Biological Assessment Alaskan Way Viaduct and Seawall Replacement Program: SR-99 S. Holgate Street to S. King Street Viaduct Replacement Project

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Alaskan Way Viaduct & Seawall Replacement Program: SR-99 S. Holgate Street to S. King Street Viaduct Replacement Project

Biological Assessment

Agreement No. Y-9556

Task AB

The SR 99: S. Holgate Street to South King Street Viaduct Replacement Project is a joint effort between the Federal Highway Administration (FHWA) and the Washington State Department of Transportation (WSDOT). To conduct this project, WSDOT contracted with:

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List of Acronyms and Abbreviations

BA	biological assessment
BMP	best management practices
CCP	construction contingency plan
City	City of Seattle
CSO	combined sewer overflow
CSO Plan	Combined Sewer Outflow Reduction Plan Amendment
DNR	Washington Department of Natural Resources
DO	dissolved oxygen
DPS	distinct population segment
Ecology	Washington State Department of Ecology
EFH	essential fish habitat
ESA	Endangered Species Act
ESU	evolutionarily significant unit
FHWA	Federal Highway Administration
HUC	Hydrologic Unit Code
MHHW	mean higher high water
MTCA	Model Toxics Control Act
NHP	Natural Heritage Program
NMFS	National Marine Fisheries Service
NPDES	National Pollutant Discharge Elimination System
NTU	nephelometric turbidity unit
PAH	Polynuclear Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyls

PCE	primary constituent elements
PHS	Priority Habitat and Species
PSAMP	Puget Sound Ambient Monitoring Program
Seawall	Seattle Seawall
Services	National Marine Fisheries Service and U.S. Fish and Wildlife Service
SPCC	spill prevention, control, and countermeasures
SPL	sound pressure level
SR	State Route
SRKW	southern resident killer whale
SWPPP	storm water pollution prevention plan
TESC	temporary erosion and sediment control
TIA	total impervious area
TRA	Tidal Reference Area
USFWS	U.S. Fish and Wildlife Service
WDFW	Washington Department of Fish and Wildlife
WOSCA	Washington-Oregon Shippers Cooperative Association
WSDOT	Washington State Department of Transportation

Executive Summary

The Federal Highway Administration (FHWA) is contributing funds to the Alaskan Way (viaduct) Replacement Program (Program) to replace the deteriorating viaduct structure, which is nearing the end of its functional life, as a Federal Highway Administration Project. Besides being an old and deteriorating structure, the viaduct's joints and columns were damaged during the 2001 Nisqually earthquake, accelerating the viaduct's deterioration.

The SR-99 S. Holgate Street to S. King Street Viaduct Replacement Project (Project), a component of the Program, will replace the existing portion of the viaduct between S. Holgate Street and S. King Street with a new roadway that is partially elevated and partially constructed at ground level. The Project is necessary to maintain long-standing support of State Route (SR) 99 as a critical regional transportation corridor.

Project Location

The Project extends approximately 0.89 mile, from milepost 29.89 to milepost 30.78 along SR 99 (Figure ES-1). The Project is located within Hydrologic Unit Code (HUC) 17110019, Puget Sound.

Project Description

The proposed action would demolish and replace the SR 99 mainline from S. Walker Street (just south of S. Holgate Street) to the vicinity of S. King Street. This section of roadway would be replaced with an improved three-lane roadway in each direction. The improved roadway would transition to match the existing viaduct in the vicinity of S. King Street. The existing access ramps at Railroad Avenue would be maintained, and a new northbound off-ramp and a new southbound on-ramp from Alaskan Way just north of S. Royal Brougham Way would be built in the vicinity of S. King Street.

The Project would also provide grade-separated access for freight and general-purpose traffic traveling between the Burlington Northern Santa Fe (BNSF) Railyard, SR 519 connections, and the Port of Seattle container terminals along Seattle's waterfront. These east–west movements would be provided via a U-shaped, lowered roadway extending from the intersection of S. Atlantic Street/Colorado Avenue to the intersection of S. Atlantic Street and E. Marginal Way. This new connection would improve vehicle access compared to existing conditions, particularly for freight, by providing a grade-separated route for east–west traffic when rail cars on the tail track (that portion of the track that is used to assemble trains) block the at-grade roadway. At-grade access connecting these two areas (on the east and west) would continue to be provided via S. Atlantic Street. However, Royal Brougham Way S. would no longer provide east–west at-grade connections between First Avenue S. and Alaskan Way or E. Marginal Way as it does today.

Ferry holding lanes would be constructed between S. Royal Brougham Way and S. King Street along the east side of SR 99.

Construction of the Project will take approximately 3 years and 8 months and will occur in 5 sequential stages.   Numerous measures will be employed to minimize or avoid potential effects on species and habitats in the action area. These include:

- The Project will secure and comply with all applicable local, state and federal permits and authorizations protecting natural resources.
- Best management practices (BMPs) and monitoring measures will be specified in a construction National Pollutant Discharge Elimination System (NPDES) permit to ensure that construction stormwater and dewatering water discharged to Elliott Bay and Duwamish Waterway will not impair water quality in these waters.
- The Project will not directly or indirectly create an increase in pollutant generating impervious surface.
- Basic stormwater treatment facilities and detention facilities will be added to portions of the completed Project discharging stormwater runoff to Elliott Bay and Duwamish Waterway such that runoff from the entire project will not increase pollutant loading in these waters.

Action Area

The action area is the area of direct and indirect effects attributable to the Project. For the Project, the limit of such effects is determined by potential effects caused by impact sound waves generated by impact hammer pile driving. Aerial transmission of sound could affect terrestrial habitats within approximately 4,600 feet of the construction site. All other effect mechanisms are within this area, except for the West Point Treatment Plant outfall; therefore the action area covers all areas within approximately 4,600 feet of the project area. The action area also includes a discontinuous area located within 105 feet of the West Point Treatment Plant outfall. The 105-foot zone around the outfall was based on the distance at which it is unlikely compounds contained in the discharge will exceed water quality standards (Jones and Stokes 2001).

Species Information

This biological assessment (BA) was prepared to determine the potential effects of the Project on listed and proposed threatened and endangered species and their designated critical habitat. Species addressed in this BA include:

- southern resident killer whale (*Orcinus orca*, endangered),
- Steller sea lion (*Eumetopias jubatus*, threatened),

- Chinook salmon (*Oncorhynchus tshawytscha*, threatened),
- steelhead (*Oncorhynchus mykiss*, threatened),
- bull trout (*Salvelinus confluentus*, threatened), and
- marbled murrelet (*Brachyramphus marmoratus*, threatened).

Designated critical habitat for Chinook salmon, bull trout and the southern resident killer whale DPS also occurs within the action area. Critical habitat for steelhead trout is currently under review but has not been designated.

The lower Duwamish River and the Seattle waterfront are considered a migration corridor and rearing area for juvenile Chinook salmon and steelhead trout. Anadromous bull trout may use the Elliott Bay nearshore habitat for foraging. Marbled murrelets have not been documented along the Seattle shoreline, but they have been reported from many sites near the action area, and could forage in aquatic portions of the project area. Killer whales are occasionally seen near the action area, such as near Alki Point and West Point. Steller sea lions are rarely seen in this portion of Puget Sound and have not been documented in the action area.

Effects Analysis and Determinations

Table ES-1 summarizes effect determinations for each species. The primary potential effects on listed species are due to airborne noise from upland impact pile driving and the discharge of project stormwater from existing outfalls. Minimization measures incorporated into the project description and BMPs to be employed in construction and operation, summarized above, will avoid and/or minimize adverse effects to listed species.

Essential fish habitat (EFH) for Pacific salmon, groundfish, and coastal pelagic species occurs in the action area. Effects on EFH are addressed in this BA (Appendix A). Implementation of conservation measures and BMPs will minimize impacts to nearshore habitat and water quality during project construction. Project design, construction, and permitting requirements will ensure no long-term degradation of water quality. No structures will be installed which could obstruct passage or impact habitat for EFH species. Any effects to EFH species prey will be temporary, insignificant and discountable. Therefore, the project will have **no adverse effect** on EFH.

Table ES-1. Summary of Effects Determinations for Listed Species and Critical Habitat

Common Name Scientific Name	ESA Status[1]	Impacts Analysis Determination
Chinook salmon *Oncorhynchus tshawytscha*	T	May affect, not likely to adversely affect

Common Name Scientific Name	ESA Status[1]	Impacts Analysis Determination
Steelhead (*Oncorhynchus mykiss)*	T	May affect, not likely to adversely affect
Bull trout *Salvelinus confluentus*	T	May affect, not likely to adversely affect
Marbled murrelet *Brachyramphus marmoratus*	T	May affect, not likely to adversely affect
Southern resident killer whale *Orcinus orca*	E	May affect, not likely to adversely affect
Steller sea lion (*Eumetopias jubatus)*	T	May affect, not likely to adversely affect
Chinook salmon critical habitat	D	May affect, not likely to adversely affect
Bull trout critical habitat	D	May affect, not likely to adversely affect
Marbled murrelet critical habitat	D	No effect
Southern resident killer whale DPS critical habitat	D	No effect

[1]T = threatened, E = endangered, D = designated, P = proposed

Figure ES-1. Project Area

1.0 Project Overview

The Washington State Department of Transportation (WSDOT) and the Federal Highway Administration (FHWA) propose to replace the existing Alaskan Way Viaduct between S. Walker Street on the south to S. King Street on the north along State Route (SR) 99 (Project) (Figure 1-1).

Currently, the viaduct is structurally unsound and vulnerable to failure during an earthquake. The existing structure, designed and built to last approximately 50 to 75 years, is now nearing the end of its serviceable lifespan. The viaduct is seismically vulnerable to earthquake damage. The viaduct's age, design, and location render it vulnerable to damage from soil liquefaction, and studies suggest that the structure could fail in a strong earthquake. Damage sustained by the structure during the February 2001 Nisqually earthquake further compromised seismic stability. The Project will provide a transportation facility with improved earthquake resistance and will maintain mobility and access while improving traffic safety along the corridor.

