result of major storm events, all utilities and infrastructure in the project area are at immediate risk of damages and loss.

In 1998, a segment of seawall to the north of the proposed federal project failed, prompting emergency actions by the City to stabilize the structure and bank; refer to Figure 4 below. This failure was stabilized by City crews with a repair consisting of a major riprap structure placed seaward of the failed seawall. The riprap extends over 50 feet into the nearshore area and provides adequate protection for infrastructure and lands from storm and tidal forces. The sewer main along this stretch of shoreline begins to move landward away from the beach; whereas, the sewer main is located much closer to the shoreline in the proposed federal project area and is considered to be at a higher risk of impacts.

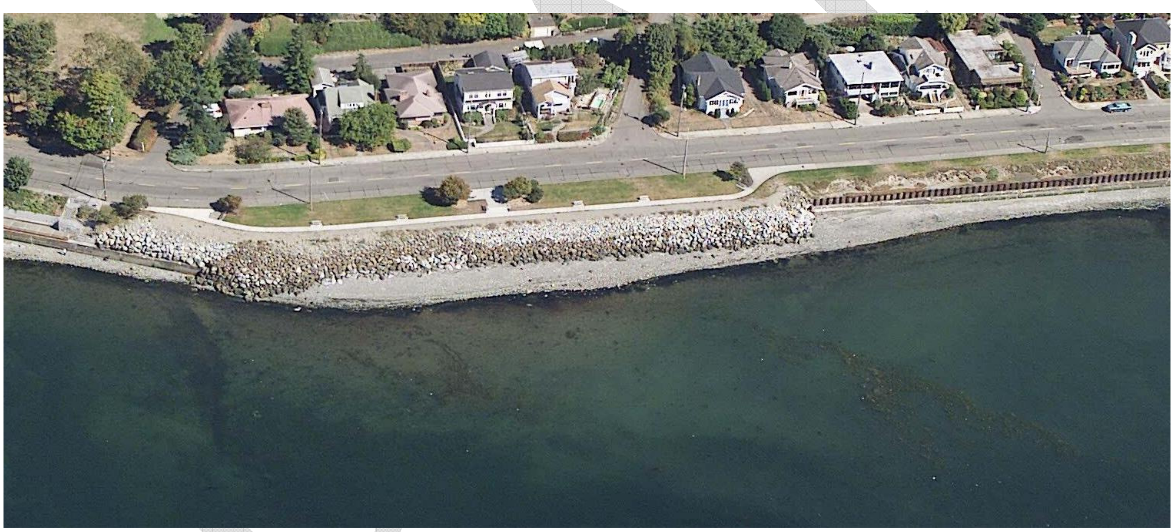

Figure 4. Extent of 1998 seawall failure.

Additionally, there are potentially significant environmental impacts associated with a failure of the sewer main. Puget Sound is home to a diverse ecosystem that includes several Endangered Species Act-listed species, such as bull trout, steelhead and chinook salmon, and marbled murrelet. Sewer main failure could result in significant amounts of raw sewage discharging into Puget Sound. The nearshore area at the project location is generally wider than most nearshore areas in the general vicinity and is comprised of both sands and gravels. The study area does not include forage fish spawning[4], but does include patchy eel grass. The eelgrass beds and nearby kelp beds provide important food and shelter for numerous species which would be negatively impacted by failure of the sewer main. Furthermore a failure of the seawall and subsequent failure of the sewer main would likely result in emergency repairs that would have a larger footprint (such as a riprap revetment), resulting in a greater loss of beach habitat and future disturbance through repeated repairs.

### 5.1. Reliability Analysis

The integrity of the steel rail beam sections is the focus of the reliability analysis as this is the critical part of the structure which would result in the greatest consequences. Figure 5 shows the fault tree developed for the seawall. As annual wave loading exceeds the earth pressures behind the wall the highest probability of failure is during a coastal storm event. This is consistent with observations during the failure of the northern section of seawall in 1998.

The steel beam sections supporting the concrete face panels have been exposed to persistent corrosion since original construction in 1927. Over time this has reduced the cross-sectional area of the beam and thus translates to larger stresses applied in the beam. Based on lateral loading conditions (earth or wave pressures acting on the wall), the steel beam yield stress[5], and the corrosion rate of the steel there exists a critical threshold at which the loading will exceed the allowable stress in the rail section and results in failure of the beam and wall. Assumptions of these parameters were specified and then randomly varied using a Monte Carlo simulation to develop reliability curves for the seawall. The Monte Carlo analysis is performed as described in EC 1110-2-6062 (USACE 2011a). The parameters specified in the analysis are as follows:

- Steel rail beam yield stress = 28 ksi
- Steel rail beam section modulus (assume ASCE 6040) = 18.69 $in^3$/ft
- Corrosion rate (thickness/year) = 0.09 mm/yr
- 1-year wave event moment at seawall footing = 6.8 kip-ft/ft (i.e. 100% chance of occurring within one year)

The results indicate that the structure is 50-percent reliable in 2023 for a 1-year event (or conversely has a 50-percent chance of failure by 2023. Refer to Figure 6 below.



[4] http://corpsmap.nws.usace.army.mil
[5] Yield stress: Stress at which the material will deform permanently

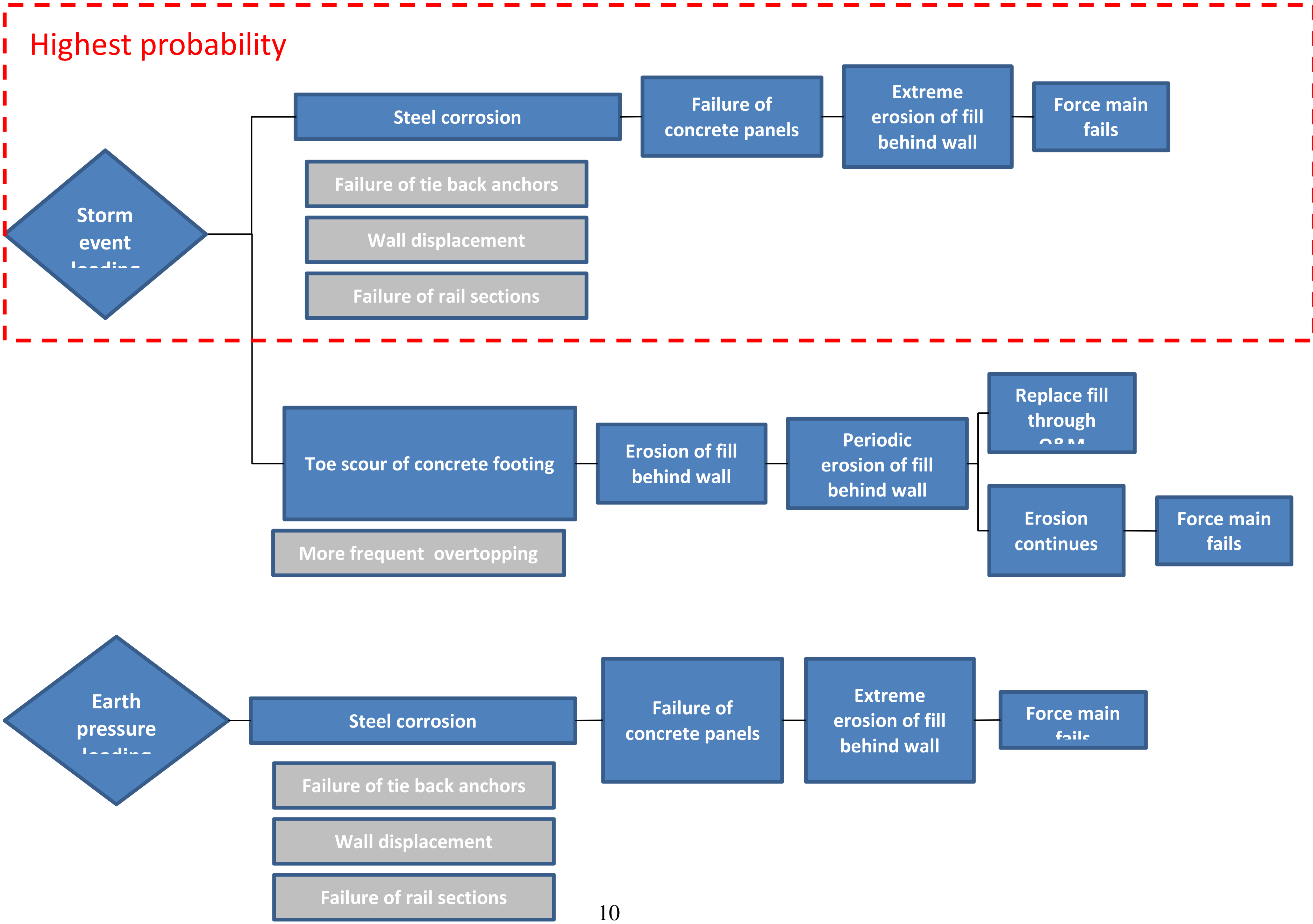
Highest probability
Storm event loading
Steel corrosion
Failure of concrete panels
Extreme erosion of fill behind wall
Force main fails
Failure of tie back anchors
Wall displacement
Failure of rail sections
Toe scour of concrete footing
Erosion of fill behind wall
Periodic erosion of fill behind wall
Replace fill through O&M
Erosion continues
Force main fails
More frequent overtopping
Earth pressure loading
Steel corrosion
Failure of concrete panels
Extreme erosion of fill behind wall
Force main fails
Failure of tie back anchors
Wall displacement
Failure of rail sections

Figure 5. Fault Tree for Existing Structure.

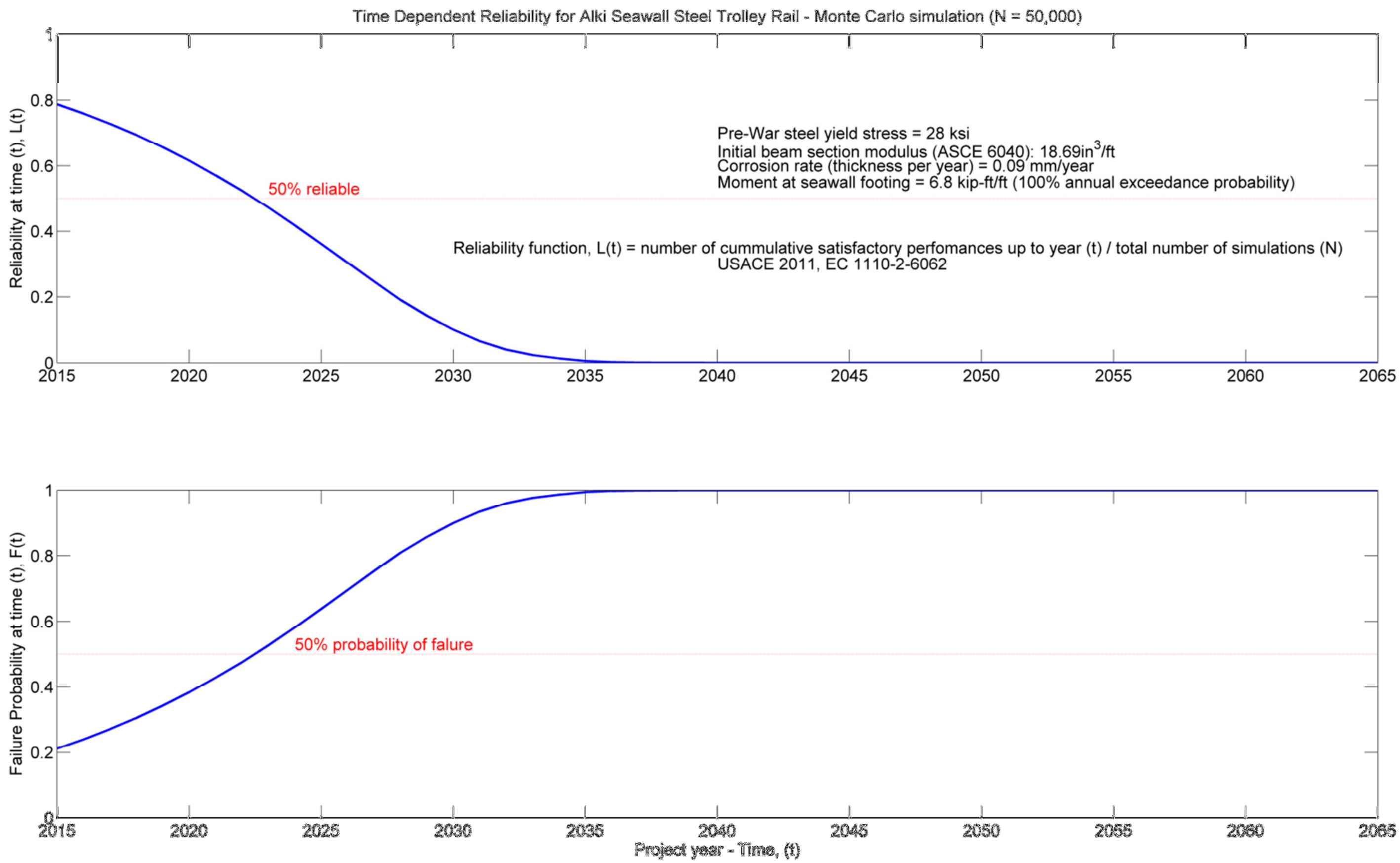


Figure 6. Computed Seawall Reliability and Failure Curves for the Annual Wave Loading Event

## 5.2. Coastal Engineering

The project is located in central Puget Sound which is exposed to tidal and wind generated waves. Tides in Puget Sound are mixed semidiurnal in type, indicating two daily high and low tides unequal in magnitude. The mean tidal range is 7.7 feet. The longest fetch length and strongest winds occur from the southerly directions. Winds oriented from the south produce the largest storm waves.