The Project is located within the range of species protected under the federal Endangered Species Act (ESA) of 1973, as amended. Because the Project will receive funding from FHWA, interagency consultation with the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) is required pursuant to section 7(a)(2) of ESA. WSDOT has prepared this biological assessment (BA) on behalf of FHWA, as required under section 7(c) of ESA, to facilitate interagency consultation and address potential impacts of the Project on species that have been listed or proposed for listing under ESA.

Listed species and their designated critical habitats within the action area were identified through the NMFS website (NMFS 2007) and USFWS website (USFWS 2007). To determine the potential occurrence of these species within the action area, project biologists reviewed Priority Habitat and Species (PHS) data obtained from the Washington Department of Fish and Wildlife (WDFW) (WDFW 2007). Local experts were also consulted, as was existing literature as cited in the text. Based on the presence of potentially suitable habitat and/or documented species occurrences within the action area, this BA addresses impacts on:

- southern resident killer whale (*Orcinus orca*) (endangered) and designated critical habitat;
- Steller sea lion (*Eumetopias jubatus*) (threatened);
- Puget Sound evolutionarily significant unit (ESU) Chinook salmon (*Oncorhynchus tshawytscha*) (threatened) and designated critical habitat;
- Puget Sound ESU steelhead (*Onchorhynchus mykiss*) (threatened);
- Coastal/Puget Sound distinct population segment (DPS) bull trout (*Salvelinus confluentus*) (threatened) and designated critical habitat; and

- marbled murrelet (*Brachyramphus marmoratus*) (threatened) and designated critical habitat.

In addition to ESA, the Magnuson-Stevens Fishery Conservation and Management Act requires that projects that may adversely affect essential fish habitat (EFH) consult with NMFS. Appendix A provides an analysis of the impacts of the Project on EFH.

1.1 Project Location

The project limits for the S. Holgate Street to S. King Street Viaduct Replacement Project (Project) extend from S. Walker Street on the south to S. King Street on the north along SR 99. The Project is within Hydrologic Unit Code (HUC) 17110019, Puget Sound. This is located in portions of Water Resource Inventory Area (WRIA) 9 (T24N, R4E, S6 and 7).

1.2 Existing Conditions

The project area comprises the portion of SR 99 between approximately S. Walker Street and S. King Street, the area underneath elevated portions of the raised viaduct in this area, and portions of First Avenue South, Colorado Avenue South, South Atlantic Street, and South Royal Brougham Avenue. The existing viaduct was designed and built to last approximately 50 to 75 years and is now nearing the end of its serviceable life span. Currently, SR 99 is a primary north–south route through Seattle, carrying 20 to 25 percent of the traffic traveling through downtown. Existing conditions are shown on Figure 1-2.

1.3 Proposed Conditions

Following construction, the new SR 99 will have 3 travel lanes in each direction, the same as under the existing condition, but with improved lane width, shoulder width, sight distance, and geometrics. SR 99 will continue to provide the functions of the existing structure, with greatly improved reliability and greatly reduced vulnerability to earthquake damage. Maintenance requirements of the new structure are expected to be minor (e.g., resurfacing SR 99 and routine maintenance) during its life span (minimum 100 years). The road will be upgraded to enhance safety and meet FHWA highway standards, but there will be no increase in traffic capacity or in impervious surface area.

1.4 Consultation History

This project has been the subject of several meetings between WSDOT, FHWA, the City of Seattle, and the Services (USFWS and NMFS). A preconsultation meeting to discuss the Project was held on January 17, 2008. Consultation also occurred during preparation of the Alaska Way Viaduct/Seawall Replacement Biological Assessment (Jones & Stokes 2006).

1.5 Information Sources

The project team has coordinated with the relevant federal, state, and local agencies since 2001. This coordination has led to the development of a number of documents providing technical information to support the issues and development of the project design. The evaluation of potential effects on listed and proposed species relies on information provided by the following documents:

- Federal Highway Administration, Washington State Department of Transportation, and City of Seattle. 2004. *Alaskan Way Viaduct & Seawall Replacement Project Draft Environmental Impact Statement.* Prepared by Parametrix, Bellevue, Washington. 168 p. + appendices.
- Federal Highway Administration, Washington State Department of Transportation and City of Seattle. 2006. SR99: *Alaskan Way Viaduct & Seawall Replacement Project Supplemental Draft Environmental Impact Statement and Section 4(f) Evaluation*. Seattle, WA: WSDOT.
- Shannon & Wilson Inc. 2004. *Geotechnical Analyses for Alaskan Way Seawall Rebuild Options*. Unpublished report to Washington State Department of Transportation, City of Seattle, and Federal Highway Administration by Parsons Brinckerhoff Quade & Douglas, Inc., Seattle, Washington. 23 p. + appendices.
- Parametrix. 2007. Alaskan Way Viaduct Pollutant Loading Methods. Technical Memorandum to David Mattern (WSDOT 2007).

USFWS also provided the following guidance for determining the action area:

- NMFS and USFWS. 2005. Biological Opinion, City of Seattle, Seattle Aquarium, Pier 59 Piling Superstructure Maintenance, Fifth Field HUC 1711001904, Puget Sound/East Passage. By National Marine Fisheries Service and U. S. Fish and Wildlife Service, Lacey Washington. 112 p.

Figure 1-1.Project Area

2.0 Project Description

This chapter describes the Project, describing each stage of the Project and the types of activity and equipment used. It also describes the measures that will be implemented during project design and construction to minimize or avoid effects to federally listed or proposed species or their designated critical habitat.

2.1 Project Limits

The project limits for the S. Holgate to S. King Street Viaduct Replacement Project (the Project) extend from S. Walker Street on the south to S. King Street on the north. See Figure 2-1.

2.2 Overview of Proposed Action

The proposed action would replace the State Route (SR) 99 mainline from S. Walker Street (just south of S. Holgate Street) to the vicinity of S. King Street. This section of roadway would be replaced with an improved three-lane roadway in each direction. The improved roadway would transition to match the existing viaduct in the vicinity of S. King Street. The existing access ramps at S. King Street would be maintained, and new access ramps would be added. A new northbound off-ramp and a new southbound on-ramp from Alaskan Way S. just north of S. Royal Brougham Way would be built.

The Project would provide grade-separated access for freight and general purpose traffic traveling between the BNSF Seattle International Gateway (SIG) Railyard, SR 519 connections, and the Port of Seattle container terminals along Seattle's waterfront. These east–west movements would be provided via a U-shaped underpass extending from the intersection of S. Atlantic Street/Colorado Avenue S. to the intersection of S. Atlantic Street and E. Marginal Way S. This new connection would improve vehicle access compared to existing conditions, particularly for freight, by providing a grade separated route for east–west traffic when rail cars on the tail track (the portion of the track that is used to assemble trains) block the at-grade roadway. At-grade access connecting these two areas (on the east and west) would continue to be provided via S. Atlantic Street. However, S. Royal Brougham Way would no longer provide east–west at-grade connections between First Avenue S. and Alaskan Way S. or E. Marginal Way S. as it does today.

Ferry holding lanes would be constructed between S. Royal Brougham Way and S. King Street along the east side of SR 99.

2.3 Purpose and Need

The purpose of this project is to replace the SR 99 mainline with a seismically sound structure between approximately S. Walker Street and S. King Street. This portion of SR 99, also known as the Alaskan Way Viaduct, is deteriorating. In this area, the new SR 99 facility will maintain or improve access to, from, and across SR 99 for general purpose vehicles, transit, and freight.

The ability of the Alaskan Way Viaduct to withstand earthquakes needs to be improved. The viaduct is vulnerable to earthquakes because of its age, design, and location. Built in the 1950s, the viaduct is past the halfway point in its 50- to 75-year design life and does not meet today's seismic design standards. The viaduct's existing foundations are embedded in liquefiable soils, and the structure is deteriorating. These factors necessitate viaduct replacement. If an earthquake were to damage portions of SR 99 that are at risk, WSDOT would likely restore the section of the SR 99 corridor south of downtown first because it provides transportation functions critical to south Seattle and the region.

The Alaskan Way Viaduct does not meet current roadway design standards and has deficiencies that need to be improved. Specifically, the viaduct has narrow lanes that can adversely affect traffic safety, operating speeds, and roadway capacity. Substantial sections of the viaduct roadway have minimal or no shoulders. Lack of shoulders or narrow shoulder widths can also adversely affect roadway safety, operations, and capacity.

This section of SR 99 and E. Marginal/Alaskan Way provides access near the Port of Seattle, one of the largest ports on the west coast. The Port/Duwamish industrial area surrounding this portion of SR 99 also contains approximately 80 percent of Seattle's designated industrial lands. The transportation system in this area plays a crucial role in the movement of goods and services for the entire state and the Pacific Northwest region. As such, this surrounding area is a vital international trade and transportation crossroad, where goods are distributed via roadway, water, rail, and air. It is home to the Port of Seattle's primary shipping operations, the main Amtrak and freight rail yards for Washington State, and the intersection of several major highway routes including I-5, I-90, SR 99, and SR 519. Connections between all of these facilities are often congested and railyard operations often block freight and local traffic.

This area is also home to two professional sports stadiums and an exhibition center. On game days and during special events thousands of people, vehicles, pedestrians, and buses are present. This area also serves traffic getting to the Seattle Ferry Terminal, which is WSDOT's busiest ferry terminal. Hundreds of cars queue up to use the ferry's service in this section of the SR 99 corridor. In addition, this section of SR 99 supports transit to and from West Seattle and other areas south of downtown.

Specific areas where access needs to be improved to support key transportation functions in this area include:

- Transit access into downtown. Transit access to downtown is currently provided at Columbia and Seneca Streets, which are located in the middle of downtown. Transit access could be improved if access to and from SR 99 were provided south of downtown.

- East–west access across SR 99 between Port/Duwamish industrial facilities, railyards, and the stadiums. This access is currently provided via at-grade connections at S. Atlantic and Royal Brougham and is often blocked by trains being assembled on the tail track.
- Access between Alaskan Way and East Marginal Way and SR 519/First Avenue S. This access is also often blocked by trains being assembled on the tail track.