The seawall is fronted by a mildly sloping foreshore beach which results in depth limited conditions at the seawall. This means wave height is strictly dependent on the water depth, thus the time varying water level is a significant parameter controlling the hydraulic forcing on the seawall. Water levels during storm events are affected by tide, atmospheric pressure, and wave setup. The latter two are typically collectively termed storm surge and may result in increases in water level 2 to 3 feet above the predicted tide for durations up to 72 hours. The 2% annual exceedance probability water level computed at the Seattle, Washington water level station is 14.5 feet above MLLW. This water level coincident with an extreme wind event is capable of producing a wave height of 7.1 feet offshore of the seawall and resultant wave forces exceeding 3.2 kip/foot. Given the condition of the existing seawall components, horizontal loading of this magnitude produces a high risk for catastrophic failure. Such an event would also result in significant wave overtopping of the seawall and result in further erosion of sediments behind the wall, which currently provides some lateral and overturning resistance to wave forcing. Continued loss of this material will continue to increase the fragility of the structure. Finally, progressive wave scour in front of the wall may expose the toe of the existing concrete footing. The failure in 1998 of the northern section of the seawall can be considered a strong predictor of what could occur to the southern 475 feet of seawall should no action occur. The northern section of seawall likely failed first as this section bends approximately 25 feet seaward from the southern seawall section. It is speculated near this bend point wave overtopping and erosion of sediments behind the wall was exacerbated. This may be due to increased wave heights acting on the seawall – either from wave focusing on this bend point and/or larger wave heights associated with deeper water depths in front of the wall.

Given the strong dependence of water level on hydraulic forcing, this project is relatively sensitive to changes in mean sea level. Thus sea level rise presents a significant risk to the future without project condition.

Refer to Appendix B for detailed coastal engineering analysis.

## 5.3. Geotechnical Engineering

In the feasibility phase, geotechnical investigation resources were limited to a survey of existing data. Therefore, several assumptions were made in the determination of foundation materials at the seawall location. It was considered reasonable to assume that the site conditions at the project site are similar to the geology of other nearby locations, which may have been investigated to some extent, that are within close proximity and possess similar geographic characteristics.

The project area is within the central part of the Puget Lowland. Geological history for the area was detailed as part of a 1988 Corps project at Lincoln Park ("Section 103 Lincoln Park Report" Pg. D-4) which is approximately 2.5 miles to the south along the coastline. The underlying geology is described as unconsolidated Pleistocene deposits covering a large part of the land surface within the lowland. The Vashon drift, deposited by the last glacial advance, includes carved silt and clay, extensive till, and associated outwash consisting of sand, gravel, and clay. The Vashon till is a compact, concrete like mixture of silt, sand, gravel, and clay as much as 150 feet thick but generally less than 50 feet thick. The till mantles most of the elongate hills which characterize the basin. Sea cliff development along the periphery of Puget Sound frequently exposes glacial deposits of various types, precipitating landslides in many areas.

The mariner nearshore area is generally composed of marine deposits.

In 2003, Corps staff performed some preliminary boring investigations along the seawall alignment and visually identified the encountered materials to a depth of 40 to 50 feet. This information, combined with historical geotechnical data obtained by others and within close proximity to the study area alignment was compiled and used to estimate the foundation conditions. Based on this data, it is assumed that the wall is founded on predominantly stiff clayey silt with some interbedded sand layers. Boring data from all information sources support this assumption and include material descriptions to a maximum depth of 50 feet below ground surface. The material description included in the obtained boring data is also consistent with the characteristics of the Vashon drift deposits described earlier.

Refer to Appendix C for additional geotechnical information and boring logs.

### 5.4. Hazardous, Toxic, and Radiological Waste (HTRW)

A limited Phase I database search for hazardous, toxic, and radiological waste (HTRW) was conducted during the feasibility phase to identify any known pollutants or contaminants. Source data from the U.S. Environmental Protection Agency and the WDOE were searched and records do not indicate potential HTRW concerns in the project area. Additional analysis and research will be conducted as the design phase progresses, as required.

Refer to Appendix D for additional information, sources, and findings.

### 5.5. Future Without Project Conditions

The City of Seattle has observed storm impacts and erosion in the project area, most notably in 1998, as well as continual degradation of the existing structure over time, despite routine annual maintenance. Since 1998, the City has continued to replace voids in and around the existing seawall on at least seven occasions, including three times since 2011. The work typically includes filling voids behind and below the existing structure that have formed due to erosion resulting from storm events.

The existing structure has far exceeded its expected design life and routine operations and maintenance (O&M) such as filling eroded sediments behind the wall will not be able to keep pace with continued corrosion of primary structural components. Based on coastal engineering analyses and estimates of future sea level change scenarios[6], the future without project condition scenario finds that coastal storm frequency and intensity increases throughout the period of analysis and subsequently results in a 50 percent probability of failure of the existing seawall in approximately 10 years with subsequent damage or loss of existing utilities and infrastructure.

# 6. ALTERNATIVES ANALYSIS

## 6.1. Preliminary Alternatives

The City and the Corps developed and screened multiple alternatives, including the No Action alternative, as required under the National Environmental Protection Act (NEPA), as well as both structural and non-structural solutions to prevent future coastal storm damages and erosion. Additionally as per EC 1165-2-212 each alternative must consider the effect of future sea level change. Alternatives developed and screened by the Project Delivery Team (PDT) as potential solutions to coastal storm damages and future erosion are provided below followed by a brief description of each:

**Alternative 1. No Action:** The No Action alternative assumes that the Corps does not participate in developing solutions to reduce future storm damages. The existing seawall would remain and the infrastructure behind the seawall would continue to be vulnerable to coastal storm damage. The results of the No Action alternative reflect the future without project conditions of the project area if no action was taken by the Corps.

**Alternative 2. Non-Structural Cobble Revetment:** This alternative includes the placement of small cobbles in front of the existing infrastructure extending toward the water to create a sloped cobble beach (dynamic revetment) to absorb wave energy. Due to wave action this alternative would experience material transport and therefore would require periodic cobble replenishment in order to maintain the desired level of protection from coastal storms. This alternative has the largest waterward footprint, due to the need to fill from the beach to the top of the existing wall and create a gentle waterward slope of rounded rock. A conservative estimate using a 2 horizontal to 1 vertical slope would result in a footprint approximately 40 feet waterward of the existing structure.

**Alternative 3. Sheet Pile Wall:** This alternative consists of a new sheet pile retaining wall placed either immediately in front of or immediately behind the existing seawall. The new sheet piles would be driven to appropriate depths to provide protection from coastal storms. The sheet pile wall would tie into the ground using tiebacks, soil anchors, or other forms of support to stabilize the new seawall. The existing seawall could remain in place or be removed depending on the alignment of the final alternative.

**Alternative 4. Soldier Pile Wall:** This alternative consists of a soldier pile wall with concrete lagging spanning the length of the project using concrete-encased steel beams to support soldier piles spaced at several foot intervals. Small concrete lagging panels would be installed in front

[6] USACE 2011b. Sea Level Change Considerations for Civil Works Programs. EC 1165-2-212

of the soldier piles and would be designed to withstand coastal storm events. Tiebacks may be added to provide additional lateral support as needed based on the final height of the structure.

**Alternative 5. Beach Armor / Beach Fill:** This alternative consists of placing large beach armor / beach fill in front of the existing structure to provide protection from storm damages and erosion. Large armor rock would be placed from the face of the existing structure towards the water and would be sloped appropriately. This alternative is similar to the emergency repair action taken immediately to the north of the project area by the City in 1998.

**Alternative 6. Retaining Wall:** This alternative includes installing a concrete retaining wall reinforced with steel rebar designed to hold back soil behind the wall and withstand storm damages. The retaining wall would be supported by a large concrete footing to prevent wave overtopping of the structure.

### 6.2. Screening Criteria for Alternatives

Under Section 103, the Program Management Plan for the Continuing Authorities Program (CAP) developed by the Corps of Engineers' Northwestern Division provides for a formulation and evaluation of potential solutions based on the least-cost alternative. Additionally, "the least cost alternative plan is considered to be justified if the total costs of the tentatively selected plan are less than the costs to relocate the threatened facilities."[7] To reduce the number of alternatives being considered, alternatives previously discussed in this section were evaluated qualitatively by the PDT based on the following considerations:

1. Effectiveness: Evaluation of the magnitude of the benefits in addressing the specified coastal storm damage problem and opportunities.
2. Efficiency: Evaluation of the cost-effectiveness in addressing coastal storm damage problems and opportunities.
    - Real estate acquisition: Assesses the amount of real estate acquisition required for the alternative.
    - Construction costs: Assesses the assumed total project costs of the alternative based on the footprint, professional judgment, etc.
3. Completeness: The plan must provide and account for all necessary investments needed to ensure the realization of the planned benefits; environmental risks, real estate acquisition, O&M costs, and sponsorship should be considered.
4. Acceptability: Evaluation of whether the recommended plan is acceptable to the non-federal cost-sharing partner, to state and federal resource agencies, local governments, and the general public.
5. Risk-Based Analysis: Evaluation of potential risks associated with implementation of coastal storm damage management alternatives.
    - Environmental risk / potential impacts, including intrusion and effects on habitat: Assesses the temporary and permanent environmental impacts related to implementation of the plan.

[7] Northwestern Division, USACE. Program Management Plan for the Continuing Authorities Program. October, 2012.

- Required amount of fill material and rock: Assesses the environmental acceptability of the amount of fill material placed in the marine nearshore environment to reduce potential impacts to habitat.
- Constructability / duration: Assesses constructability based on known existing conditions and the estimated construction period.

### 6.3. Results of Alternatives Screening

Qualitatively, the PDT and City of Seattle screened alternatives based on the above criteria. A rating scale of (-2) to (2) was used to score each alternative. An overall risk-based category was included to further screen alternatives based on assumed risk. The lowest risk, acceptable alternatives would be the ones carried forward for further evaluation and consideration in the study. In this evaluation, the No Action alternative is assumed to be the future without project condition. In the case of future without project conditions, it is expected that during the period of analysis the existing seawall structure would likely fail as a result of continued degradation related to storm events, storm surges, and storm-induced erosion and due to corrosion of the existing steel supports. A failure would prompt emergency actions to stabilize the bank and prevent damages to utilities, roadways, and erosion of public lands. This assumption is validated by the failure that occurred in 1998 as a result of a series of three small coastal storm events (3-5 year return period).

The No Action alternative was scored based on existing information and assumptions made in respect to the likelihood of storm events, storm surges, and storm-induced erosion. Each of the remaining alternatives was then scored based on comparison to the No Action alternative. In the case of a negative score, it was assumed that the condition would worsen based on the existing and future conditions (No Action alternative) and a positive score was indicative of an improvement over the existing and future conditions. The results of the screening process are provided in Appendix F and summarized below in Table 1.

The No Action alternative scored poorly in every evaluation criteria category due to the high risk for future storm damages. It was assumed that annual O&M would increase as the site continued to degrade and an eventual failure of the existing structure would prompt emergency actions and repairs to prevent further damage. The high risk for future damages and failure also presented an assumed high risk for potential environmental impacts related to a sewer main failure which could cause sewage to flow freely into Puget Sound until the system is capped or plugged.

The remaining alternatives were considered to be both complete and effective but varied in acceptability and efficiency. The non-structural revetment (Alternative 2) was rated slightly lower than the structural alternatives in the effectiveness category due to potential cobble erosion as a result of coastal storm events and surges. Additionally, routine renourishment would increase O&M requirements and extend the overall project duration resulting in increased costs and a commitment to continual replenishment. The non-structural alternative was assumed to

Table 1. Alternative Screening Scores

| Alternative | Final Score | Risk Level | Objectives | | | | |
|---|---|---|---|---|---|---|---|
| | | | da ma ges | lic lan ds | ntal imp acts | on del ays | con stra ints |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Alternative 1. No Action | -15 | High | -- | -- | -- | -- | - |
| Alternative 2. Non-Structural Cobble Revetment | 2 | High | + | + | + | + | - |
| Alternative 3. Sheet Pile Retaining Wall | 11 | High | + | + | + | + | + |
| Alternative 4. Soldier Pile Wall | 11 | Low | ++ | ++ | ++ | ++ | + |
| Alternative 5. Beach Armor / Beach Fill | 5 | High | + | + | + | + | - |
| Alternative 6. Retaining Wall | 11 | Low | ++ | ++ | ++ | ++ | + |

have the largest footprint in order to create a more natural slope resulting in a large amount of nearshore area impacted as a result of the project and likely requiring significant mitigation, thereby raising total project costs. A conservative estimate using a 2 horizontal to 1 vertical slope would result in a footprint approximately 40 feet waterward of the existing structure. The non-structural alternative was, therefore, viewed as a high risk project versus other alternatives.

The structural alternatives rated similarly, with the exception of the beach armor alternative (Alternative 5). This alternative rated negatively in acceptability to the sponsor and Resource Agencies, who, in an April 2013 site visit, stressed the importance of reducing fill into the nearshore area and indicated that any project similar to the 1998 emergency repair (riprap placement) would not be acceptable. Beach armor could result in a footprint increase of nearly 40 feet waterward and could require almost 7,000 cubic yards of material. This alternative would likely require significant mitigation and is known to be unacceptable to Resource Agencies, and therefore, presents a high risk for moving forward.

The remaining structural alternatives, 3, 4, and 6, were all rated evenly in the screening process. These alternatives scored well in minimizing the overall footprint, thereby reducing environmental impacts. Additionally, because of the design of the project, annual O&M requirements were assumed to be minimal as routine renourishment would not be required. The sheet pile wall alternative, however, was viewed as a high risk because of the construction technique. Sheet piles would be driven in close proximity to the existing sewer main and the vibration could result in settlement or liquefaction of the soils potentially impacting the sewer. Lateral support would also be required for the sheet pile alternative resulting in additional excavation and placement of tiebacks or soil anchors, adding to complexity and risk. This alternative, though receiving the same score as others, was deemed too high risk and had a lower construability score and was not carried forward for further evaluation due to potential impacts to the sewer during construction.