The project would address these needs as described below:

- From S. Walker Street, SR 99 would transition from an at-grade, side-by-side roadway to an aerial, side-by-side roadway crossing over S. Atlantic Street and the tail track continuing to S. Royal Brougham Way. North of S. Royal Brougham Way, SR 99 would be a side-by-side, at-grade roadway for approximately 1,800 feet, and then it would transition to a stacked, aerial structure to connect with the existing stacked viaduct at about S. King Street.
- A new northbound off-ramp and southbound on-ramp would be provided south of S. King Street.
- New roadways and connections would be provided in the vicinity of S. Atlantic Street. These connections include:
    1. Grade-separated access for freight and general-purpose traffic traveling between the BNSF Railyard, E. Marginal Way, SR 519, and the Port of Seattle.
        - Access would be provided via a U-shaped, lowered roadway extending from the intersection of S. Atlantic Street/Colorado Avenue to the intersection of S. Atlantic Street and E. Marginal Way. This new connection would improve vehicle access by providing a route for east–west traffic when rail cars on the tail track block the at-grade roadway.
    2. S. Royal Brougham Way would no longer provide a direct at-grade, east–west connection between First Avenue and E. Marginal Way as it does today. Instead, a northbound and southbound directional couplet would connect S. Atlantic Street and S. Royal Brougham Way to Alaskan Way. These directional couplets would also provide access to ferry holding lanes for Colman Dock.
    3. Colorado Avenue would be improved to enhance access to the BNSF Seattle International Gateway (SIG) Railyard.
- The existing northbound on-ramp and southbound off-ramp at Railroad Way S. would be retained.
- Pedestrian and bicycle access would be maintained and improved where feasible. From S. Walker Street to S. Atlantic Street, a bicycle/pedestrian shared use path

would be located to the west of the mainline. North of S. Atlantic Street, the bicycle/pedestrian path would be west of the relocated tail track (in accordance with the City of Seattle Bicycle Master Plan). North of S. Atlantic Street the bike path would proceed north to the vicinity of S. Dearborn Street as part of the Mountains to Sound Greenway. A multi-use pathway would be constructed to the east of SR-99 from S. Atlantic Street north to approximately S. King Street. Surface streets in the project area would also be widened to add bike lanes along the west side of Alaskan Way, E. Marginal Way, and S. Royal Brougham Way.

- The rail tail track would be relocated west of the new SR 99 roadway and would extend north from the railyard to the vicinity of S. King Street.
- Ferry holding lanes would be constructed between S. Royal Brougham Way and S. King Street along the east side of the corridor.

2.4 Construction Approach

In the process of evaluating several construction sequencing and traffic control scenarios, WSDOT determined that maintaining traffic capacity on SR 99 as much as possible throughout the construction period was of key importance. An approach that would minimize effects on First Avenue S. traffic and maintain access to and from area businesses and the stadiums was considered to be a design priority. The construction approach described in this BA was based on several assumptions and constraints, which are summarized as follows:

- A minimum of two lanes of SR 99 traffic in each direction must be maintained during peak traffic hours or a comparable detour will be provided, except for nights and weekends when full closures are allowed.
- Ferry traffic between the Pier 50 terminal and both I-90 and I-5 must be maintained.
- Event traffic to and from the sports stadiums and event center must be maintained.
- Traffic mobility along Alaskan Way S within the project limit must be maintained.
- Access to and from the north SIG Railyard and the Port of Seattle's Terminal 46 (T-46) must be maintained at all times.
- Railroad tracks and the Whatcom Railyard must remain in service, except for periodic closures of short duration (8 hours or less) to facilitate construction activities.
- The City's Fourth Avenue S. loop ramp from the Spokane Street Viaduct will be completed prior to Stage 2 (described in Section 2.8, Project Timeline, below).

2.5 Proposed Action

This section describes the proposed action.

2.5.1 Viaduct Replacement

2.5.1.1 Description of the Alignment

The proposed action would replace the existing stacked viaduct structure between S. Holgate Street and S. King Street as shown in Figure 2-1. At S. Walker Street, SR 99 would transition from an at-grade, side-by-side roadway to an aerial, side-by-side roadway crossing over S. Atlantic Street and the BNSF tail track. SR 99 would return to a side-by-side, at-grade roadway for a short distance north of S. Royal Brougham Way. SR 99 would then transition to a stacked, aerial structure to connect with the existing stacked viaduct at about S. King Street. Resurfacing and striping will transition from the existing roadway to the south and the replacement structure in the vicinity of S. Holgate Street.

2.5.1.2 Access and Connections

In the vicinity of S. Atlantic Street, the proposed action would:

- Provide grade-separated access for freight and general-purpose traffic traveling between the SIG Railyard, SR 519, E. Marginal Way, and the Port of Seattle. Access would be provided via a U-shaped underpass extending from the intersection of S. Atlantic Street/Colorado Avenue S. to the intersection of S. Atlantic Street and Alaskan Way S. This new connection would improve vehicle access by providing a route for east–west traffic when railroad cars on the tail track block Atlantic Street.

- Reconstruct Colorado Avenue S. to improve access to the SIG Railyard. A dedicated truck-only lane would be provided in each direction on the west half of Colorado Avenue S. One lane in each direction would be provided for general-purpose traffic on the east half of Colorado Avenue S. Additionally, a parking lane would be provided along the east side of the street, south of the Bemis Building.

- Provide both northbound and southbound directional couplets to connect S. Atlantic Street and E. Marginal Way to the south, and Alaskan Way S. to the north. The northbound directional couplet would also provide access to ferry-holding and queuing lanes for Colman Dock. S. Royal Brougham Way would no longer provide the direct, at-grade east–west connection between First Avenue S. and Alaskan Way S.

North of S. Royal Brougham Way the proposed action would:

- Provide a new northbound off-ramp and southbound on-ramp, connecting SR 99 to Alaskan Way S. These ramps would be located just south of S. King Street. The existing northbound on-ramp and southbound off-ramp at Railroad Way S. would be retained.

2.5.2 Other Features

2.5.2.1 Rail

The rail tail track would be relocated west of the new SR 99 roadway and would extend north from the railyard to the vicinity of S. King Street. This will help to maintain the connections between the Whatcom Railyard on the west side of SR 99 and the SIG Railyard on the east side of SR 99.

2.5.2.2 Ferry Holding

Ferry-holding lanes would be constructed between S. Royal Brougham Way and S. King Street along the east side of SR 99.

2.5.2.3 Bicycle and Pedestrian Facilities

Existing pedestrian and bicycle access would be both maintained and improved as part of this project. From S. Holgate Street to about S. Massachusetts Street, a bicycle/pedestrian shared-use path would be located to the west of SR 99. North of S. Atlantic Street, the bicycle/pedestrian path would continue west of the relocated tail track (in accordance with the City of Seattle Bicycle Master Plan) and proceed north to the vicinity of S. Dearborn Street (Figure 2-1).

The existing Waterfront Bicycle/Pedestrian Facility would connect with the future Mountains to Sound Greenway Trail at First Avenue S. and S. Atlantic Street and would connect to the south with the multi-use trail along E. Marginal Way S. Surface streets in the project area would also be widened to add bike lanes along both sides of E. Marginal Way S. and S. Royal Brougham Way, the west side of Alaskan Way S., and the east side of the proposed new northbound Alaskan Way S. directional couplet running along the east side of SR 99 between S. Atlantic Street and Alaskan Way S.

2.6 Construction Activities

2.6.1 Staging Areas

Construction activities would be staged within the existing SR 99 and street right-of-way, where possible. In addition, a portion of the WSDOT-owned property east of the SR 99 alignment would be used. The property lies to the west of First Avenue S. between S. Royal Brougham Way and S. Dearborn Street.

Another primary staging site is bounded by S. Atlantic Street, the existing BNSF rail track under the existing viaduct, S. Royal Brougham Way, and private properties on the east side. Contractors would access the site from either S. Royal Brougham Way or S. Atlantic Street. Later in the project, most of this site would be occupied by the built facility on the west side, and the east side could be used as a work zone for the construction of the northbound Alaskan Way directional couplet. The adjacent WSDOT-owned Trager Building and U-Park sites, located along S. Dearborn Street and Railroad Way S., would also be used for staging.

2.6.2 Construction Working Hours

Construction may occur up to 24 hours per day, 7 days per week at times during the construction period, but would typically take place 5 days per week, 10 hours per day. Some night or weekend work may be required for roadway crossings, rail track relocation, or other critical construction phases.

2.6.3 Construction Haul Routes

Trucking routes are expected to use established routes, including S. Atlantic Street, E. Marginal Way S., S. Michigan Street, and I-5. Haul routes to and from the work zone would use First Avenue S., Fourth Avenue S., or E. Marginal Way S. Material hauled along these routes would include new construction materials as well as demolished structure materials, excavated soil, and spoils created by ground improvement activities.

2.6.4 Construction Equipment

Equipment expected to be used for construction includes:

- Trucks;
- Cranes;
- Pile-driving hammers;
- Backhoes;
- Excavators;
- Drilling rigs;
- Vibrator probes;
- Compactors;
- Loaders;
- Forklifts and manlifts;
- Jackhammers;
- Pumps;
- Grading and paving equipment;

- Compressors;
- Generators; and
- Welding equipment.

2.6.5 Utility Relocations

Relocations of utilities would be required for the project. The temporary and permanent utility relocations would include:

- Water lines and mains;
- Drainage facilities;
- Wastewater facilities;
- Electrical facilities;
- Gas lines; and
- Communication duct bank and lines.

2.7 Construction Methods

Construction of the bridges, street-level facilities, and retained cuts that would comprise the new SR 99 roadway and ramps would require the following activities:

- Utility relocation;
- Drainage improvements;
- Surface street improvements;
- Demolition and removal of materials;
- Support wall construction;
- Ground improvements;
- Substructure installation;
- Retained fill construction; and
- Retained cut construction.

2.7.1 Demolition and Material Removal

The Project would require demolishing and removing all structures south of the intersection of Railroad Way S. and Alaskan Way (Bent No. 121). In total, the viaduct demolition would remove approximately 40,000 cubic yards of reinforced concrete. Demolition and material removal is expected to take about 3 months. The viaduct is composed of steel-reinforced concrete supported on pile foundations. The piles are composite, with the upper portion composed of reinforced concrete and the lower portion of timber. The viaduct would be demolished to approximately 2 feet below the existing ground surface. Pile caps interfering directly with proposed construction and generally below proposed retained fill would also be removed. Demolition would likely require removing the concrete portion of the piles (leaving the timber pile in place) in addition to the pile cap. Approximately 20 foundations would be removed in this manner.

Equipment needed for demolishing and removing the viaduct would include backhoes, front loaders, and excavators with crunching/shearing and hammering attachments. Concrete saws and splitters along with cutting torches would also be used.

Construction staging and traffic detours would use the WSDOT-owned WOSCA property. Three buildings on the property will be demolished; two will be removed by WSDOT independently from this Project and one is scheduled to be removed as part of a separate electrical utility relocation project. . Approximately 1.2 million cubic feet of structure with an estimated material volume of 4,500 cubic yards would be removed. The fourth building (the WOSCA Freighthouse) located at the northern end of the property would not be demolished.

2.7.2 Building the Undercrossing

The U-shaped undercrossing would be built with a retained cut, using an internally braced excavation support wall. The support wall would be constructed of secant piles. Secant pile walls are constructed of overlapping drilled concrete piles. The overlap is created by placing primary piles slightly less than two pile diameters apart; the close spacing ensures that secondary piles placed into the gaps will cut into the adjacent piles to join them.

The secant piles are placed using an oscillator pile drill. The drill's oscillating motion cuts through the varying soil and rock layers and pulls the excavation casing down behind it. A grab bucket is used to clean out the large-diameter cased holes created by the oscillator. Concrete is tremied into the excavation to form the pile as the casing is extracted. Construction of primary piles involves filling in the spaces between secondary piles by boring through the concrete in the secondary piles to key the primary piles between them. Usually only the primary piles are reinforced with reinforcing cages or steel wide-flange sections; however, in some cases, the secondary piles are also reinforced.

2.7.3 Ground Improvement

Ground improvements would be required to offset the risk of soil liquefaction and lateral spreading of soils throughout the project area in the event of an earthquake. These improvements would consist of a combination of deep soil mixing, jet grouting, earthquake drains, and stone columns or displacement piles.

Deep soil mixing would be required along the length of the Project to reduce lateral spreading of soils. The remaining ground improvement methods— earthquake drains, stone columns, and displacement piles—would be used to control potential liquefaction-induced settlement beneath proposed structural earth fills and in the vicinity of bridge abutments and piers. Jet grouting would be used in place of deep soil mixing within the S. Atlantic Street right-of-way where existing utilities preclude access for deep soil mixing equipment.

The construction staging for this Project allows for the deep soil mixing to be completed prior to bridge construction. This would give the deep soil mixing operation unlimited vertical clearance and would improve the construction efficiency. Ground improvements would be needed in an area approximately 50 feet wide below the proposed southbound SR 99 structure between the southern abutment and S. Atlantic Street. Within S. Atlantic Street, a portion of the 50-foot ground improvement area would intersect with utilities and would need to use jet grouting. North of S. Atlantic Street, the deep soil mixing would extend to the west and end at its northern terminus near S. Royal Brougham Way.

Earthquake drains are recommended in a 40-foot-wide band immediately east of the deep soil mixing zone to reduce the potential for liquefaction and reduce lateral pressures imposed on the deep soil mixing zone. Earthquake drains are generally plastic perforated pipe, installed vertically in the ground and spaced at intervals of about 4 to 5 feet apart. They are used to relieve soil pore pressure that builds in a seismic event. This reduces the risk of soil liquefaction. Stone columns (or displacement piles) also reduce seismic event pore pressures as well as stabilize retained fills against ground settlement.

Ground spoils would be produced by both deep soil mixing and jet grouting. Volumes of spoils would range from 30 to 50 percent of treated ground volume for deep soil mixing and from 50 to 100 percent of treated ground volume for jet grouting. Earthquake drains, stone columns, and displacement piles would produce minimal spoils.

2.7.4 Substructure Installation for Foundations

The proposed foundations include drilled concrete shafts, cast-in-place concrete piles, and auger-cast piles or micropiles. The foundations would support steel-reinforced concrete columns and bent caps for all structures except the temporary bridges. Temporary bridge columns and pier caps would be made of steel.

Cast-in-place concrete piles would be used for the southern portion of the bridges carrying SR 99 over S. Atlantic Street. Piles would have 2-foot diameters and would be driven to an average depth of 150 feet. The installation of the concrete piles would entail driving a closed-end, steel pipe pile and casting a concrete pile within the steel pile. The installation would be expected to produce ground vibrations during the pile driving operation, but would produce little or no spoils. A typical pile cap is expected to have a plan dimension of 30 feet by 50 feet and a height of 5 to 7 feet. Approximately 600 cubic yards of soil would be excavated for each pile cap.

The remainder of the mainline bridges, including the transition bridges, would be founded on drilled concrete shafts. The depth of competent soil and the relatively small footprint of drilled shafts make them ideal for this construction. Shafts would most likely be bored using a rotary-oscillator drill rig capable of boring through obstacles within the soil. Each drilled shaft would require the excavation of approximately 250 to 350 cubic yards of soil. A steel reinforcing cage is then placed into the shaft hole, and concrete is tremied to the bottom of the excavation until the hole is filled. A tremie is a pipe or hose that allows the concrete to be placed below water in the shaft excavation. As the water is displaced, it is pumped from the excavation and treated before disposal. The steel excavation casing is extracted as the concrete fills the hole.

Temporary bridges proposed for Traffic Stage 3 would be founded on auger cast piles or micropiles. These pile types would not produce heavy ground vibrations and would protect the existing utilities from damage. The excavation required for one pile would be approximately 10 cubic yards with additional excavation required for pile caps. Total excavation volume is estimated at approximately 650 cubic yards. The pile would be drilled using an auger drill or a rotary drill. A steel reinforcing cage or bar would then be cast into the hole.

Construction of the mainline substructures would be completed with the casting of the reinforced concrete columns and pier caps. This operation would require the erection of steel reinforcing cages and formwork to support the concrete while it cures. In addition to the formwork, construction machinery and workers would require extensive access around the proposed piers. These activities would need to be coordinated with railroad, port, and general traffic.

2.7.5 Retained Fill Construction

Structural earth walls are proposed for all the retained fills. A structural earth wall is restrained with straps that extend into the embankment, so that the wall does not require large footings to counter overturning forces. This allows the wall to be built in a footprint very close to that of the roadway it is supporting. This construction method works well for construction of facilities that are closely adjacent to the railroads or utilities.

Structural earth walls are built by placing and compacting progressive lifts of soil. Retaining straps made from plastic or steel are placed with the lifts at typically 2-foot vertical spacing. The successive layers of soil and retaining straps create a block of soil that acts as a solid wall. The wall's exterior face is typically wrapped with a metal or plastic mesh to prevent erosion; a system of reinforced concrete face panels may also be connected to the retaining straps. The face panels stop erosion and can be cast with architectural finishes.

2.7.6 Retained Cut Construction

Construction of the retained cut structures would consist of secant piles, ground improvements, excavation, concrete bottom slabs, and finally the interior concrete. The retained cuts would be built using an internally braced excavation support wall. The support wall would be constructed of secant piles.

Excavation of the cut would follow the ground improvement activities. Excavation depth is expected to vary between 0 and 40 feet. The maximum depth allows for a concrete seal up to 15 feet thick to be placed at the base of the retained cut. The concrete would be placed with a tremie, and a concrete bottom slab would provide a water barrier to allow the interior of the cut to be dewatered. This is necessary because the existing ground water level is approximately 5 to 10 feet below existing ground surface. The cut would then be pumped empty, and the interior concrete construction and finishes would be completed in dry conditions.

2.7.7 Stormwater Management

The Project is located in an urban setting that currently consists almost entirely of impervious surfaces. Although it will not create any new impervious surfaces, the Project will replace a substantial amount of current impervious surfaces and will result in a 2.1-acre net decrease in impervious surface area. The Project will not increase the total stormwater discharge; rather, approximately 3 million gallons of water per year will be shifted from discharging to Puget Sound via existing conveyance and the West Point Treatment Plant to discharging to Elliott Bay via existing conveyance system and outfalls after basic stormwater treatment. A portion of the stormwater from the Project will continue to be discharged into Puget Sound via the West Point Treatment Plant. Both Puget Sound and Elliott Bay are considered flow-exempt waters; the addition of new volumes of stormwater to flow-exempt water bodies are not considered a concern. A portion of the project area will be retrofitted with stormwater treatment best management practices (BMPs). Details of the proposed stormwater collection and treatment systems are presented in Appendix B and summarized in Table 2-1 and Figure 2-2.

Table 2-1 Replaced Pollution-Generating Impervious Surfaces and Existing and Proposed Stormwater Quality Treatment Facilities in the Project Area

Subbasin	Existing/ Impervious Surface (acres)	Replaced Impervious Surface (acres)	Existing Stormwater Management Approach	Proposed Stormwater Management Approach
Lander	1.3	1.4	Untreated; separated	Treated; separated
Royal Brougham/ Connecticut	21.1	20.0	11.1 acres[1] untreated; to low flow diversion[2]	14.5 acres[1] retrofit with treatment BMPs; conveyed to low flow diversion[2]
			12.1 acres[1] untreated; to combined sewer system	8.6 acres[1] untreated; retrofit with detention BMPs; conveyed to combined sewer system
King	5.5	4.5	Untreated – to combined sewer system	Retrofit with detention BMPs; untreated; ; conveyed to combined sewer system

1 Area inclusive of pervious and impervious surface areas; it was assumed that the entire Royal Brougham basin consists of pollution-generating surfaces for the purpose of the pollutant loading analysis.