The proximity of the sewer main to the existing structure presents a high risk for damages and impacts during construction. As a result, the footprint for all alternatives was proposed immediately in front of the existing structure to reduce risks. Based on preliminary discussions with Resource Agencies (refer to Section 13.9), all proposed solutions are expected to require mitigation as a result of this intrusion into the nearshore area. Alternatives 4 and 6 were viewed as the lowest risk alternatives because of the relatively low environmental impact associated with their footprint compared to other alternatives and reduced fill quantities needed during construction. Since several of the alternatives require approximately the same footprint and because more impactful alternatives were screened out, the recommended alternative is not expected to change as a result of mitigation requirements.

Additionally, Alternatives 4 and 6 are less complex in design and construction methodology and, therefore, will utilize standard construction techniques. As a result, these alternatives were considered the most complete, effective, efficient, and acceptable alternatives to carry forward for further evaluation. A summary of the final scores are provided in the table below.

### 6.4. Summary of Screening Results

**Alternative 1. No Action:** This alternative received a negative score as it did not meet the planning objectives and is unacceptable to the project sponsor. This alternative does not adequately address the risk of damages to utility and roadway infrastructure and potential erosion of public land.

The No Action alternative scored poorly in every evaluation criteria category due to the high risk of future storm damages. Given the strong dependence of water level on hydraulic forcing, this project is relatively sensitive to changes in mean sea level. Thus potential future sea level rise presents a significant risk to the no action alternative. It was assumed that annual O&M costs would increase as the site continued to degrade and an eventual failure of the existing structure would prompt emergency repairs to prevent further damage. The high risk for future damages and failure also presented an assumed high risk for potential environmental impacts related to a sewer main failure leading to a large-volume sewage release into Puget Sound. This alternative does not meet the project goal.

This alternative was <u>not carried forward</u> as a viable solution; however, NEPA requires that the no action alternative be evaluated in the environmental impact analysis of the project. The remaining alternatives were considered to be both complete and effective but varied in acceptability and efficiency.

**Alternative 2. Non-Structural Cobble Revetment:** This alternative received a positive score and meets several of the planning objectives.

The non-structural revetment was rated slightly lower than the structural alternatives in the effectiveness category due to potential cobble erosion from coastal storm events and surges. Additionally, routine renourishment would increase O&M requirements. This would extend the overall project duration resulting in increased costs and would require a long-term commitment to continual replenishment. The non-structural alternative was assumed to have the largest footprint requiring the placement of a large amount of fill into the nearshore environment. Due to the presence of eelgrass beds and other important aquatic habitat in this area, placement of this fill could have a large impact on aquatic habitat function and continued replenishment would require future periodic disturbance of the area. The non-structural alternative was, therefore, viewed as a high risk project versus other alternatives.

Because of the continual O&M expected with periodic beach nourishment and the significantly increased project footprint this alternative, this alternative was not acceptable to the City of Seattle and is therefore not carried forward.

**Alternative 3. Sheet Pile Wall:** This alternative received the highest score and meets several of the planning objectives. Alternatives 3, 4, and 6, were all rated evenly in the screening process. These alternatives scored well in minimizing the overall footprint, thereby reducing environmental impacts. Additionally, because of the design of the project, annual O&M requirements were assumed to be minimal. The sheet pile wall alternative, however, was viewed as a high risk because of the construction technique. Sheet piles would be driven in close proximity to the existing sewer main and the vibration could result in settlement or liquefaction of the soils, potentially damaging the sewer. Additionally, the noise associated with driving sheetpiles would be a concern for nearby homeowners and fish and wildlife. Lateral support would also be required for the sheet pile alternative resulting in additional excavation and placement of tiebacks or soil anchors, adding to complexity and risk for damage to the sewer during construction. This alternative, though receiving the same score as others, had a lower constructability score and a higher risk to the sewer and therefore was not carried forward for further evaluation.

**Alternative 4. Soldier Pile Wall:** Alternatives 4 and 6 were viewed as the lowest risk alternatives because of the relatively low environmental impact associated with their smaller footprint compared to other alternatives and the reduced fill quantities needed during construction. Additionally, Alternatives 4 and 6 are less complex in design and construction methodology and will utilize standard construction techniques. As a result, these alternatives were considered the most complete, effective, efficient, and acceptable alternatives and were carried forward for further consideration.

**Alternative 5. Beach Armor / Beach Fill:** This alternative received an overall positive score and meets some of the planning objectives. Alternative 5 rated negatively in acceptability to the sponsor and Resource Agencies, who, in an April 2013 site visit, stressed the importance of reducing fill into the nearshore area and indicated that any project similar to the 1998 emergency repair (riprap placement) would not be acceptable. Beach armor could result in a footprint increase of nearly 40 feet waterward (for a total loss of 0.4 acres of beach) and would require almost 7,000 cubic yards of material. This alternative would likely require significant mitigation and is known to be unacceptable to Resource Agencies, and therefore was not carried forward for further evaluation.

**Alternative 6. Retaining Wall:** As stated above, alternatives 4 and 6 were viewed as the lowest risk alternatives because of the relatively low environmental impact associated with their smaller footprint compared to other alternatives and the reduced fill quantities needed during construction. Additionally, Alternatives 4 and 6 are less complex in design and construction methodology and will utilize standard construction techniques. As a result, these alternatives were considered the most complete, effective, efficient, and acceptable alternatives and were carried forward for further consideration.

### 6.5. Final Array of Alternatives

A summary of the plans to be carried forward for further consideration is below in Table 2:

Table 2. Alternative Results

| Alternative | Results |
|---|---|
| Alternative 1. No Action | Not Carried Forward |
| Alternative 2. Non-Structural Cobble Revetment | Not Carried Forward |
| Alternative 3. Sheet Pile Retaining Wall | Not Carried Forward |
| Alternative 4. Soldier Pile Wall | Carried Forward |
| Alternative 5. Beach Armor / Beach Fill | Not Carried Forward |
| Alternative 6. Retaining Wall | Carried Forward |

Based on screening jointly conducted by the City and Corps PDT, Alternatives 4 and 6 were recommended to be carried forward for further consideration in the study. These alternatives were screened further based on constructability and environmental analysis to identify the preferred alternative. The location of King County's sewer main was expected to have major influence over the constructability of any alternative based on its proximity to the seawall and potential alignments of a new structure. The sewer main runs parallel to the shoreline throughout the project area and City records indicate that the western most edge of the sewer main is at its closest location approximately 2 to 5 feet away from the back face of the existing seawall.

Alterative 6, a retaining wall, would require a significant footing to prevent overtopping of the structure and the footing could extend at least 5 ½ feet landward from the back of the retaining wall face. The deep footing would require removal of the existing structure and footing and would require temporary shoring of the sewer to prevent damages during construction. Alternatively, to construct in front of the existing structure, a retaining wall would require additional intrusion waterward to allow space for the footing to be placed. Due to the potential risks associated with the requirement to protect the sewer during construction, additional complexity in removing the existing structure, and potential increased intrusion of the structure's footprint into Puget Sound, Alternative 6 was eliminated from further consideration.

Alternative 4, a soldier pile wall is generally easier to construct. Further, it would be less intrusive into the Puget Sound nearshore than Alternative 6 if constructed immediately in front of the existing seawall. With the new seawall constructed immediately in front of the existing structure, the old seawall could be left in place and buried. Alternative 4 is tentatively selected as the recommended alternative.

# 7. RECOMMENDED PLAN

The National Economic Development (NED) plan and the recommended plan are both Alternative 4. The recommended plan is the NED plan because it provides the greatest net benefits.

The recommended plan consists of a new soldier pile wall with precast concrete lagging constructed immediately in front of the existing seawall structure to a height of 22 feet MLLW, to account for storm wave heights and future sea-level rise. Columns, 24 inches in diameter, will be drilled to a depth of 18 feet and spaced 6 feet apart. Precast concrete face panels will then be placed vertically between columns to create the wall panels. The columns will include corrosion protection due to the potential impacts of the tidal cycle and salt water.

The new seawall will run the total length of the project area. Additional length is being considered to mitigate for environmental impacts (see Section 13.9). The total length of replacement plus mitigation is approximately 500 feet. The new seawall will tie into the riprap placed by the City in 1998 on the north end and an existing private seawall on the south end. The existing seawall will be left in place and buried with backfill material to provide a stable and safe slope up to the existing sidewalk grade.

Refer to Appendix G for the preliminary site plan and typical cross-sections.

## 7.1. Economic Analysis

### 7.1.1. Economic Profile of Study Area

The major population surrounding the project location, assumed to be the majority user of the study area, is the population of West Seattle. As such, most of the socioeconomic data is developed using demographic information for the residents of the Seattle, King County Metropolis. The resident population of King County is approximately 1.93 million with 1.5 million of those being 18 and over (Bureau 2013). The total number of businesses in King County is approximately 63,000 with the highest percent of industries being in scientific and technical services (15.3%), following by health care (10.9%), retail trade (10.5%), and accommodation and food services (9%). The median income from 2007 through 2011 is approximately $70,600 with an estimated 2.4 persons per household. The unemployment rate in December of 2012 was approximately 6.1%, this down by 1% from a year earlier (Washington 2013).

### 7.1.2. Tentatively Selected Plan Benefits

Economic benefits of the tentatively selected plan were based on the probability of damage to and failure of the existing seawall and the subsequent damages to associated facilities at the project site. Damages were separated into physical and non-physical categories.

Physical categories include structural damages to buildings, streets, highways, railways, sewers, bridges, utility lines, bulkheads, seawalls, boardwalks, and other infrastructure (IWR 1991).

Non-physical damages include categories such as income loss, emergency costs, temporary evacuation, temporary relocation, and transportation delays. Although many of these damages are expected to occur with the loss of the existing seawall, they were not all expected to be sufficient enough to warrant a full investigation, thus not all categories were taken as a benefit category in the investigation but may be qualified in the Economic Appendix.

If the aforementioned physical and non-physical damages could be prevented, reduced, or otherwise avoided in the with-project versus the with-out project condition then they can be taken as a benefit of implementing the project.

#### 7.1.3. Damages Prevented

The economic analysis was based on quantifying the physical damages to public infrastructure and non-physical damages, mostly transportation delays, which could occur as a result of coastal storm events and erosion within the project area that would cause a failure. For purposes of the analysis, the project year one, the first year a project could be in operation, was assumed to be 2015. The economic analysis is based on an economic project life of 50 years and with an interest rate of 3.75%. The existing seawall, in its current degraded state, provides a reduced level of protection to the public infrastructure than originally intended. The difference between damages in the with-project versus the with-out project condition was taken as benefits as these are considered to be damage reductions that are directly attributed to the project.

There are multiple single family residences that sit directly behind the seawall that would be affected by a failure of the existing seawall. In addition, if the seawall were to fail we can expect to have to replace the road, sewer, and lands that are adjacent to the project. Along with these physical damages we expect to see costs associated with transportation delays, emergency response, and emergency spill response and cleanup. Table 3 below provides a summary of the potential damage and the corresponding replacement cost to public infrastructure that could occur. Refer to Appendix E for details on the full economic analysis.

Table 3. Economic Analysis

| Reduction in Physical Damages (1,000's) | | |
|---|---|---|
| Damage Category | Net Present Value | Percent of Total |
| Roadway and Sewer | $1,686 | 51% |
| Lost Lands (Boardwalk & Park) | $50 | 1.5% |
| Reduction in Non-Physical Damages (1,000's) | | |
| Transportation Delays | $925 | 28% |
| Emergency Stabilization | $540 | 16% |
| Sewage Spill Response | $120 | 3.6% |
| Operations and Maintenance | $5 | 0.1% |
| TOTAL | $3,326 | 100% |

Without implementation of the project, the expected annual damages (EAD) quantified is expected to be approximately $298,000. With implementation, the expected EAD is approximately $56,000. Therefore the approximate EAD of at least $242,000 are considered as preventable with the project. Table 4**Error! Reference source not found.** shows the with- and with-out EAD and the resulting expected annual damages reduced (benefits) based on the sample of infrastructure and damages. Damages beyond the 50-year recurrence interval were not estimated during the planning phase.

Table 4. Annual Project Benefits

| Estimated Annual Project Benefits | |
|---|---|
| Without-Project EAD | $298,000 |
| With-Project EAD | $56,000 |
| EAD Reduced (Annual Benefits) | $242,000 |

The total estimated project cost is approximately $1.77 million (Table 5. Annualized Cost and Benefit-Cost Ratio) and the total economic cost used to derive the benefit to cost ratio is approximately $1.8 million. The economic cost includes interest during construction, operation and maintenance, and the value of the LERRD. The estimate of these costs are annualized at the FY14 discount rate of 3 ½ percent over the 50-year period of analysis at the October 2013 price level. The total project costs, annualized costs, and resulting benefit to cost ratio is displayed in Table 5 below.

Table 5. Annualized Cost and Benefit-Cost Ratio

| Annualized Cost and Benefit-Cost Ratio | |
|---|---|
| Total Project Costs | $1,770,000 |
| Interest During Construction | $14,000 |
| LERRD | $50,000 |
| Total Investment Cost | $1,835,000 |
| *Annual Cost* | |
| Project and Interest (50 yrs @ 3.5%) | $78,000 |
| Operation and Maintenance | $2,000 |
| Total Annual Cost | $80,000 |
| Total Annual Benefit (EAD Reduced) | $242,000 |
| **Benefit-Cost Ratio** | **3 to 1** |

### 7.1. Operations, Maintenance, Repair, Rehabilitation, and Replacement

Expected Operations, Maintenance, Repair, Rehabilitation, and Replacement (OMRR&R) costs are considered to be minimal and are a 100 percent non-federal sponsor requirement. Required action could include annual inspections and replacement of soil voids on the slope landward of the project. Annual OMRR&R costs are expected to include regular inspections of the structures and labor and materials for City of Seattle crews and are estimated to be $2,000 annually over the period of analysis. The City has demonstrated capability and willingness to operate and maintain the project after construction and will be provided an O&M manual.