2 With low flow diversions, stormwater is diverted into the combined sewer system at low flows. During high flows, this stormwater is discharged to Elliott Bay or the Duwamish Waterway. For this analysis, it is assumed that 90 percent of stormwater runoff is discharged to Elliott Bay via the Royal Brougham–Connecticut outfall and the remaining 10 percent conveyed to the combined sewer system.

During construction, stormwater within the project area will be detained, treated, and discharged, as necessary, in accordance with appropriate state and local permits.

The effective impervious surface area within the action area will decrease as a result of the Project. Some of the existing impervious surface area will become pervious landscaping and open space.

Once the Project is complete, stormwater will be discharged via four pathways:

1. Basic treatment with discharge to existing conveyance and ultimate discharge through existing outfalls to Elliott Bay/Duwamish Waterway;
2. Basic treatment with conveyance to combined sewer system with treatment at West Point Wastewater Treatment Plant prior to discharging via an existing permitted outfall at a depth of 240 feet into Puget Sound;
3. Detention and no treatment before conveyance to combined sewer system, then treatment at West Point Wastewater Treatment Plant prior to

discharging via an existing permitted outfall at a depth of 240 feet into Puget Sound;

4. Detention and no treatment before conveyance to combined sewer system, then discharge to Elliott Bay/Duwamish Waterway as combined sewer overflow (CSO) events through existing outfalls to Elliott Bay/Duwamish Waterway.

Installation of stormwater detention facilities for flows conveyed directly to the combined sewer system in the King and Royal Brougham subbasins and a 3.3-acre reduction of the area in the Royal Brougham subbasin conveyed to the combined sewer system may help to reduce CSO events. However, the beneficial effects of these facilities will not likely result in a measurable change in CSO discharge volumes and frequency given the complexity of the system and the relatively small contribution of stormwater from the project area to the combined sewer system. For example, the portion of the project area within the Royal Brougham subbasin accounts for less than 3% the total area of the Royal Brougham subbasin which is approximately 852 acres according to information from the City of Seattle. The annual CSO frequencies and volumes from outfalls in the project area are expected to remain the same or decrease marginally following construction of the proposed project. All runoff discharged from the project area directly to Elliott Bay and Duwamish Waterways is currently untreated; however, after construction, stormwater from the portion of the Royal Brougham basin routed to the low-flow diverter and the Lander subbasin will be retrofitted with basic treatment BMPs described in the Highway Runoff Manual (WSDOT 2006a) and per City of Seattle drainage code requirements. These treatment provisions will reduce stormwater pollutant loading in Elliott Bay, compared to current conditions. Stormwater will be discharged via existing outfalls in the project area and at the West Point Wastewater Treatment Plant. No new outfalls will be constructed.

2.8 Project Timeline

The overall project duration is expected to be 3 years and 8 months. Construction will begin in fall 2009 and be completed in early 2013. Construction is planned to occur in five sequential stages, as summarized in Table 2-2. Between stages there will be weekend road closures for re-striping the road and changing signs so that traffic is diverted around the area under construction. Following construction, SR 99 will have 3 travel lanes in each direction, the same as currently provided, but with improved lane width, shoulder width, sight distance, and geometrics.

Table 2-2. Construction Sequencing

Stage	Date Range (duration)	Activities
Stage One	(15 months)	▪ Relocate existing utilities. ▪ Construct a temporary Whatcom lead and tail track. ▪ Modify the existing tail track at South Atlantic Street. ▪ Provide a temporary ferry holding area west of the viaduct. ▪ Improve soils along southbound SR 99. ▪ Construct a transition ramp for southbound SR 99. ▪ Construct the east and west halves of the under-crossing. ▪ Construct the west half of the southbound retaining wall. ▪ Construct the southbound detour lanes.
Stage Two	(6 months)	▪ Remove the east half of the existing southbound SR 99 between South Holgate Street and South Massachusetts. ▪ Complete construction of the southbound retained fill structure. ▪ Construct the northbound WOSCA detour.
Stage Three	(8 months)	▪ Remove existing Alaskan Way Viaduct south of Dearborn Street. ▪ Construct the north- and southbound transition structures between South Dearborn Street and South Royal Brougham Way. ▪ Install soil improvement for the transition structures and northbound SR 99. ▪ Begin to construct the east half of the under-crossing.
Stage Four	(9 months)	▪ Construct the final Whatcom lead track. ▪ Connect to the tail track. ▪ Complete construction of the northbound over-crossing. ▪ Complete construction of the east half of the under-crossing.
Stage Five	(6 months)	Complete paving, signing, striping, and other restoration activities on surface streets.

2.9 Minimization Measures

The following measures will be implemented to minimize effects to listed species from the Project:

- A Temporary Erosion and Sediment Control (TESC) Plan and a Stormwater Pollution Prevention Plan will be developed and implemented for all required clearing, vegetation removal, grading, ditching, filling, embankment compaction, or excavation, including ground improvements, drilling, and pouring concrete. The BMPs in the plans will be used to control sediments from all vegetation removal or ground disturbing activities.

- All equipment to be used for construction activities shall be cleaned and inspected prior to arriving at the project site, to ensure no potentially hazardous materials are exposed, no leaks are present and the equipment is functioning properly.

- Heavy equipment will be inspected daily (working days) to ensure there are no leaks of hydraulic fluids, fuel, lubricants, or other petroleum products.

- Erosion control devices (i.e., silt fence) will be installed as needed to protect surface waters. Actual location will be specified in the field, based upon site conditions.

- Should a leak be detected on heavy equipment used for the project, shutdown or repair prior to continued use on the project will occur and immediate action shall be taken to control the source of the pollutant.

- Material storage areas will be located a minimum of 50 feet from surface waters, in currently developed areas such as parking lots or other developed areas.

- The contractor will designate at least one employee as the erosion and spill control (ESC) lead. The ESC lead will be responsible for the installation and monitoring of erosion control measures and maintaining spill containment and control equipment. The ESC lead will also be responsible for ensuring compliance with all local, state, and federal erosion and sediment control requirements.

- Materials subject to erosion that may be temporarily stored for use in project activities will be covered with plastic or other impervious material to prevent sediments from being washed from the storage area to the stormwater system or waters of the state.

- All temporary and permanent erosion and sedimentation control measures will be inspected on a regular basis maintained and repaired to assure continued performance of their intended function.

- Silt fences will be inspected immediately after each rainfall, or at least daily during prolonged rainfall. Sediment will be removed as it collects behind the silt fences and prior to their final removal.

- All silt fencing and staking will be removed upon project completion.

- A concrete truck chute cleanout area shall be established to properly contain wet concrete.

- If necessary, a WSDOT biologist shall re-evaluate the project for changes in design or potential impacts associated with those changes, as well as the status and location of listed species, every 6 months until project construction is completed. Consultation with the Services will be reinitiated if there are changes in project design or changes in listed species.

- A 3-year monitoring plan of revegetated areas will be implemented to ensure 100% survival of vegetation by stem count at the end of one year and 80% survival by stem count at the end of the 3-year monitoring period.

- The contractor shall prepare a Spill Prevention, Control and Countermeasures (SPCC) Plan prior to beginning construction. The SPCC Plan shall identify the appropriate spill containment materials, which will be available at the project site at all times.

- All construction activities will comply with water quality standards set forth in the Implementing Agreement between the Washington State Department of Transportation and the Washington State Department of Ecology regarding Compliance with the State of Washington Surface Water Quality Standards (WSDOT and Ecology 1998) and the State of Washington Surface Water Quality Standards (WAC 173-201A). The current WSDOT/Ecology Water Quality Implementing Agreement allows for a mixing zone not to exceed a specified distance downstream of the project corridor based on the characteristics of the waterbody.

- All exposed soils will be stabilized during the first available period, and shall not be untreated for more than seven days without receiving the erosion control specified in the TESC Plan. For western Washington, no soils shall remain unstabilized for more than two days from October 1 to April 30, and for more than seven days from May 1 to September 30.

- Where practicable, excavation activities shall be accomplished in the dry. All surface water flowing towards the excavation shall be diverted through utilization of berms. Berms must be constructed of sandbags, clean rock, steel sheeting, or other non-erodible material.

- No paving, chip sealing or stripe painting will occur during periods of rain or wet weather.

- There will be no visible sheen from petroleum products in the receiving water as a result of project activities.

- WSDOT policy and construction administration practice is to have a WSDOT inspector on site during construction. The role of the inspector will ensure contract and permit requirements.

- WSDOT environmental staff will provide guidance and instructions to the onsite inspector to ensure the inspector is aware of permit requirements.

Figure 2-1. Project Area

Figure 2-2. Existing and Proposed Stormwater Disposition

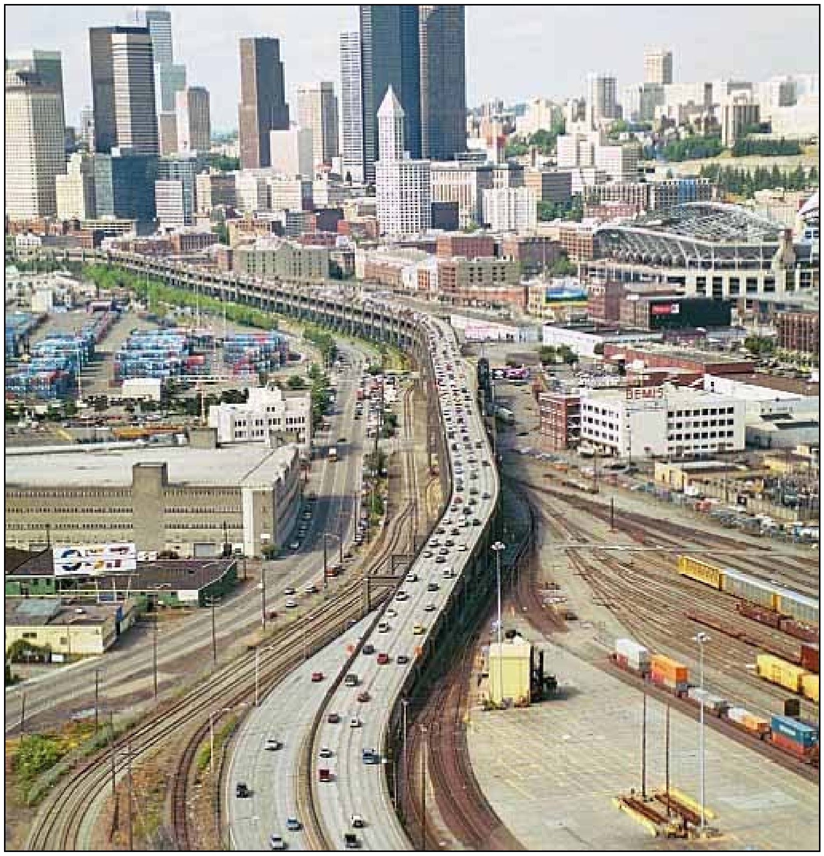
3.0 Action Area

The action area is defined as all areas to be affected directly or indirectly by the Project, and not merely the immediate area directly adjacent to the action. Therefore, the action area includes the project area and all surrounding areas where project activities could potentially affect the environment directly, indirectly or through interrelated or interdependent actions. In this project, the construction activity with the largest area of potential effect is terrestrial pile driving near S. Atlantic Street using an impact hammer. The operational activity with the largest area of potential effect is the stormwater system and its discharges.

The project area is located in a highly urbanized setting that is fully developed along the shoreline for the length of the project area (Figure 3-1) and in all upland areas adjacent to the roadway (Figure 3-2).

Figure 3-1. Aerial view of Alaskan Way Viaduct along Stadiums and Waterfront

Figure 3-2. Aerial view of Project portion of Alaskan Way Viaduct. Photo Looking North from Approximately S. Holgate to Beyond S. King Street (Approximately across from North End of Qwest Field Stadium)



Typical terrestrial ambient noise levels in the downtown Seattle area near the waterfront (such as Pioneer Square and the Colman Dock area) are in the range of 71–83 dBA[1] which is consistent with the elevated noise levels of typical urban and downtown major metropolitan areas (Parsons Brinkerhoff Quade & Douglas 2004). To define the action area, 71 dBA was assumed to be the typical terrestrial ambient noise level along the Elliott Bay waterfront (i.e. the portion of the action area capable of supporting listed species).

The potential direct effects due to construction of the Project are primarily the result of construction activities, such as excavation, grading, removal of the existing viaduct, and installation of cast-in-place concrete piles to carry SR 99 over S. Atlantic Street. Piles would have 2-foot diameters and would be driven through the earth beneath the existing viaduct to an average depth of 150 feet.

[1] Sound measurements in this document are expressed as dBA or dB_{PEAK} where dB signifies “decibels,” the standard unit of sound measurement. dBA indicates A-weighted decibels and is used to describe in-air noise because it is calibrated to the human ear. dB_{PEAK} indicates the highest instantaneous measurement recorded during any given period of time.

The installation of the concrete piles would entail driving a closed-end, steel pipe pile and casting a concrete pile within the steel pile. The installation of the steel pipe piles would be expected to produce airborne noise and ground vibrations during the pile driving operation. Impact hammer pile driving is the loudest construction activity associated with the Project, generating construction effects that could travel the greatest distance from the Project. Vibrations from terrestrial pile driving are a point source and are expected to produce an estimated peak sound pressure of 110 dBA at 50 feet (15.2 meters) in the air (WSDOT 2007). All pile driving will occur in upland areas at distances greater than 280 feet from the nearest waterbody (i.e., Coast Guard slip). Although ground vibrations will occur, it is highly unlikely that these will generate underwater noise at levels sufficient to effect aquatic species, given the distances involved, the various infrastructure located in the soils (e.g., foundations, utility conduits, etc.), and the presence of the seawall and armoring around the waterway. Other sources of noise include point source noise from other construction equipment (e.g., jackhammers, excavators, etc.) estimated at up to 98 dBA and line source noise from vehicle traffic which is estimated to be 86 dBA at 50 feet (15.2 meters) in the air (WSDOT 2007).

Therefore, the area of increased noise over background created by terrestrial impact hammer pile driving has been used to define the extent of the action area based on point source attenuation rates through air (See Section 6.1.1 for the noise analysis). Terrestrial point source noise attenuates at a rate of 6.0 dB per doubling of distance. Based on this approach, the 110 dBA (measured at 50 feet (15.2 meters) distance) produced during pile driving will attenuate to the ambient noise level of 71 dBA at approximately 4,600 feet (1,383 meters) from the pile-driving activities. In reality, pile driving will only occur in a portion of the project area (i.e. near S. Atlantic Street). In most of the project area, the loudest equipment regularly in use (jackhammers) will produce noise in the air of up to 98 dBA (Parsons Brinkerhoff Quade & Douglas 2004) which will attenuate to the ambient noise level of 71 dBA at approximately 1,196 feet (365 meters). Traffic noise (86 dBA) will attenuate to the ambient noise level of 71 dBA at approximately 1,600 feet (489 meters) using an attenuation of 3.0 dB per doubling of distance for line source noise.

The Project generates stormwater in three subbasins (from south to north): Lander Street, Royal Brougham/Connecticut Street, and King Street. The Project will discharge stormwater differently in each subbasin (water quality and stormwater analysis are described in detail in Appendix B). The area around each of these outfalls where pollutant concentrations are above the effect threshold due to stormwater discharge is the underwater action area for stormwater effects. These vary by drainage basin and are described in Appendix B. The aquatic habitats surrounding these outfall locations are within the approximately 4,600-foot (1,383-meter) action area defined by the noise attenuation zone. Therefore the Project action area is all areas within 4,600 feet (1,383 meters) of the project area (Figure 3-3), based on the area of noise attenuation through the air. The action area also includes a 105-foot zone around the West Point Treatment Plant outfall because project stormwater would be discharged through the treatment plant outfall after secondary treatment under most flow scenarios. The 105-foot zone around the outfall was based on the distance at which it is unlikely compounds contained in the discharge will exceed water quality standards (Jones and Stokes 2001).

Figure 3-3. Action Area

4.0 Listed and Proposed Species Occurrence within the Action Area

Listed or proposed species that may occur within the action area were identified from species lists on the NMFS web site (NMFS 2007) and the USFWS web site (USFWS 2007).

Information regarding species occurrence and distribution was obtained from the WDFW PHS database received December 2007 and a review of available literature, including the Seattle Biological Evaluation (City of Seattle 2007). Additional habitat information is presented in Chapter 5 Environmental Baseline.

WSDOT and FHWA have assembled information on rare, sensitive, threatened, and endangered plant species and plant communities that may occur in the project vicinity from the Washington Department of Natural Resources (DNR) Natural Heritage Program (NHP) database. The database does not indicate that any threatened or endangered plants occur within the action area. No federally listed or proposed plant species have been identified within the action area, nor does suitable habitat for these species exist.

Six federally listed species are known to occur, or could potentially occur, within the action area; critical habitat has been designated for four of these species (Table 4-1). The biology of listed species is presented in Appendix C.

Federally listed species occurring in the project vicinity and their current listings were verified on the NMFS and USFWS websites on November 29, 2007.

Additional species and critical habitat identified by the USFWS as potentially present in King County (USFWS 2007) are listed in Table 4-2.

Table 4-1. Federally Listed Species and Critical Habitat that May Occur within the Action Area

Common Name (Scientific Name)	Federal Endangered Species Act Status
Killer whale (*Orcinus orca*) Southern Resident DPS	Endangered
Steller sea lion (*Eumetopias jubatus*)	Threatened
Chinook salmon (*Oncorhynchus tshawytscha*) Puget Sound ESU	Threatened
Steelhead trout (*Oncorhynchus mykiss*) Puget Sound ESU	Threatened
Bull trout (*Salvelinus confluentus*) Coastal/Puget Sound DPS	Threatened
Marbled murrelet (*Brachyramphus marmoratus*)	Threatened
Southern Resident DPS Killer Whale critical habitat	Designated; does not occur in action area
Chinook salmon critical habitat	Designated in action area
Bull trout critical habitat	Designated in action area
Marbled murrelet critical habitat	Designated; does not occur in action area

Table 4-2. Listed Species and Critical Habitat within King County, But Not Addressed in this Biological Assessment

Species common name (*Scientific name*)	ESA status
Canada lynx (*Lynx canadensis*)	Threatened
Gray wolf (*Canis lupus*)	Endangered
Grizzly bear (*Ursus arctos*)	Threatened
Humpback whale (*Megaptera novaeangliae*)	Endangered
Leatherback sea turtle (*Dermochelys coriacea*)	Endangered
Northern spotted owl (*Strix occidentalis caurina*)	Threatened
Marsh sandwort (*Arenaria paludicola*)	Endangered
Golden paintbrush (*Castilleja levisecta*)	Threatened
Fisher (*Martes pennanti*)	Candidate
Northern spotted owl critical habitat	Designated; does not occur in Action area

No suitable habitat exists within the urbanized action area for the species listed in Table 4-2. Examination of the PHS database maps from WDFW and an analysis of habitat types and conditions within the action area showed that these species do not occur in the action area, so they are not addressed further in this BA.

4.1 Killer Whale Southern Resident DPS

In November 2005, NMFS listed the southern resident killer whale (SRKW) DPS as endangered under the ESA (70 FR 69903). In May and June of each year since 1973, the Center for Whale Research in Friday Harbor, Washington, has taken photographs that identify every SRKW individual. This annual survey amounts to a census of the entire population. The population has fluctuated considerably over the 30 years of the study. As of November 2007, the SRKW population is estimated to include 88 individuals (J Pod 26, K Pod 19, and L Pod 43) (Center for Whale Research 2007).

Photo-identification and tracking by boats have documented the ranges and movements of SRKW pods since the early 1970s. Ranges are best known from late spring to early autumn. During this period, all three pods are regularly present in the Georgia Basin, but spend relatively little of their time in Puget Sound (Heimlich-Boran 1988; Felleman et al. 1991; Olson 1998; Osborne 1999, Ford et al. 2000).