### 7.2. Real Estate Considerations

A preliminary analysis of the real property interest was conducted by the Corps' Real Estate Division. The City of Seattle owns all in fee lands within the project area (0.5 acres), including the land in the immediate nearshore zone and the roadway right-of-way. City park lands or other City property is expected to be available for staging and temporary access and these sites will be identified during design. The preliminary work area analysis estimated an approximate value per square foot of park land based on the assessed tax value and that value was extrapolated to estimate the total land value for the project area. A conservative initial estimate places the City's LERRD at approximately $50,000. This value is reflected within the cost estimate developed for the planning phase. A more detailed evaluation will be completed during final design to include a real estate map, certification of real property interest, Government approved appraisal, and all rights-of-entries. Land acquisition will not be needed for this project.

### 7.3. Preliminary Cost Estimate

A planning level cost estimate for the proposed plan was developed by the Corps' Cost Engineering Section using Micro-Computer Aided Cost Estimating System (MCACES). The cost estimate is based on assumptions provided by the PDT based on known conditions and will be updated as design and analyses progress. A contingency of 20% was applied during the planning process to account for risk and uncertainty with the current design and known conditions. The requirement for mitigation has not been finalized because only a planning-level design has been completed to date. A couple of mitigation options were discussed with USFWS and WDFW and the higher cost option was incorporated into the planning cost estimate. This option was chosen to present a more conservative cost estimate for mitigation and accounts for potential impacts to the Puget Sound nearshore environment.

Refer to Appendix I for a summary overview of the cost estimate and inputs.

### 7.4. Monitoring

The City of Seattle will assume operation and maintenance of the project after construction and will conduct regular inspections to ensure continued operability and safety of the structure at 100 percent cost to them. An Operations and Maintenance (O&M) manual will be developed during the design phase that will outline the frequency of inspection and how to operate and maintain the structure. It is expected that minimal monitoring and maintenance will be required throughout most of the intended design life of the structure. Additionally, the project will likely be included in the Seattle District's Inspection of Completed Works program and may be routinely inspected by District staff to ensure the O&M requirements are being met and the structure is being maintained.

## 8. AFFECTED ENVIRONMENT

### 8.1. Physical Characteristics

The project site is located on City of Seattle Parks and Recreation lands in a park known as Emma Schmitz Memorial Overlook. Emma Schmitz Park is a linear park that is approximately 1,640 feet in length between Beach Drive and Puget Sound. The proposed project is located at the southern end of the park. The park is a grassy strip with a few trees at the top of the seawall with walking/biking paths and benches that provide recreational opportunities for local residents. The northern section of the park also has stairs which allow visitors access to the cobble beach that runs at the toe of the seawall throughout the area.

The existing seawall was originally constructed by the City of Seattle in 1927 and runs parallel to Beach Drive Southwest. The seawall provides storm damage protection for public utilities and transportation infrastructure located immediately behind the seawall. Further, the seawall prevents loss of public lands associated with the erosive storm and tidal forces in Puget Sound.

The crest of the existing seawall is 20.3 feet above MLLW (City of Seattle 1987). The vertical wall is comprised of 7 inch thick by 5 foot 8 inch high by 4 foot 8 inch wide (PND Engineers 2008) precast concrete slabs imbedded vertically in a concrete footing that is embedded to 5.7 feet above MLLW (City of Seattle 1922). The precast concrete slabs are held in place by vertical steel trolley rails. Horizontal tiebacks (a buried concrete structure called a "deadman" and wire rope anchoring) were installed to the top waler in order to provide lateral support to the structure, but these connections have completely eroded.

### 8.2. Soils

In the feasibility phase, geotechnical investigation resources were limited to a survey of existing data. Therefore, several assumptions were made in the determination of foundation materials at the seawall location. It was considered reasonable to assume that the site conditions at the project site are similar to the geology of other nearby locations, which may have been investigated to some extent, that are within close proximity and possess similar geographic characteristics.

The project area is within the central part of the Puget Lowland. Geological history for the area was detailed as part of a 1988 Corps project at Lincoln Park ("Section 103 Lincoln Park Report" Pg. D-4) which is approximately 2.5 miles to the south along the coastline. The underlying geology is described as unconsolidated Pleistocene deposits covering a large part of the land surface within the lowland. The Vashon drift, deposited by the last glacial advance, includes carved silt and clay, extensive till, and associated outwash consisting of sand, gravel, and clay. The Vashon till is a compact, concrete like mixture of silt, sand, gravel, and clay as much as 150 feet thick but generally less than 50 feet thick. The till mantles most of the elongate hills which characterize the basin. Sea cliff development along the periphery of Puget Sound frequently exposes glacial deposits of various types, precipitating landslides in many areas. The mariner nearshore area is generally composed of marine deposits.

In 2003, Corps staff performed preliminary boring investigations in the vicinity of the project and visually identified the encountered materials to a depth of 40 to 50 feet. This information, combined with historical geotechnical data obtained by others and within close proximity to the study area alignment was compiled and used to estimate the foundation conditions. Based on this data, it is assumed that the wall is founded on predominantly stiff clayey silt with some interbedded sand layers. Boring data from all information sources support this assumption and include material descriptions to a maximum depth of 50 feet below ground surface. The material description included in the obtained boring data is also consistent with the characteristics of the Vashon drift deposits described earlier. Refer to Appendix C for additional geotechnical information and boring logs.

### 8.3. Water Quality

The Puget Sound Basin contains surface- and ground-water resources of significant economic and ecological significance (USGS 1994). These provide water for a large population, recreational opportunities for residents and visitors, and an ecosystem that supports an economically important fishery. Water quality issues identified for surface waters in the Puget Sound Basin include: the degradation of aquatic habitat through destruction of riparian habitat, sediment deposition and channel scour; bacterial contamination and nutrient enrichment from sewage treatment plant discharges, failed septic systems, and agricultural runoff; and contamination by point discharges and storm runoff of metals, pesticides, and petroleum products (USGS 1994).

Index scores of marine water condition have generally declined over the past ten years, indicating an overall decrease in water quality (Puget Sound Partnership 2012). The largest driver of the decline has been the increase in nitrate levels caused by human inputs to the system. Increased nitrate levels can fuel algal blooms, leading to low dissolved oxygen.

### 8.4. Submerged Aquatic Vegetation

Eelgrass (*Zostera marina*) beds are patchy throughout the project area and running along the shoreline from Alki Point to the north and past Lincoln Park to the south. The beds are just offshore and in shallow waters all along the Puget Sound shoreline of Seattle.

Bull kelp (*Nereocystis luetkana*) is absent from the shoreline directly adjacent to the project site, but has a patchy presence immediately to the north and south of the project. A large kelp bed occurs north of Lincoln Park. While the density of the bull kelp in this area has decreased precipitously since the mid-1980's, the distribution of the kelp does not appear to have substantially changed over the same time frame (Antrim and Thom 1995). In 1996, *Laminaria* kelp was observed in many places where bull kelp was observed in previous years (EPA 1996).

### 8.5. Fish

Cutthroat trout (*Oncorhynchus clarki clarki*) and chinook (*O. tshawytscha*), chum (*O. keta*), coho (*O. kisutch*), and pink salmon (*O. gorbuscha*) feed and rear in nearshore areas in the vicinity of the project area. Juvenile salmonids feed on epibenthic invertebrates in the intertidal zone. Adult salmonids migrate along the shoreline during the late summer to early winter months. Fauntleroy Creek, about 2.8 miles south of the project area, supports a run of coho salmon that was re-introduced in 1991 as part of the Salmon in the Classroom program (Fauntleroy Watershed Council 2002). The Duwamish River, approximately 5 coastal miles from the project, supports runs of Chinook, chum, coho, pink, bull trout, and steelhead.

In addition to salmonids, marine fish such as a variety of surfperch (Embiotocidae), flatfish (Pleuronectiformes), gunnel (Pholididae), prickleback (Stichaeidae), and rockfish (*Sebastes* sp.) species occur along Puget Sound shorelines. Common species that likely utilize the project nearshore habitat include striped perch (*Embiotoca lateralis*), surf smelt (*Hypomesus pretiosus*), staghorn sculpin (*Leptocottus armatus*), English sole (*Parophrys vetulus*), copper rockfish (*Sebastes caurinus*), and cabezon (*Scorpaenichthys marmoratus*). The intertidal and shallow subtidal zones provide feeding and rearing habitat for young marine fish and offer feeding and spawning habitat for mature adult fish. As with salmonids, the benthic invertebrate resources in nearshore areas provide abundant prey for marine fish.

### 8.6. Birds

Shallow nearshore waters and intertidal sediments in the project area produce fish, vegetation, and invertebrate forage for a variety of waterfowl, gulls, shorebirds, and other marine birds. Bird species known to occur in the area include pigeon guillemot (*Cepphus columba*), black brant (*Branta bernicla nigricans*), common goldeneye (*Bucephala clangula*), harlequin duck (*Histrionicus histrionicus*), white-winged scoter (*Melanitta fusca*), marbled murrelet (*Brachyramphus marmoratus*), and rhinoceros auklet (*Cerorhinca monocerata*). With the exception of black brant (which prefer eelgrass and algae), these birds feed primarily on crustaceans, mollusks, and small fish.

Birds that frequent the Seattle portion of the Puget Sound shoreline must adapt to a moderately high level of disturbance. In the vicinity of the project site, the disturbance level is moderate and ranges from pedestrians (some with dogs) to regular boat traffic.

### 8.7. Shellfish

The intertidal area adjacent to the project provides habitat for a variety of mollusks including butter clams (*Saxidomus gigantea*), littleneck clams (*Protothaca staminea*), macoma clams (*Macoma* spp.), and common cockle (*Clinocardium nuttalli*); as well as a variety of crabs including Dungeness crabs (*Cancer magister*) and red rock crab (*Cancer productus*). The Washington State Department of Health advises against shellfish harvest on any beach on the eastern shore of Puget Sound between Everett and Tacoma due to pollution.

### 8.8. Sensitive, Threatened and Endangered Species.

In accordance with Section 7(a)(2) of the Endangered Species Act (ESA) of 1973, as amended, federally funded, constructed, permitted, or licensed projects must take into consideration impacts to federally listed and proposed threatened or endangered species. Several species protected under the Act are found in King County (Table 6).

Table 6. ESA Protected Species listed in King County

| Species | Listing Status | Critical Habitat |
|---|---|---|
| Marbled Murrelet<br>*Brachyramphus marmoratus* | Threatened | Designated, not in project area |
| Northern spotted owl<br>*Strix occidentalis caurina* | Threatened | Designated, not in project area |
| Coastal/Puget Sound Bull Trout<br>*Salvelinus confluentus* | Threatened | Designated |
| Puget Sound Chinook Salmon<br>*Oncorhynchus tshawytscha* | Threatened | Designated |
| Puget Sound Steelhead<br>*Oncorhynchus mykiss* | Threatened | Proposed |
| Bocaccio<br>*Sebastes paucispinis* | Endangered | Proposed |
| Eulachon<br>*Thaleichthys pacificus* | Threatened | Designated, not in project area |
| Canary rockfish<br>*Sebastes pinniger* | Threatened | Proposed |
| Yelloweye rockfish<br>*Sebastes ruberrimus* | Threatened | Proposed |
| Green sturgeon<br>*Acipenser medirostris* | Threatened | Designated, not in project area |
| Humpback Whale<br>*Megaptera novaeangliae* | Endangered | Not designated |
| Southern Resident Killer Whale<br>*Orcinus orca* | Endangered | Designated |

| | | |
|---|---|---|
| Leatherback Sea Turtle<br>*Dermochelys coriacea* | Endangered | Designated, not in project area |
| Canada lynx<br>*Lynx canadensis* | Threatened | Designated, not in project area |
| Gray wolf<br>*Canis lupus* | Endangered | Designated, not in project area |
| Grizzly bear<br>*Ursus arctos horribilis* | Threatened | Not designated |
| North American wolverine<br>*Gulo gulo luteus* | Proposed | Not proposed |

Many of the species listed in Table 6 would not be expected to occur at this urban project site due to a lack of habitat availability. These include Northern spotted owl, Canada lynx, gray wolf, grizzly bear, and North American wolverine.

### 8.8.1. Marbled Murrelet

Marbled murrelets are small seabirds that feed on fish and invertebrates usually within 2 miles of shore and nest inland in stands of mature and old-growth forest. The marbled murrelet typically forages for prey during the day and visits its nest site at dawn or dusk. Marbled murrelets spend most of their lives in the marine environment, where they forage in areas 0.3 to 2 km from shore. Prey species include herring, sand lance, anchovy, seaperch, sardines, rockfish, capelin, smelt, as well as euphasiids, mysids, and gammarid amphipods. Marbled murrelets aggregate, loaf, preen, and exhibit wing-stretching behaviors on the water.

Although marine habitat is critical to marbled murrelet survival, USFWS' primary concern with respect to declining marbled murrelet populations is loss of terrestrial nesting habitat. In the marine environment, USFWS is primarily concerned with direct mortality from gillnets and spills of oil and other pollutants (USFWS 1996). Recently the USFWS has found that noise in the marine environment, especially from pile-driving, can result in injury to marbled murrelets (USFWS 2009).

Marbled murrelets occur in Puget Sound marine habitats in relatively low numbers (Speich and Wahl 1995). The species moves about a great deal over several temporal scales: seasonally, daily, and hourly. Regional patterns of activity tend to be seasonal, and are tied to exposure to winter storm activity. There is generally a shift of birds from the Strait of Juan de Fuca and British Columbia during spring and summer to areas in the San Juan Islands and eastern bays during the fall and winter (Speich and Wahl 1995). Murrelets are often found in specific areas (e.g., Hood Canal, Rosario Strait/San Juan Islands), as foraging distribution is closely linked to tidal patterns. However, occurrences are highly variable as they move from one area to another, often in short periods of time.

### 8.8.2. Coastal/Puget Sound Bull Trout

The Coastal/Puget Sound bull trout Distinct Population Segment (DPS) was listed as a threatened species under the ESA in October, 1999 (USFWS 1999). Bull trout populations have declined through much of the species' range; some local populations are extinct, and many other stocks are isolated and may be at risk (Rieman and McIntyre 1993). A combination of factors, including habitat degradation, expansion of exotic species, and exploitation, has contributed to the decline and fragmentation of indigenous bull trout populations. Washington's native char exhibit four life histories: anadromous, adfluvial, fluvial, and resident. The least information is available on the anadromous form of bull trout, but it is assumed that they occur in a number of Puget Sound basins, possibly as far south as the Puyallup River. Bull trout movement in response to developmental and seasonal habitat requirements makes their movements difficult to predict both temporally and spatially. A WDFW (1999) summary paper on bull trout in Stillaguamish Basin provided some general information on bull trout distribution in Puget Sound river basins. Newly emergent fry tend to rear near spawning areas, while foraging juvenile and sub-adults may migrate through river basins looking for feeding opportunities. Post-spawn adults of the non-resident life form quickly vacate spawning areas and move downstream to forage, some returning to their "home" pool for additional rearing. Anadromous sub-adults and non-spawning adults are thought to migrate from marine waters to freshwater areas to spend the winter.

Little data is available on the life history and distribution of bull trout in Puget Sound river basins (WDFW 1998). The closest river to the project area in which bull trout have been captured is the Duwamish River (USACE 2003), but it is not known if those fish were produced in the basin or strayed from other locations. Anadromous sub-adults and adults utilize estuarine and nearshore marine habitats in Puget Sound for foraging. Based on research in the Skagit Basin (Kraemer 1994), anadromous bull trout juveniles migrate to the Puget Sound estuary in April-May, then re-enter the river from August through November. Most adult fish entered the estuary in February-March, and returned to the river in May-June. Sub-adults, fish that are not sexually mature but have entered marine waters, move between the estuary and lower river throughout the year.

### 8.8.3. Puget Sound Chinook Salmon

Chinook salmon utilize freshwater, nearshore, and offshore environments during their lifecycles. Chinook salmon require cold, freshwater streams that contain gravel beds suitable for reproduction. Spawning occurs from November to January, with the eggs hatching the following spring. After emerging, Chinook fry seek shallow, nearshore habitat with low water velocities, and eventually move to progressively deeper, faster water as they grow. Fry will remain in streams for up to a year before they move seaward the following spring. Most Chinook return to their native streams to spawn after spending 2-4 years maturing in the open ocean.

Migrating adults on their way to spawn follow shoreline environments and may congregate around the mouth of spawning streams prior to entry. Juvenile Chinook rear exclusively in the estuarine and nearshore areas of Puget Sound. Initially, juveniles tend to follow shorelines associated with structure, but as they get larger they move into deeper water habitats. Most Chinook complete their out-migration to the Pacific Ocean in a very short time however some may remain in Puget Sound for a year or more.

The Duwamish/Green basin (approximately 5 coastal miles from the project) is the closest Chinook-bearing river to the project site. Most Puget Sound Chinook populations, including the Duwamish/Green stock, have declined in abundance since 2005 and trends since 1995 are mostly flat (Ford et. al. 2010).

Chinook life history stages that might occur near the project site include larger juveniles and adults. Since the project site is a good distance from a source of outmigrating juvenile salmonids, juvenile Chinook are likely relatively large by the time they encounter the project site and, therefore, they do not rely as heavily on nearshore areas as when they enter the marine environment. However, some juvenile Chinook likely do forage in nearshore areas in the project vicinity. Adult Chinook may orient their migrations and movements with the shoreline but are not likely heavily dependent upon shoreline resources for food or refuge.

### 8.8.4. Puget Sound Steelhead

The Puget Sound DPS of steelhead was listed as threatened effective June 11, 2007 (NMFS 2007). Unlike salmon, steelhead can spawn more than once during their lives, returning to saltwater afterwards. According to Wydoski and Whitney (1979), Washington steelhead adults often spend two years at sea. Most spend two years in freshwater before outmigrating as smolts to the estuary and saltwater, generally from April through June and peaking in mid-April. Steelhead smolts are larger and more mobile than Chinook smolts, so they are better able to avoid some adverse circumstances.

Adult steelhead use the southern Puget Sound mainly during winter, from November through January with a peak in December (Dames and Moore 1981). In general these winter run, or ocean maturing, steelhead return as adults to the tributaries of Puget Sound from December to April. Spawning occurs from January to mid-June, with peak spawning occurring from mid-April through May (NMFS 2007). The inshore migration pattern of juvenile steelhead in Puget Sound is not well understood. It is generally thought that steelhead smolts move quickly offshore (Hartt and Dell 1986).

### 8.8.5. Bocaccio

Boccacio are large Pacific coast rockfish. Rockfish give birth to live larval young which are found in surface waters extending several hundred miles offshore. Larvae and juvenile rockfish remain in open ocean for several months, being passively dispersed by currents. Adults are most common between 160 and 820 feet depth, with strong associations to rocky bottoms and outcrops. Juveniles and subadults may be more common in shallower waters and are associated with reefs, kelp beds, and artificial structures such as piers. In Puget Sound, most bocaccio are found south of the Tacoma Narrows (NMFS 2013a). The primary reason for this species decline is overfishing (NMFS 2013a).

### 8.8.6. Eulachon

Eulachon typically spend 3 to 5 years in saltwater before returning to freshwater to spawn from late winter through mid spring. After fertilization, the eggs sink and adhere to the river bottom, typically in areas of gravel and coarse sand. Most eulachon adults die after spawning. Eulachon eggs hatch in 20 to 40 days and the larvae are then carried downstream where they are dispersed by estuarine and ocean currents shortly after hatching. Juvenile eulachon move from shallow nearshore areas to mid-depth areas. Eulachon are infrequently found in coastal rivers and tributaries to Puget Sound (NMFS 2013b).

### 8.8.7. Canary Rockfish

Canary rockfish have a similar life history to bocaccio, bearing live young that disperse in surface waters. Adults are found between 160 and 820 feet depth, with strong associations to rocky bottoms and outcrops where they hover just above the bottom. Juveniles and subadults may be more common in shallower waters and are associated with reefs, kelp beds, and artificial structures such as piers. Like bocaccio, the primary reason for the decline of this species is overfishing (NMFS 2013c).

### 8.8.8. Yelloweye Rockfish

Yelloweye rockfish have a similar life history to bocaccio and canary rockfish. They bear live young that disperse in surface waters. Adults are found between 80 and 1560 feet depth, with strong associations to rocky bottoms and outcrops. Juveniles and subadults may be more common in shallower waters and are associated with reefs, kelp beds, and artificial structures such as piers. Yelloweye rockfish are among the longest lived of rockfishes, living up to 118 years old. Like bocaccio and canary rockfish, the primary reason for the decline of this species is overfishing (NMFS 2013d).

### 8.8.9. Green Sturgeon

Green sturgeon are long-lived, slow-growing fish, and are the most marine-oriented of the sturgeon species. Green sturgeon are believed to spend the majority of their lives in nearshore oceanic waters, bays, and estuaries. Adult sturgeon return to freshwater to spawn when they are about 15 years of age and more than 4 feet (1.3 m) in size. Spawning is believed to occur every 2-5 years (NMFS 2013e). Adults typically migrate into fresh water beginning in late February, and spawning occurs from March-July, with peak activity from April-June (NMFS 2013e). Green sturgeon do not spawn in Washington (NMFS 2013e). Juvenile green sturgeon spend a few years in fresh and estuarine waters before they leave for saltwater, where they disperse widely in the ocean.

### 8.8.10. Humpback Whale

Humpback whales are large cetaceans, reaching 52 feet in length. They are well-known for their complex and evolving vocalizations. They have very long, knobbed pectoral fins, and a small dorsal fin. They have baleen instead of teeth; the baleen is comb-like material used for filtering large amounts of water as it is forced out of their mouths in order to retain the whales' prey, which includes krill and small fish such as herring.

Although humpback whales are found in Puget Sound, they are relatively uncommon, possibly as a result of commercial whaling in the Strait of Georgia during the early 20th century (Osborne et al. 1988). In southern Puget Sound, Osborne et al. (1988) noted multiple observations of one individual in June 1986. Calambokidis and Steiger (1990) documented a large number of sightings of two juveniles in southern Puget Sound, including Commencement Bay, in June-July 1988. Humpbacks are more common in the ocean offshore of Washington and Vancouver Island. Humpbacks are not likely to be found in the vicinity of the project at the time of the proposed project work, due to their mobility and their likely desire to avoid areas of intense human activity.

### 8.8.11. Southern Resident Killer Whale

The orca, or killer whale, is a toothed member of the order Cetacea, which includes whales, dolphins and porpoises. The southern resident population of killer whale was listed as endangered effective February 16, 2006 (NMFS 2005). Killer whales may be found worldwide, but are more abundant in higher latitudes and in areas of higher biological productivity. Killer whales occur in groups of about 5-20 animals, though sometimes may congregate in numbers reaching over 100. Puget Sound/British Columbia killer whales are grouped into three major communities (Osborne et al. 1988). The northern resident community occurs north of the tidal boundary halfway along the east side of Vancouver Island in British Columbia. Southern resident killer whales range within about 200 miles surrounding the San Juan Islands, and do not overlap with northern residents (Osborne et al. 1988), which is supported by genetic analysis (Hoelzel et al. 1998; Barrett-Lennard 2000; Barrett-Lennard and Ellis 2001). A transient group of killer whales travels throughout the ranges of the southern and northern residents. The transients feed primarily on marine mammals, while the resident killer whales specialize in salmon. Each of these pod communities has specialized calls and migration routes, and interbreeds only within itself.

Resident killer whales are subject to impacts due to loss of prey availability. Salmon are major components of resident killer whales' food intake, and a number of stocks of salmon have been in decline in Puget Sound. In addition, the general reduction in size of individual salmon that has been occurring over the past few decades, and changes in their body composition (energy and nutritional value) may negatively affect killer whales by requiring the whales to hunt more often for smaller prey. Killer whales are also impacted by noise and vessel operations. Sources of underwater noise pollution (vessel traffic, seismic activity, drilling, dredging, construction and sonar), especially in an industrialized area like Commencement Bay, create an ambient environment that may interfere with killer whales' echolocation capabilities as well as with their navigation and communication.

Southern Residents range throughout Puget Sound, and may occasionally migrate and or forage as far south as Monterrey Bay, California; sightings have been documented as far north as the northern Queen Charlotte Islands in Canada (Krahn et al. 2004). The Southern Resident's customary range is thought to be primarily within Puget Sound, and through and within the Georgia and Johnstone Straits. Hunting is known to occur in waters of all depths, and killer whales have been seen to "herd" schools of fish into shallow bays to increase their feeding effectiveness. Killer whales are also known to swim with and adjacent to boats and ships transiting the Sound.

### 8.8.12. Leatherback Sea Turtle

The leatherback sea turtle was listed as endangered in 1970. The leatherback sea turtle is widespread in the tropical and temperate Pacific, including the U.S. and Canadian west coast from California to Alaska, and has been incidentally caught in commercial gillnets off the US west coast. There is, however, no known nesting along the U.S. west coast.

Leatherback sea turtle presence in Puget Sound has not been documented, though it may be found in the Strait of Juan de Fuca and off the Washington coast. There is no information that would indicate that the leatherback sea turtle is likely to be present in the project area. NMFS and USFWS (2007) state that sightings of this species are very rare, and there are no known breeding areas in NMFS' Northwest Region jurisdictional area, which includes Puget Sound.

### 8.9. Historic and Cultural Resources

The project lies within the traditional territory of the ancestors of the Muckleshoot Tribe. Two place names are located within 0.25 miles of the project location and include T3EsbEd or "winter house" for a creek south of Alki Point. The second place name is GwEl or "to capsize" for a second small creek. Two archaeological sites are located within 1 mile of the project and include a historic archaeological site of the former South Alki School. Native American burials were identified at a private residence approximately 0.90 miles north of the project area.

A Corps archaeologist conducted Washington Information Systems Architectural and Archaeological Records Data records search and background information on the project. The retaining wall was constructed in 1927 and has not yet been evaluated for inclusion on the National Register. The Corps notified the Confederated Tribes and Bands of the Yakama Nation; the Muckleshoot Indian Tribe, the Sauk-Suiattle Indian Tribe, the Snoqualmie Indian Tribe, the Suquamish Tribe and Tulalip Tribes of the Tulalip Reservation by letter on April 9, 2013 asking the Tribes to identify any concerns and sought information about properties of religious or cultural significance that might be affected by the project. The Snoqualmie Indian Tribe responded by email on April 19th, 2013 asking if an inadvertent discovery plan was in place for the project and asked for updates as the project progresses. The Muckleshoot Tribe of Indians expressed concern about the possibility of artifacts along the beach and provided information regarding the Native American burial found 0.90 miles north of the project area. In addition, the Muckleshoot Indian Tribe asked to accompany the Corps archaeologist during the cultural resources survey of the project area. On July 24th, 2013 the Corps sent a letter to the Washington State Historic Preservation Officer (SHPO) regarding the Area of Potential Effects (APE) for the project. SHPO agreed with the Corps APE in a letter dated July 25th, 2013.

The Corps is in the process of conducting a cultural resources investigation for this project. Once the investigation is complete the Corps will finish Section 106 consultation with the Tribes and SHPO. The results of the cultural resources investigation and Section 106 consultation will be included in the final EA.