During early autumn, SRKW pods (especially J pod) expand their movements into Puget Sound, where they are likely to feed on chum and Chinook salmon (Osborne 1999). Recently, this has been the only time of year that K and L pods regularly use Puget Sound. Similar movements into other seldom-visited waters to forage on salmon are also most likely to occur during early autumn.

During late autumn, winter, and early spring, the ranges and movements of SRKW are less well known. J pod continues to be seen intermittently in the Georgia Basin and Puget Sound (Osborne 1999). Each year since the winter of 1999 to 2000, K and L pods have remained in inland waters until January or February, but are completely absent from the Georgia Basin and Puget Sound from early- to mid-February until May or June. Recent evidence suggests that during this period they may forage off the outer Washington, Oregon and California coast (NMFS 2005a).

The frequency of sightings by month of SRKW individuals in Tidal Reference Area (TRA) 5 between 1993 and 2006 are presented in Table 4-3. This table shows the frequency class of observation during each month for the years 1993 through 2006 and shows that observations are higher from October through February in TRA 5. TRA 5 (Seattle) is defined as all saltwater areas northerly of a line projected true west and true east across Puget Sound from the northern tip of Vashon Island and southerly of a line projected true east from Point Jefferson-47” 15’ N. latitude across Puget Sound. This area includes Port Orchard, Port Madison, and Dyes and Sinclair Inlets (WAC 220-110-240).

Table 4-3. Frequency of Sightings of SRKW Individuals in Tidal Reference Area 5 Between 1993 and 2006

Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
6 - 25	6 - 25	1 - 5	1 - 5	1 - 5	1 - 5	1 - 5	1 - 5	1 - 5	6 - 25	6 - 25	6 - 25

Source: Pers. Comm. B. Norberg, 2006.

4.1.1 Killer Whale Southern Resident DPS Designated Critical Habitat

On November 29, 2006, NMFS designated critical habitat in Washington for SRKWs (71 FR 69054). Under this designation, SRKW critical habitat includes approximately 2,560 square miles (6,630 square kilometers) of the inland waterways of Washington State. The area defined as critical habitat is within the geographical area occupied by the species and contains Primary Constituent Elements (PCEs) required by killer whales. Eighteen military sites are excluded from the designation due to national security impacts.

The shallow waters of Puget Sound (waters less than 20 feet [6.1 meters] deep relative to extreme high water) are not considered to be within the geographical area occupied by the species. Because of their large size, killer whales may experience limited maneuverability in water less than 20 feet deep, and SRKWs are seldom observed in such conditions. However, due to a lack of information regarding SRKW usage of shallow habitat and the fact that transient and Northern Resident killer whales are both known to utilize shallow waters, NMFS has requested further information.

NMFS has designated the following PCEs for the SRKW DPS critical habitat:

- water quality to support growth and development;
- prey species of sufficient quantity, quality and availability to support individual growth, reproduction and development, as well as overall population growth; and
- passage conditions to allow for migration, resting and foraging.

At this time, NMFS lacks sufficient information about the effects of sound disturbance on Killer Whale critical habitat in order to include it as a PCE. However, NMFS will continue to consider sound in any future revisions of the critical habitat designation (71 FR 69055).

4.2 Steller Sea Lion

Steller sea lions occur year-round in Washington waters, but do not breed in Washington (NMFS 1992). The number of sea lions in Washington decline during summer months when they travel to Oregon and British Columbia rookeries for the breeding season. They appear to be the most abundant in the spring and fall. The locations of Steller sea lion haul-outs (onshore rest areas not generally used for breeding) in inland marine waters of Washington State are presented below in Table 4–4.

Table 4–4. Steller Sea Lion Haul-Out Sites, Washington Inland Marine Waters

Marine Region of Washington	Haul Out Location	Latitude / Longitude[1]
Puget Sound	Toliva Shoals Buoy	4712.15 / 12236.25
San Juan Islands	Bird Rocks	4829.16 / 12245.61
	Bird Rocks	4829.23 / 12245.56
	Whale Rock	4826.84 / 12256.46
	Clements Reef	4846.55 / 12253.20

[1]Latitude and Longitude reported in decimal degrees

Source: Jefferies et al. (2000) and pers. comm. A. Agness (2007)

Within Washington State inland marine waters, Steller sea lion haul-outs occur primarily around the San Juan Islands, with one haul-out located at the Toliva Shoals Buoy in southern Puget Sound. Less than ten Steller sea lions have been seen on buoys off Toliva Shoals south of Steilacoom (Jefferies et al. 2000). Other haul-outs in Canadian waters within Puget Sound are located at Race Rock off Vancouver Island in the Strait of Juan de Fuca and near Vancouver Island in the Belle Chain Area near Saturna Island and at Trial Island (Jefferies et al. 2000). None of these documented haul-out sites are within the action area.

Steller sea lions are known to migrate into Puget Sound. Documented sightings in central Puget Sound have occurred within the project action area near tribal fishing nets in Elliott Bay and in the Duwamish Waterway. Steller sea lions were also seen in the area between October 1987 and January 1988 during the steelhead fishing season (Gearin et al. 1988; Chumbley 1993; Gearin et al. 1999; Jeffries et al. 2000).

Steller sea lions feed in open water habitat in nearshore areas, out to the edge of the continental shelf (WDFW 1993a). Stomach and scat analysis in British Columbia indicates that principal prey items include hake (*Merluccius productus*), herring (*Clupea* spp.), octopus (*Octopus* spp.), Pacific cod (*Gadus macrocephalus*), rockfish (*Sebastes* spp.), and salmon (Olesiuk et al. 1990).

4.3 Puget Sound Chinook Salmon ESU

Puget Sound ESU Chinook salmon are known to occur in the Green-Duwamish River basin (WDFW 1993b) and to pass through Elliott Bay as they migrate from Puget Sound to the Green-Duwamish River. Additionally, juvenile Chinook salmon from many other Puget Sound Basin river systems migrate and forage along Elliott Bay shorelines in the spring months. During this brief but important phase of their life cycle, they remain close to the shoreline and near the water surface (Table 4-5).

The abundance of Puget Sound Chinook salmon has declined greatly from historic levels. There is concern for the effects of hatchery supplementation on genetic fitness of the stock, as well as severely degraded spawning and rearing habitats throughout the area (Myers et al. 1998).

The Green-Duwamish River Chinook are a mix of wild and hatchery-produced fish. They are considered a "healthy" stock based on escapement levels (WDFW 2002a) Good et. al. (2005, cited in City of Seattle, 2007) estimated the average number of adult Chinook spawning in the watershed was 13,815 between 1998 and 2002, with 83 percent of the fish spawning from 1997 to 2001 originating in hatcheries.. They are nearly all summer/fall run fish that begin entering the Duwamish River as adults in mid-June, reach peak abundance in August, and continue entering the river through October and early November (Weitkamp and Ruggerone 2000; City of Seattle 2007).

Natural reproduction occurs outside of the project action area, mainly in the middle and upper Green River, with mainstem spawning occurring in the Green River from river mile (RM) 24 to RM 61. The City of Seattle has also conducted surveys for Chinook in Longfellow Creek, a tributary to the lower Duwamish River's West Waterway, since 1999. One spawning pair and one potential Chinook salmon redd was noted in Longfellow Creek in 2001. This is also outside of the project action area.

Chinook salmon fry emerge from gravel beds during late winter and spring. Past studies have shown Green River Chinook salmon fry emerge from the gravel in late February through April, with peak migration not occurring until mid April (Dunstan et al. 1955, Hilgert and Jeanes 1999, Jeanes and Hilgert 2000). However, surveys conducted from 2001–2003 by Nelson et al. (2004) and confirmed by a 2004-2005 study by the U.S. Army Corps of Engineers (Corps 2005a) observed two peaks of out-migrating juvenile Chinook, with the early run arriving in the Duwamish estuary as early as January and February, with a peak of outmigration generally occurring from mid-February to mid-March. The majority of out-migration occurs during the earlier window (City of Seattle 2007). Lower levels of juvenile Chinook out-migration are observed in late March and April, followed by the second wave of out-migration by older, larger juveniles peaking in May and June. Out-migration lasts through early to mid-July (City of Seattle 2007).

The following can be summarized from Corps (2005a):

- The arrival time of young of the year (YOY) Chinook salmon in the Duwamish Waterway appears limited by developmental stage.
- During the period sampled in 2004–2005, YOY were first captured in nearshore beach seines on January 20, peaking in early February, then again in late February.
- Highest numbers of YOY Chinook salmon (64 percent of total captured) were captured at the two stations furthest upstream (upstream of Duwamish River Mile 5 near the fresh water-salt water transition zone).

- YOY were only captured in the nearshore beach seines (none were caught by purse seine in the mid-channel areas.
- There were twice the numbers of YOY caught in nighttime versus daytime beach seines.
- Age 1+ Chinook salmon were caught in very low numbers throughout the study period, both in the nearshore and in the main channel.

Juvenile Chinook migrate to and through the Duwamish River estuary and Elliott Bay, spending from a few days to about three months in the vicinity (Myers et al. 1998, Weitkamp and Ruggerone 2000). Out-migrating juveniles use transition zone area of the Duwamish River around RM 5 where fresh and marine waters first mix to acclimatize themselves to marine water and rear (City of Seattle 2007). They then rapidly migrate through the lower Duwamish, on average rearing for only one tidal cycle below the transition zone before moving out of the estuary (City of Seattle 2007). Within the action area, most juvenile Chinook salmon are hatchery fish from the Soos Creek and Wallace Falls hatcheries, although none of the YOY Chinook observed by the Corps study (Corps 2005a) were of hatchery origin.