### 8.10. Land Use

Park visitors utilize the project area for a variety of recreational activities, see Section 7.7 for details. Aside from Emma Schmitz Memorial Park at the project site, there is another nearby park known as Me-Kwa-Mooks Park. Me-Kwa-Mooks Park is about 275 feet from the project site, up SW Jacobsen Road though the northern end of Emma Schmitz Park is directly across the street from Me Kwa Mooks. Other than public park lands, surrounding land use is primarily residential.

### 8.11. Recreation

Park visitors utilize the project area for a variety of recreational activities. Amenities at the site include benches, the pedestrian walkway/promenade, and stairs leading down to the beach. Heaviest use occurs from late spring to fall, but smaller numbers of people use the park even during the winter.

## 8.12. Transportation and Utilities

Beach Drive Southwest is a main arterial that connects the west side of West Seattle to Alki Point with average daily traffic of over 5,000 vehicles. A 54 inch sewer main that services 20,000 residents and commercial businesses in the area with a capacity of up to 8 million gallons a day runs parallel to the shoreline and Beach Drive, adjacent to the existing seawall structure. The sewer main is owned and maintained by King County and is buried beneath the surface at a depth of approximately 10 feet below the roadway surface and as close as 2 feet landward from the face of the existing seawall. In addition to the sewer and roadway, there is a Puget Sound Energy gas line and a Seattle Public Utilities water line located beneath the centerline of Beach Drive Southwest. It is expected that as a result of major storm events, all utilities and infrastructure in the project area are at immediate risk of damages and loss.

In 1998, a segment of seawall to the north of the proposed federal project failed, prompting emergency actions by the City to stabilize the structure and bank; refer to Figure 4. This failure was stabilized by City crews with a repair consisting of a major riprap structure placed seaward of the failed seawall. The riprap extends over 50 feet into the nearshore area and provides adequate protection for infrastructure and lands from storm and tidal forces. The sewer main along this stretch of shoreline begins to move landward away from the beach; whereas, the sewer main is located much closer to the shoreline in the proposed federal project area and is considered to be at a higher risk of impacts.

## 8.13. Hazardous, Toxic, and Radiological Waste (HTRW)

A limited Phase I database search for hazardous, toxic, and radiological waste (HTRW) was conducted during the feasibility phase to identify any known pollutants or contaminants. Source data from the U.S. Environmental Protection Agency and the WDOE were searched and records do not indicate potential HTRW concerns in the project area. Additional analysis and research will be conducted as the design phase progresses, as required.

Refer to Appendix D for additional information, sources, and findings.

## 8.14. Future Without Project Conditions

The City of Seattle has observed storm impacts and erosion in the project area, most notably in 1998, as well as continual degradation of the existing structure over time, despite routine annual maintenance. Since 1998, the City has continued to replace voids in and around the existing seawall on at least 7 occasions, including 3 times since 2011. The work typically includes filling voids behind and below the existing structure that have formed due to erosion resulting from storm events.

The existing structure has far exceeded its expected design life and routine O&M such as filling eroded sediments behind the wall will not be able to keep pace with continued corrosion of primary structural components. Based on coastal engineering analyses and estimates of future sea level change scenarios[8], the future without project condition scenario finds that coastal storm

[8] USACE 2011b. Sea Level Change Considerations for Civil Works Programs. EC 1165-2-212

frequency and intensity increases throughout the period of analysis and subsequently results in a 50 percent probability of failure of the existing seawall in approximately 10 years with subsequent damage or loss of existing utilities and infrastructure.

# 9. EFFECTS OF THE PROPOSED ACTION

## 9.1. Conservation Measures

Several measures would be employed during construction to minimize adverse project effects on protected species and their habitat:

- All work would be completed between July16 and February 15. The work window avoids sensitive migration periods for salmonids, including bull trout.
- No heavy equipment would work from the beach as the construction of the seawall would be completed from the top of the seawall.
- Work would be completed at low tides and out of the water.
- Any beach logs moved during construction shall be immediately replaced after construction.
- Work would occur during daylight hours only.

## 9.2. Physical Characteristics

### 9.2.1. No Action Alternative

Implementation of the No Action Alternative would leave the existing seawall vulnerable to further erosion and storms. This leaves the project site at a high risk for catastrophic failure. Collapse of the seawall would endanger the infrastructure behind the seawall, particularly the large sewer main. An emergency response would likely be required to protect critical infrastructure. An emergency action would involve placement of riprap seaward of the project area. This would alter the physical characteristics of the site by requiring a larger footprint (approximately 40-foot wide) covering a larger area of existing beach. Riprap placed under emergency situations is also more prone to settling and loss of rock, likely requiring reworking and continuous repair throughout the project life. Thus, an emergency response under the no action alternative would cause a significant change to the physical characteristics of the site. Further, if an emergency response to a seawall failure was not undertaken the resultant loss of land and probable failure of the sewer main could cause a significant impact to the physical characteristics of the immediate area and the surrounding vicinity.

### 9.2.2. Soldier Pile Wall (Preferred Alternative)

The project site would continue to be maintained as a park following construction with no change to existing park amenities (sidewalks and benches). The project site would be temporarily closed to visitors during construction, though the northern sections of the park would remain open.

The existing seawall would remain in place with the new soldier pile wall placed seaward of the footing. Fill would be placed between the existing seawall and the new soldier pile wall, extending the existing park upland by 2 to 4 feet. No new park amenities would be anticipated for this filled area. Implementation of the preferred alternative would be expected to fully protect the sewer main and other infrastructure. Regular inspections would be completed throughout the project life with minimal maintenance needs. The construction of the soldier pile wall is not expected to cause a significant change to the physical characteristics of the site.

#### 9.2.3. Retaining Wall

With the retaining wall, the project site would continue to be maintained as a park after construction, with no change to existing park amenities (sidewalks and benches). The project site would be temporarily closed to visitors during construction, though the northern sections of the park would remain open.

The existing seawall could be removed to limit the waterward encroachment of the structure and accommodate the required footing for this alternative. Fill would be placed between the existing seawall and the new retaining wall, extending the existing park upland by 2 to 4 feet. No new park amenities would be placed in this filled area. Construction of the retaining wall would be expected to fully protect the sewer main and other infrastructure. Regular inspections would be completed throughout the project life with minimal maintenance needs. The construction of the retaining wall is not expected to cause a significant change to the physical characteristics of the site.

### 9.3. Soils

#### 9.3.1. No Action Alternative

As discussed above, the No Action Alternative would likely lead to an emergency action that included placement of riprap throughout the site. Existing soils for the majority of the site would be unchanged, though the land/sea interface would be modified. No significant impact to soils would occur.

#### 9.3.2. Soldier Pile Wall (Preferred Alternative)

The Soldier Pile Wall alternative would leave the existing seawall in place and would have minimal disturbance to existing soils. Imported sandy material would be used to fill the area between the new wall and the existing seawall. This material would be clean and would be purchased from a commercial facility. Overall the changes to existing soils would be minor and this alternative would not have a significant impact on this resource.

#### 9.3.3. Retaining Wall

The retaining wall has the greatest disturbance of soils within the project area as the removal of the seawall and shoring up of the sewer main would require extensive excavation. Much of the removed material would be preserved to use as backfill once the retaining wall was installed. Any additional material needed would be clean fill purchased from a commercial facility. Overall the disturbance would be temporary and this alternative would not have a significant impact on this resource.

### 9.4. Water Quality

#### 9.4.1. No Action Alternative

The No Action Alternative maintains the vulnerability of the seawall and the sewer main. Catastrophic failure of the seawall leading to a break in the sewer main could have a significant short-term impact on water quality of the Puget Sound. It is expected that a sewage release would be short-lived and that emergency actions would take place to stop the spill and stabilize the shore. A sewage release could result in high loads of fecal coliform bacteria as well as heavy metals, oil-based chemicals, pharmaceuticals, etc being flushed into Puget Sound.

#### 9.4.2. Soldier Pile Wall (Preferred Alternative)

The Soldier Pile Wall alternative, once constructed, would protect the sewer pipe from erosion. During construction, work would be done in the dry at low tide. When tides rise and hit the work area during the construction period, slight turbidity increases may occur. Use of best management practices such as working from the top of the bank, minimizing on-site equipment maintenance, and ensuring all equipment and materials are clean would minimize potential for contamination. A small amount (0.02 acres) of beach would be lost due to the footprint of the new wall. Mitigation for this loss would be included in the final project design. Overall impacts to water quality from the soldier pile wall would be minimal.

#### 9.4.3. Retaining Wall

The Retaining Wall alternative, once constructed, would protect the sewer pipe from erosion. However this alternative has a higher risk of disturbing the pipe during construction of the wall. Removal of the existing seawall and shoring up the pipe during construction increases the vulnerability during the work. As above, construction would be done at low tide and in the dry. The removal of the existing seawall leaves the excavated bank exposed as tides rise and hit the work area during the construction period. As a result, turbidity increases may occur and would require monitoring. Use of best management practices such as working from the top of the bank, minimizing on-site equipment maintenance, and ensuring all equipment and materials are clean would minimize potential for contamination. A small amount (0.02 acres) of beach would be lost due to the footprint of the new wall. Mitigation for this loss would be included in the final project design. Overall impacts to water quality from the retaining pile wall would be short-term and would be minimal.

### 9.5. Submerged Aquatic Vegetation

#### 9.5.1. No Action Alternative

Water clarity is the most serious water quality condition affecting eelgrass and other seagrasses (Berry et al 2003). Water clarity can be compromised by eutrophication, suspended sediment and shading due to overwater structures. Other impacts that would hamper the growth of vegetation include increased wave energy, the release of trace metals, or water temperature increases.

The No Action Alternative, with its associated higher risk of a sewage release could have short term impacts to water quality. It is expected that a break in the sewer pipe would receive immediate action such that the spill would be short-lived with an emergency repair of the pipe and emergency stabilization of the shoreline. Increased nutrient loading from the sewage release could cause eutrophication, however the tidal flushing of the area coupled with the expected higher wave forces during the damaging storm event would dilute the sewage and minimize local impacts to submerged aquatic vegetation. The larger footprint of the emergency stabilization of the shoreline, likely in the form of riprap placement, would decrease the beach in the area, but would not be expected to increase local wave energy or have other impacts to diminish the sites suitability for submerged aquatic vegetation. Overall, short-term impacts to submerged aquatic vegetation could occur, but the long-term effect would be minimal.

#### 9.5.2. Soldier Pile Wall (Preferred Alternative)

The Soldier Pile Wall alternative would protect the sewage pipe. Construction of the wall would move the hardened shoreline slightly waterward, however the riprap scour protection is designed to dissipate wave energy and limit scour. Minimal change to wave energy and beach composition is expected. No long-term impact to water quality or clarity is expected. Impacts to submerged aquatic vegetation are not expected to be significant.

#### 9.5.3. Retaining Wall

The Retaining Wall alternative would protect the sewage pipe. As noted above, this alternative has a higher risk of disturbing the pipe during construction of the wall and thereby a higher risk of sewage release. An accidental sewage release would have impacts similar to those discussed under the No Action Alternative, though the spill would likely be of shorter duration. The removal of the existing seawall leaves the excavated bank exposed as tides rise through the construction period. As a result, turbidity increases may occur that could have short-term impacts to submerged aquatic vegetation. Construction of the wall would move the hardened shoreline slightly waterward, however the riprap scour protection is designed to dissipate wave energy and limit scour. Minimal change to wave energy and beach composition is expected. No long-term impact to water quality or clarity is expected. Impacts to submerged aquatic vegetation are not expected to be significant.

### 9.6. Fish

#### 9.6.1. No Action Alternative

The No Action Alternative, with its associated higher risk of a sewage release could have short term impacts to habitat quality and suitability for fish. It is expected that a break in the sewer pipe would receive immediate action such that the spill would be short-lived due to an emergency repair of the pipe and emergency stabilization of the shoreline. Tidal flushing of the area coupled with the higher wave forces during the damaging storm event would dilute the sewage, limiting longer term impacts to fisheries. The larger footprint of the emergency stabilization of the shoreline, likely in the form of riprap placement, would encroach on the beach, slightly decreasing available habitat for fisheries. Construction of an emergency repair may include in water work and could potentially injure fish in the work area during construction due to rock placement. Overall, short-term impacts to fish could occur, but the long-term effect would be minimal.

#### 9.6.2. Soldier Pile Wall (Preferred Alternative)

The Soldier Pile Wall alternative would protect the sewer main. Construction of the wall would move the hardened shoreline waterward, slightly decreasing available habitat for fish. Minimal change to existing habitat characteristics is expected. Construction would occur in the dry during low tides to minimize water quality impacts and thereby limit the potential for harm to fish species. Impacts to fish are not expected to be significant.

### 9.6.3. Retaining Wall

The retaining wall would protect the sewer main. Construction would occur in the dry during low tides to minimize water quality impacts and thereby limit the potential for harm to fish species. During high tides, the exposed bank at the site from the removal of the existing seawall could lead to increased turbidity and short-term impacts to fish. Construction of the wall would move the hardened shoreline waterward, slightly decreasing available habitat for fish. Minimal change to existing habitat characteristics is expected. Overall impacts to fish from the retaining wall alternative are not expected to be significant.

## 9.7. Birds

### 9.7.1. No Action Alternative

The No Action Alternative, if it leads to a sewage release, could have short term impacts to habitat quality and suitability for birds that use the adjacent shoreline and shallow waters for foraging. Any emergency response to a break or to prevent a break would slightly increase activity over ambient levels. Some displacement of birds may occur. Due to the small size of the project, construction disturbance would be limited in size and duration. Birds moving from the vicinity of the project would not be displaced from locally important habitat and would likely find suitable habitat nearby. The completed project would not change habitat features important to bird life. Overall, adverse impacts to birds are not anticipated as a result of the proposed work.

### 9.7.2. Soldier Pile Wall (Preferred Alternative)

The proposed construction would slightly increase activity over ambient levels. Some displacement of birds may occur. Due to the small size of the project, construction disturbance would be limited in size and duration. Birds moving from the vicinity of the project would not be displaced from locally important habitat. The completed project would not change habitat features important to bird life. Overall, adverse impacts to birds are not anticipated as a result of the proposed work.

### 9.7.3. Retaining Wall

Impacts of the Retaining Wall Alternative are the same as the impacts discussed above for the Soldier Pile Wall Alternative.

## 9.8. Shellfish

### 9.8.1. No Action Alternative

Sewage spills generally cause the short term closure of nearby shellfish beds for harvest, however the Washington State Department of Health advises against harvest of shellfish in this area (any beach on the eastern shore of Puget Sound between Everett and Tacoma). Implementation of the no action alternative would be expected to result in an emergency repair, such as placement of riprap, with a larger footprint and beach impact. A change in species composition within the site or larger vicinity would not be expected. Overall impacts would not be significant for the reach of the shoreline.

### 9.8.2. Soldier Pile Wall (Preferred Alternative)

The Soldier Pile Wall alternative has the smallest footprint of the proposed repair options, thus minimizing the loss of beach habitat. The loss of 0.02 acres of beach due to soldier pile wall installation will impact the species composition in the footprint, though no change to the larger vicinity would be expected. Overall impacts would not be significant for the reach of the shoreline.

### 9.8.3. Retaining Wall

The Retaining Wall alternative has a larger footprint than the preferred alternative because of the requirement for a large footing at the base of the new structure. This results in a more significant impact to the beach habitat including nearly 3 times as much loss of beach area. The loss of 0.06 acres of beach due to retaining wall installation will impact the species composition in the footprint, though no change to the larger vicinity would be expected. Overall impacts would not be significant for the reach of the shoreline.

## 9.9. Sensitive, Threatened and Endangered Species.

### 9.9.1. No Action Alternative

Leatherback sea turtle is not known in the project area and no impact to this species would occur from any of the alternatives. Humpback whales, while present in Puget Sound on rare occasions, would not be impacted by any of the alternative actions for this project as they do not use nearshore habitats.

If the no action alternative lead to a large spill of raw sewage to the nearshore area, short-term impacts could occur to listed fish species in the vicinity of the spill, including the salmonids (bull trout, Chinook, and steelhead) as well as larval rockfish (bocaccio, canary rockfish, and yelloweye rockfish). Effects could include increased turbidity, decreased water clarity, increased toxins, and decreased dissolved oxygen levels. The salmonids using the area would likely be adults or larger juveniles that would be mobile enough to escape poor conditions. Effects of the spill would likely be diluted before reaching depths where it would impact adult rockfish species. Presence of eulachon in Puget Sound is so rare, that impacts to this species would be expected to be negligible. Any green sturgeon in the area would also be adults or subadults that would be highly mobile and able to escape the affected area.

Emergency shoreline stabilization could also impact any salmonids (bull trout, Chinook, and steelhead) and larval rockfish (bocaccio, canary rockfish, and yelloweye rockfish) in the project vicinity due to in-water rock placement, increased noise and activity, and potentially increased turbidity. The placement of the riprap revetment would result in the loss of approximately 0.4 acres of beach habitat that could be used by salmonids for foraging during high tides.

Marbled murrelet in the area could be disturbed by a sewage release and by construction of emergency repairs. The sewage release could temporarily reduce suitability of the vicinity for foraging. Construction activity and noise could cause murrelet to leave the area while the activity is ongoing. This species is highly mobile and would be expected to find other suitable habitat nearby.

Killer whale do not use nearshore habitats, but the use of these habitats as rearing for salmonids, their main prey species, does link them to work on shorelines. The limited impact to salmonids would be expected to also limit potential impacts to killer whale.

Overall impacts of the no action alternative would be short term and not significant.

### 9.9.2. Soldier Pile Wall (Preferred Alternative)

Construction of the soldier pile wall could also impact any salmonids (bull trout, Chinook, and steelhead) and larval rockfish (bocaccio, canary rockfish, and yelloweye rockfish) in the project vicinity due to increased noise and activity, and potentially increased turbidity. Presence of eulachon in Puget Sound is so rare that impacts to this species are expected to be negligible. Any green sturgeon or salmonids in the area would be highly mobile and able to escape the construction area if noise or activity made the vicinity less desirable during construction. Similar habitat is available nearby for their use. The placement of the soldier pile wall would result in the permanent conversion of approximately 0.02 acres of beach habitat to armored shoreline in an area that could be used by salmonids for foraging during high tides. Mitigation to offset this loss will be included in the project.

Similarly, construction activity and noise could cause marbled murrelet to leave the area while the activity is ongoing. This species is highly mobile and would be expected to find other suitable habitat nearby.

Killer whale do not use nearshore habitats, but the use of these habitats as rearing for salmonids, their main prey species, does link them to work on shorelines. The limited impact to salmonids would be expected to also limit potential impacts to killer whale.

Overall, with the implementation of appropriate mitigation for the permanent loss of beach habitat, impacts of the soldier pile wall alternative would not be significant.

### 9.9.3. Retaining Wall

Construction of the retaining wall could also impact any salmonids (bull trout, Chinook, and steelhead) and larval rockfish (bocaccio, canary rockfish, and yelloweye rockfish) in the project vicinity due to increased noise and activity, and potentially increased turbidity. Presence of eulachon in Puget Sound is so rare, that impacts to this species would be expected to be negligible. Any green sturgeon or salmonids in the area would be highly mobile and able to escape the construction area if noise or activity made the vicinity less desirable during construction. Similar habitat is available nearby for their use.

Similarly, construction activity and noise could cause marbled murrelet to leave the area while the activity is ongoing. This species is highly mobile and would be expected to find other suitable habitat nearby.

Killer whale do not use nearshore habitats, but the use of these habitats as rearing for salmonids, their main prey species, does link them to work on shorelines. The limited impact to salmonids would be expected to also limit potential impacts to killer whale.

Overall impacts of the retaining wall alternative would be short term and not significant.

## 9.10. Native American and Cultural Resources Sites

### 9.10.1. No Action Alternative

Under the No Action Alternative the seawall would continue to be subject to storm events leaving it vulnerable to erosion and other damage. This alternative will be further evaluated once the cultural resources investigation is complete and the seawall has been evaluated for eligibility to the National Register.

### 9.10.2. Soldier Pile Wall (Preferred Alternative)

Under the soldier pile wall alternative the seawall would remain in place. The solder pile wall would be placed in front of the existing seawall. This alternative will be further evaluated once the cultural resources investigation is complete and the seawall has been evaluated for eligibility to the National Register.

### 9.10.3. Retaining Wall

Under the retaining wall alternative the seawall would be removed. This alternative may have an adverse effect to the seawall if the seawall is determined eligible to the National Register. This alternative will be further evaluated once the cultural resources investigation is complete and the seawall has been evaluated for eligibility to the National Register.

## 9.11. Land Use

### 9.11.1. No Action Alternative

The No Action Alternative could result in the catastrophic failure of the seawall and considerable damage to the sewer main and other public infrastructure adjacent to the seawall. Damage to the sewer main could cause the disruption of service to 20,000 customers in West Seattle. A permanent loss of this line is not expected as emergency repairs would occur. Emergency repairs would allow the existing residential neighborhood to continue to be serviced by the municipal sewer, though disruption of service during the repair may occur. In addition to the pipe, loss of the seawall would erode park land and would have temporary effects on the availability of the park. It is expected that emergency measures would largely restore the park to a usable state. Impacts of the no action alternative on landuse would be temporary and would not be considered significant.

### 9.11.2. Soldier Pile Wall (Preferred Alternative)

The Soldier Pile Wall alternative would protect the sewage main and all existing landuse at the site and in the vicinity. No impacts to land use would be expected.

### 9.11.3. Retaining Wall

The Retaining Wall alternative would protect the sewage main and all existing landuse at the site and in the vicinity. No impacts to land use would be expected.

## 9.12. Recreation

### 9.12.1. No Action Alternative

The No Action Alternative could result in the catastrophic failure of the seawall and considerable damage to the sewer main and other public infrastructure adjacent to the seawall. The 54-inch sewer has the capacity of up to 8 million gallons of flow daily. A spill of this magnitude could cause temporary closure of the site and adjacent beaches to protect visitors from contamination. Emergency repairs are expected to be undertaken in the case of this event to limit the volume of the spill. In addition to the pipe, loss of the seawall would erode park land and would have temporary effects on the availability of the park. It is expected that measures would be undertaken by the City to largely restore the park to a usable state. Impacts of the no action alternative on recreation would be temporary and would not be considered significant.

#### 9.12.2. Soldier Pile Wall (Preferred Alternative)

The Soldier Pile Wall alternative would protect the park and existing park infrastructure. Temporary closure and detouring of sidewalks at the site would be necessary during construction but no long term change to the park status is expected. The current mitigation consideration is to extend the project length to place a longer length of seawall and replace the riprap. This would restore adjacent beach habitat. This could convert upland park habitat to beach habitat. The beach is accessible to the public and would remain public lands. The conversion would be approximately 1:1 ratio of lost beach (due to the seaward encroachment) to the replacement beach for a total of 0.02 acres. No significant impacts to recreation would be expected.

#### 9.12.3. Retaining Wall

The Retaining Wall alternative would protect the park and existing park infrastructure. Temporary closure and detouring of sidewalks at the site will be necessary during construction but no long term change to the park status is expected. No significant impacts to recreation would be expected.

### 9.13. Transportation and Utilities

#### 9.13.1. No Action Alternative

The No Action alternative could result in the catastrophic failure of the seawall and considerable damage to the sewer main, Beach Drive, a Puget Sound Energy gas line, and a Seattle Public Utilities water line located adjacent to the seawall. Emergency repairs would allow the homes within the area to continue to be serviced by the municipal sewer and other utility lines though disruption of service until the repair is complete. In addition to the pipes, loss of the seawall would erode adjacent land potentially impacting the safety and availability of the adjacent roadway. Detour routes from one side of the affected area to the other would be available via city streets at a minimum of 2.5 miles due to the lack of nearby connector streets. It is expected that measures would be undertaken by the City to restore Beach Drive to a usable state. Impacts of the no action alternative on transportation and utilities would be temporary and could be quite disruptive to local citizens, but would not be considered significant as they would be expected to be rectified by the City with emergency repairs.

#### 9.13.2. Soldier Pile Wall (Preferred Alternative)

The Soldier Pile Wall alternative would protect the adjacent roadway and utility lines. Temporary closure of a single lane of Beach Drive and detouring of sidewalks at the site may be necessary during construction. Signage, flaggers and other features would be used to ensure the safety of the public and minimize traffic impacts. No long term change to the roadway or utility lines is expected. No significant impacts to transportation and utilities would be expected.

### 9.13.3. Retaining Wall

The Retaining Wall alternative would protect the adjacent roadway and utility lines. Temporary closure of a single lane of Beach Drive and detouring of sidewalks at the site may be necessary during construction. Signage, flaggers and other features would be used to ensure the safety of the public and minimize traffic impacts. No long term change to the roadway or utility lines is expected. No significant impacts to transportation and utilities would be expected.

## 9.14. Hazardous, Toxic, and Radiological Waste (HTRW)

### 9.14.1. No Action Alternative

Records do not indicate potential HTRW concerns in the project area, therefore no significant impact is expected.

### 9.14.2. Soldier Pile Wall (Preferred Alternative)

Records do not indicate potential HTRW concerns in the project area, therefore no significant impact is expected.

### 9.14.3. Retaining Wall

Records do not indicate potential HTRW concerns in the project area, therefore no significant impact is expected.

# 10. CUMULATIVE EFFECTS

The NEPA defines cumulative effects as the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions (40 CFR §1508.7).

The existing seawall structure was constructed in 1927. Emma Schmitz Memorial Overlook Park was donated in 1945 by Emma Schmitz "for park...and no other purpose whatsoever" (City of Seattle 1995).

In 1998, the City of Seattle was prompted to take emergency action to stabilize a portion of the seawall to the north of the proposed federal project. Three small storm events caused waves that resulted in erosion of the seawall and threatened utilities, roadways, and public lands. The City completed permanent emergency repairs on this adjacent site in the form of a riprap revetment.

In 1988, the Corps partnered with the City of Seattle Parks and Recreation Department at Lincoln Park, approximately 2 miles south of the Alki seawall to place armor rock along 250 feet of beach at Williams Point and complete beach nourishment. The substrate placement created a gravel beach along the Lincoln Park shoreline where erosion had previously scoured all substrate down to a hard clay layer at the toe of the seawall. Periodic renourishment of the beach is needed, with the first occurring in 1994, the second in 2002, and the third in 2010.

## 11. TREATY RIGHTS

In the mid-1850's, the United States entered into treaties with a number of Indian tribes in Washington. These treaties guaranteed the signatory tribes the right to "take fish at usual and accustomed grounds and stations . . . in common with all citizens of the territory" [U.S. v. Washington, 384 F.Supp. 312 at 332 (WDWA 1974)]. In U.S. v. Washington, 384 F.Supp. 312 at 343 - 344, the court also found that the Treaty tribes had the right to take up to 50 percent of the harvestable anadromous fish runs passing through those grounds, as needed to provide them with a moderate standard of living (Fair Share). Over the years, the courts have held that this right comprehends certain subsidiary rights, such as access to their "usual and accustomed" fishing grounds. More than de minimis impacts to access to usual and accustomed fishing area violates this treaty right [Northwest Sea Farms v. Wynn, F.Supp. 931 F.Supp. 1515 at 1522 (WDWA 1996)]. In U.S. v. Washington, 759 F.2d 1353 (9th Cir 1985) the court indicated that the obligation to prevent degradation of the fish habitat would be determined on a case-by-case basis. The Ninth Circuit has held that this right also encompasses the right to take shellfish [U.S. v. Washington, 135 F.3d 618 (9th Cir 1998)].

The proposed project has been analyzed with respect to its effects on the treaty rights described above. We anticipate that:

1. The work will not interfere with access to usual and accustomed fishing grounds or with fishing activities or shellfish harvesting;
2. The work will not cause the degradation of fish runs and habitat; and
3. The work will not impair the tribes' ability to meet moderate living needs.

## 12. IRRETRIEVABLE AND IRREVERSIBLE COMMITMENTS OF RESOURCES

No federal resources would be irreversibly and irretrievably committed to the proposed action until the DPR/EA is finalized and a “Finding of No Significant Impact” has been signed.

## 13. ENVIRONMENTAL COMPLIANCE

### 13.1. National Environmental Policy Act

Section 1500.1(c) and 1508.9(1) of the National Environmental Policy Act of 1969 (as amended) requires federal agencies to “provide sufficient evidence and analysis for determining whether to prepare an environmental impact statement or a finding of no significant impact” on actions authorized, funded, or carried out by the federal government to insure such actions adequately address “environmental consequences, and take actions that protect, restore, and enhance the environment". This assessment evaluates environmental consequences from the proposed coastal erosion control project in Seattle, Washington.

### 13.2. Endangered Species Act

In accordance with Section 7(a)(2) of the Endangered Species Act of 1973, as amended, federally funded, constructed, permitted, or licensed projects must take into consideration impacts to federally listed or proposed threatened or endangered species. The potential effects of the project and conservation measures taken to reduce those effects will be addressed in more detail in a Biological Evaluation (BE). The BE will be submitted to the U.S. Fish and Wildlife

Service (USFWS) and the National Marine Fisheries Service (NMFS) for consultation. The consultation process will be completed prior to the finalization of this DPR/EA.

### 13.3. Clean Water Act Compliance

The proposed work will be evaluated pursuant to Section 404(b)(1) of the Clean Water Act in accordance with the guidelines promulgated by the Environmental Protection Agency (40 CFR 230) for evaluation of the discharge of dredged or fill material into waters of the United States. In addition, consideration has been given to the need for the work and to such water quality standards as are appropriate and applicable by law. A Joint Aquatic Resources Permit Application (JARPA) will be sent to the WDOE for consultation under Section 401 of the Clean Water Act. An individual water quality certification is expected to be needed due to the beach encroachment. The proposed discharge represents the least environmentally damaging practicable alternative and would include all appropriate and practicable measures to minimize adverse effects on the aquatic environment.

### 13.4. Essential Fish Habitat

In accordance with the Essential Fish Habitat (EFH) requirements of the Magnuson-Stevens Fishery Conservation and Management Act, the Corps will consult with NMFS on any potential impacts to EFH. The Corps' determination of effects will be transmitted to NMFS as a part of the BE.

### 13.5. National Historic Preservation Act

Section 106 of the NHPA (16 U.S.C. 470) requires that Federal agencies evaluate the effects of Federal undertakings on historical, archeological, and cultural resources and afford the Advisory Council on Historic Preservation opportunities to comment on the proposed undertaking if there is an adverse effect to an eligible Historic Property. The lead agency must examine whether feasible alternatives exist that would avoid eligible cultural resources. If an effect cannot reasonably be avoided, measures must be taken to minimize or mitigate potential adverse effects.

The Corps is in the process of coordinating its review of cultural resources impacts for NEPA with agency responsibilities under Section 106 of the National Historic Preservation Act (NHPA). The Corps is consulting with the Confederated Tribes and Bands of the Yakama Nation; the Muckleshoot Indian Tribe, the Sauk-Suiattle Indian Tribe, the Snoqualmie Indian Tribe, the Suquamish Tribe, the Tulalip Tribes of the Tulalip Reservation and the Washington SHPO.

The Corps is in the process of conducting a cultural resources investigation for this project. Once the investigation is complete the Corps will finish Section 106 consultation with the Tribes and SHPO. The results of the cultural resources investigation and Section 106 consultation will be included in the final DPR/EA.

### 13.6. Clean Air Act

The proposed project will be analyzed for conformity applicability pursuant to regulations implementing Section 176(c) of the Clean Air Act. The proposed activities will have temporary impacts to local air quality due to the emissions of construction vehicles, however the short duration of construction and the lack of any exceed de minimis levels of direct emissions of a criteria pollutant or its precursors long-term recurring emissions from the work is unlikely to exceed de minimis levels of direct emissions of a criteria pollutant or its precursors.

### 13.7. Environmental Justice

Executive Order 12898 directs federal agencies to identify and address disproportionately high and adverse human health or environmental effects of agency programs and activities on minority and low-income populations. No tribal resources would be harmed. No adverse effects to minority or low-income populations would result from the implementation of the proposed project.

### 13.8. Coastal Zone Management Act

The Coastal Zone Management Act of 1972, as amended, requires Federal agencies to carry out their activities in a manner which is consistent to the maximum extent practicable with the enforceable policies of the approved Washington Coastal Zone Management Program. A consistency determination will be written and provided to WDOE for their review.

### 13.9. Initial Environmental and Cultural Coordination

Preliminary Resource Agency and Tribal coordination was conducted during this phase of the study. Endangered Species Act consultation, Clean Water Act compliance, National Historic Preservation Act coordination, and NEPA documentation will be prepared during the design and implementation phase and will be completed ahead of soliciting any contract action for construction of execution of the project.

Federal, State, and local resource agencies along with Federally-recognized tribes were invited to attend a site visit during the feasibility phase. The purpose of the meeting was to solicit preliminary input on environmental and cultural topics for the tentatively selected plan. Invitees included the USFWS, NMFS, Muckleshoot Indian Tribe, Suquamish Tribe, Sauk-Suiattle Indian tribe, Snoqualmie Indian tribe, Tulalip Tribes, Yakama Nation, Duwamish Tribe (currently applying for Federal recognition), WDOE, WDFW, DNR, DAHP, and the City. Attendees to the 26 April 2013 meeting included the Corps, the City, USFWS, and WDOE.

Following the introduction to the project, questions and concerns focused on the need to move waterward and potential mitigation opportunities. Options discussed include planting the upper bank to the extent possible above the seawall or adjacent areas, removal of a portion of the northern riprap structure, and purchasing credit at a mitigation bank. Discussion also included consideration of placing wood on the beach in front of the structure or removing a potentially derelict outfall in the area. However, the concern was that removal of the pipe without replacement with some structure would cause a large change in how sediment accumulates in the area and any wood placement would require large anchors that had the potential to be quite impactful.

USFWS put forth the potential to do work outside of the typical windows recommended for fish, if work could be done during low tides and out of the water. Further discussion of the final plans will be needed to confirm this option. WDOE also stated that they felt the project would likely need an individual Water Quality Certification (as opposed to analogy to a Nationwide Permit) due to the waterward footprint change. This process can take up to one year to complete. Also further development of the mitigation plan will be needed once the full impact analysis is complete to ensure that the proper amount of mitigation is proposed.

On April 9th, 2013 tribal coordination letters were sent out to the following Tribes informing them of the project: Tulalip Tribes of the Tulalip Reservation; Confederated Tribes and Bands of the Yakama Nation; Muckleshoot Indian Tribe; Sauk-Suiattle Indian Tribe; Snoqualmie Tribe; and Suquamish Indian Tribe. National Historic Preservation Act (NHPA) documentation will be prepared during the design and implementation phase and will include a cultural resources report and coordination with the Washington State Historic Preservation Officer and Tribes.

Refer to Appendix H for additional information regarding initial environmental and cultural coordination efforts.

## 14. DESIGN AND IMPLEMENTATION PHASE

### 14.1. Plan Implementation

Upon approval of this report, the City and Corps may initiate the design and implementation phase of the project. This phase will include completing final plans and specifications of the recommended plan, completing final environmental documentation, preparing and soliciting a construction contract, and completing construction of the project.

#### 14.1.1. Project Partnership Agreement

A Project Partnership Agreement (PPA) must be signed by the City and Corps in order to complete design and initiate construction. The PPA will outline roles and responsibilities and will include cost sharing, LERRD, and maintenance requirements.

#### 14.1.2. Cost Share

A detailed cost estimate for the NED has been prepared as part of the study. The sponsor has agreed to provide their share of funds through a combination of cash and work in-kind completed during the design phase. The cost share for design and implementation of the recommended plan is 65 percent Federal and 35 percent non-Federal.

### 14.2. Final Design

During the design phase, the recommended plan will be advanced from a planning level of design to final plans and specifications ready for construction. Design will be completed in-house by the Seattle District and coordinated with the City of Seattle. District Quality Control (DQC) reviews will be scheduled and completed based on the schedule for design developed by the PDT and ahead of any external reviews to ensure that quality products have been developed. An Agency Technical Review (ATR) will be completed during the design phase and the 95 percent plans and specifications will undergo a biddability, constructability, operability, and environmental (BCOE) review conducted by the Seattle District. The ATR will be conducted by another Corps District and the team will be identified based on expertise in small scale coastal storm projects on the west coast and should include an environmental reviewer familiar with the Puget Sound region. Cost estimates will be maintained and updated as the design progresses and an Independent Government Estimate will be prepared ahead of contract bid openings.

Additional data collection and survey analyses will be conducted to confirm assumptions made during the feasibility phase, including but not limited to, topographic surveys, utility locates, and geotechnical investigations. A geotechnical investigation will be required to identify the type and distribution of foundation materials, to identify sources and characteristics of backfill materials, and to determine material parameters for use in design analyses. Specifically, the required data will be used to adequately and efficiently estimate the required pile depths, spacing, and size of the wall lagging, locate groundwater levels, estimate settlements, and identify any possible excavation problems. Testing may include but is not limited to grain size analysis, Atterberg Limit tests, determination of unit weight, moisture content, and determination of friction angle. Subsequently, the newly collected data will be used to adjust the soil properties used for the design, and to provide more accurate soil loading estimates for the structural design of the seawall. Utility locates will be essential to mapping and identifying potential risks associated with designs and construction techniques.

As part of the final design efforts, final NEPA coordination will be completed, including a final DPR/EA. Coordination through NEPA will identify the potential impacts and will help determine any mitigation required as a result of construction of the project. A project risk table will be developed and updated by the PDT as risks are identified and appropriate risk management strategies will be developed and coordinated at the appropriate levels.

### 14.3. Environmental Coordination

All Endangered Species Act consultation with USFWS and NMFS, Clean Water Act compliance coordination with WDOE, National Historic Preservation Act coordination with Tribes and SHPO, and Coastal Zone Management Act consultation with WDOE will occur in the design phase. Additional NEPA analysis will also occur during the design phase and a final EA will be prepared to complete all NEPA requirements. The preliminary feedback from an initial site visit with Resources Agencies was positive, and the agencies generally agreed on the purpose and need for the project as well as potential solutions; however the details of the final design will be further coordinated to ensure that impacts are avoided and minimized to extent possible and any unavoidable impacts are fully mitigated. Based on the preliminary coordination, mitigation is expected for the tentatively selected plan as a result of a small intrusion into the nearshore area.

### 14.4. Design and Construction Schedule

The projected design and implementation schedule below is based on the assumptions and information documented within this report and is subject to change, as needed. The schedule also assumes that sufficient funding is available for the project.

Table 7. Design and Implementation Schedule

| Milestone | Task Name | Projected Finish Date |
|---|---|---|
| CW150 | Submit Federal Interest Determination Report to NWD | **21 February 2013 (A)** |
| CW040 | Project Management Plan Approval | **28 February 2013 (A)** |
| CW170 | Federal Interest Determination Report Approved | **04 March 2013 (A)** |
| CW035 | Peer Review Plan Approved | **04 March 2013 (A)** |
| CW190 | Conduct Alternative Formulation Briefing | **24 June 2013 (A)** |
| | Agency Technical Review of Draft Report | January 2014 |
| | Public Review of Integrated Document | February 2014 |

| | | |
|---|---|---|
| CW170 | NWD approval of Detailed Project Report | February 2014 |
| CW130 | Project Partnership Agreement Executed | June 2014 |
| | Environmental Assessment/FONSI Complete | December 2014 |
| | Plans and Specs Complete | December 2014 |
| | Real Estate Certification | December 2014 |
| | Construction Contract Ready to Advertise | January 2015 |
| CC800 | Construction Contract Awarded | March 2015 |
| | Construction Begins | April 2015 |
| CW450 | Construction Physical Complete | September 2015 |
| CW480 | Notice of Project Completion | October 2015 |
| | Project Fiscally Closed Out | September 2016 |

## 15. CONCLUSION AND RECOMMENDATION

### 15.1. Conclusion

This DPR/EA has identified problems and opportunities that are within the authority for Section 103 of the CAP and completed a determination of the federal interest in pursuing a project to provide protection to critical public infrastructure from coastal storm damages and preventing shoreline erosion. The NED plan meets all of the project objectives, reduces or minimizes potential adverse effects to the environment, and has the full support of the local cost-sharing partner, the City of Seattle. The NED plan will provide a long-term solution to reduce the risks associated with coastal storms in Puget Sound and will serve to protect the environment from potential impacts.

### 15.2. Recommendation

Based on the economic, engineering, and environmental evaluations completed as part of the study phase of the project, it has been determined that a project to protect critical public infrastructure and prevent negative environmental impacts is within the federal interest. Accordingly, the Corps of Engineers, Seattle District, recommends that the tentatively selected plan, as identified within the body of this report, be adopted and carried forward for further design and implementation pursuant to Section 103 of the Rivers and Harbors Act of 1962, as amended.

The estimated cost of the NED plan is $1.7 million. The federal proportionate share is estimated to be $1,100,000 while the non-federal proportionate share is estimated to be $595,000. Average annual net benefits are $242,000, indicating a strong contribution to the nation’s economic output by the project. Average annual benefits of the NED plan exceed the average annual cost by a ratio of 3 to 1.

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