Table 4-5. Salmon Observations from Diving and Snorkeling Surveys

Survey Type	Fish and Invertebrate Species	Count	Location	Dates of Obs	Transect	Transect Aspect Relative to Pier Line[1] or Seawall[2]	Location of organisms relative to shade structure:
Snorkeling	Chinook salmon	28	Pier 57/56	8/11/2006	1	0–20 ft	A
Snorkeling	Chinook salmon	3	Pier 57/56	8/11/2006	4	+40 ft	E
Snorkeling	Chinook salmon	6	Pier 55/54	8/16/2006	1	0–20 ft	A
Snorkeling	Chinook salmon	1	Pier 55/54	8/16/2006	2	20–40 ft	A
Snorkeling	coho salmon	1	Pier 57/56	8/11/2006	2	20–40 ft	A
Snorkeling	coho salmon	2	Pier 55/54	8/16/2006	2	20–40 ft	A
Diving	juvenile salmonids	100	Pier 57/56	8/7/2006	2	North	E
Diving	juvenile salmonids	100	Pier 55/54	8/7/2006	2	North	E
Diving	coho salmon	1	Pier 62/59	8/16/2006	3	North	E

[1](North, South, Mid Channel) [2](0–20 ft, 20–40 ft, +40 ft)

E = edge; A = away

Source: Hayworth pers. comm.

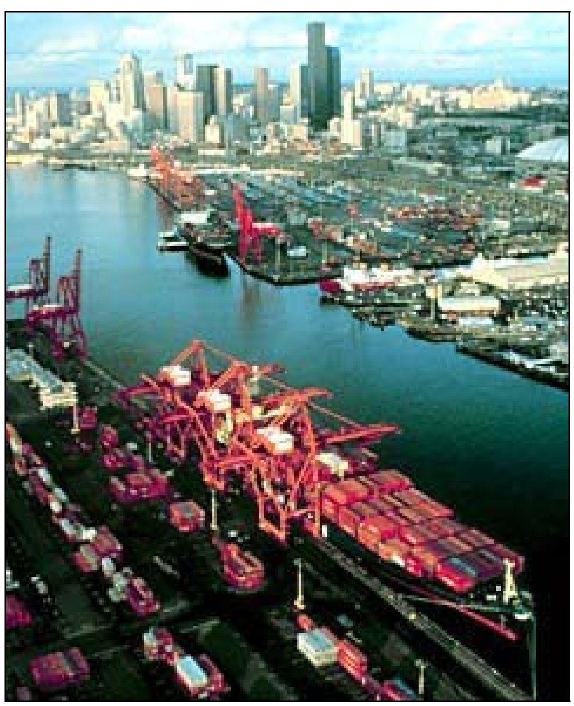
Chinook salmon fry rear and migrate in shallow water along shorelines during their estuarine and early marine residence (Healey 1991). Juveniles are seldom observed in water deeper than approximately 2 meters (6 feet) until they have grown to 70 to 80 millimeters (approximately 3 inches) in length, although they do sometimes migrate near the surface water in deeper waters farther from shore. Migration primarily occurs at night (Healey 1991). Both locally spawned and non-local juvenile Chinook use the nearshore areas in the Duwamish estuary and Elliott Bay for rearing. These juveniles may re-enter the marine areas of the lower Duwamish during the summer and winter after out-migration (City of Seattle 2007). Therefore, juvenile Chinook salmon could be present in some number during all months of the year.

As adult Chinook salmon migrate through the action area on the way to spawn in the Green-Duwamish River, they typically migrate in deeper waters offshore from the docks and piers of Elliott Bay. Adults also congregate at the mouth of the Duwamish prior to upstream migration.

4.3.1 Puget Sound Chinook Salmon ESU Designated Critical Habitat

Critical habitat for Puget Sound Chinook salmon was designated on September 2, 2005 (70FR52630). Critical habitat within the Project action area includes the urbanized shoreline of the Duwamish River East Waterway and Elliott Bay (principally the Coast Guard vessel slip) (Figure 4-1).

Figure 4-1. Urbanized Shoreline of Duwamish River East Waterway and Coast Guard Vessel Slip (lower right of photo)



Nearshore marine areas of Puget Sound designated as Chinook salmon critical habitat extend from the extreme high water line out to a depth of 30 meters (98 feet), which is the approximate depth of light penetration. This designation includes all nearshore and Duwamish River waters in the action area to a depth of 30 meters (98 feet).

NMFS has defined primary constituent elements (PCEs) for Chinook salmon critical habitat. The PCEs that apply to critical habitat for Chinook salmon in estuarine-marine areas include:

- Estuarine areas free of obstruction with water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh and salt water; natural cover such as submerged and overhanging large woody debris, aquatic vegetation, large rocks and boulders, and side channels; and juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation.
- Nearshore marine areas free of obstruction with water quality and quantity conditions and forage, including aquatic invertebrates and fishes, which support growth and maturation; and which possess natural cover such as submerged and overhanging large woody debris, aquatic vegetation, large rocks and boulders, and side channels.
- Offshore marine areas with water quality conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation.

4.4 Puget Sound Steelhead DPS

Puget Sound steelhead DPS were listed as threatened on May 11, 2007 (72 FR 26722). Steelhead from the Puget Sound DPS are present in the Green-Duwamish River (WDFW 2003). Both winter and summer and juvenile steelhead from the Green-Duwamish River and other river systems may occur within the action area during any time of year. During the migration from fresh to saltwater, steelhead may spend a considerable amount of time in Puget Sound (Puget Sound Steelhead Biological Review Team 2005) and extensively utilize nearshore habitats for rearing after leaving fresh water.

Both a summer and winter stock of steelhead are present in the Green-Duwamish River. The summer steelhead population is considered depressed, based on escapement levels (WDFW 2002b). Historically, there is no evidence of summer steelhead in the Green-Duwamish River prior to hatchery introductions; it is a non-native stock with composite (wild and hatchery) production (WDFW 2002b).

Summer run steelhead return to the Green-Duwamish River watershed from April through October (WDFW et al 1994; City of Seattle 2007). Spawning timing for natural spawners is unknown, but is assumed to be similar to that of hatchery-origin summer steelhead adults in the Green-Duwamish River, from mid-January through mid-March (WDFW 2002b).

The Green-Duwamish winter steelhead population is considered healthy, based on escapement levels (WDFW 2002b). It is a native stock with wild composition that returns to freshwater from November through May and spawning occurs from February and through the end of June, with a peak in mid-May (Grette and Salo 1986; City of Seattle 2007). Both summer and winter steelhead generally spawn above RM 30.0.

The principal juvenile salmonid out-migration season for steelhead, coastal cutthroat trout, and coho salmon occurs from mid-April through mid-June (Grette and Salo 1986, Corps 1998). Steelhead smolts emigrate from the Green-Duwamish River watershed from the middle of March to the middle of July for both winter and summer stocks (City of Seattle 2007).

Juvenile steelhead have been reported from the nearshore environment of Elliott Bay, but they are exceedingly rare. One survey involving 390 beach seines in 2002 and 2003 found several hundred juvenile Chinook salmon, but only two juvenile steelhead (Shannon 2006 pers. comm.). Another survey involving 600 beach seines in 2001 and 2002 found 2,400 juvenile Chinook salmon, but only nine juvenile steelhead (Brennan 2006 pers. comm.).

4.5 Coastal/Puget Sound Bull Trout DPS

Bull trout are classified as native char by WDFW. Native char include bull trout and Dolly Varden (*Salvelinus malma,* a related species); the two species cannot reliably be distinguished without genetic analysis.

The USFWS listed bull trout in the Coastal/Puget Sound DPS as threatened under the ESA on November 1, 1999 (USFWS 1999). The Coastal/Puget Sound DPS of bull trout includes the Skykomish River/Snohomish River subpopulation, which is unique because it is thought to contain the only anadromous forms of bull trout within the contiguous U.S. (USFWS 1998a). The decline of bull trout has been attributed to habitat degradation, blockage of migratory corridors by dams, poor water quality, the introduction of competing non-native species, and the effects of past fisheries management practices (USFWS 1998a).

Little information exists regarding the current distribution of bull trout in Elliott Bay and the Duwamish River basin, but some native char have been observed in the Duwamish River mainstem and its major tributaries (King County DNR 2000a, Bill Taylor pers. comm. in Goetz et al. 2004), and there is conclusive evidence that anadromous bull trout occur in various areas of Puget Sound (Kraemer 1994; Goetz et al. 2004).

Anadromous forms typically return to fresh waterduring late spring and summer, where they spawn from August through December in upper tributaries and headwater areas that have low water temperatures (Goetz et al. 2004, cited in City of

Seattle 2007). Some bull trout may begin their spawning migration as early as April. Young anadromous bull trout usually rear in fresh water two or three years before migrating to salt water in the late winter and spring (Wydoski and Whitney 2003). However, the stock status and life history strategies of the Green-Duwamish River subpopulation are officially described as unknown (WDFW 1998, USFWS 1998b). Anadromous bull trout migrate extensively, and enter rivers other than their natal systems to feed or spawn (Armstrong 1984), meaning that bull trout produced in other river systems may migrate to the Green-Duwamish River and Elliott Bay.

Spawning habitat for bull trout is not accessible in the Green-Duwamish River system. Bull trout do not spawn near the project area or action area. However, adult bull trout are believed to utilize the estuaries and reaches of river systems that do not support spawning, such as the Duwamish River. Bull trout are believed to forage on juvenile salmonids and other fish while occupying these areas. The lower Green/ Duwamish River system is considered foraging, migrating and overwintering habitat for bull trout, with individuals observed in the lower Duwamish likely originating from other watersheds (City of Seattle 2007).

Few bull trout have been observed in the Duwamish River. Four adult char were captured near RM 7 in 1978 (Brunner 1999, cited in City of Seattle 2007). More recently, Taylor and Associates, working for the Port of Seattle, captured nine sub-adult char in the turning basin of the lower Duwamish (RM 5.3) (Corps 2005b; City of Seattle 2007). Of these nine char, six were caught in August 2000, two were caught in September 2000, and one was caught in September 2002. The size of these fish ranged from 223 to 370 mm with a mean size of about 290 mm, corresponding to mostly sub-adult sized fish. The most recent capture occurred at Kellogg Island in May 2003. This fish was a large adult (585 mm) (J. Shannon, Taylor and Associates, E. Jeanes, R2 Resource Consultants, pers. comm.; cited in Corps 2005b). However, weekly beach seining between December 2004 to July 2005 of a variety of sites between RM 1 and RM 8.5 did not produce any bull trout (G. Ruggerone, NRC, pers. comm. 2006, cited in City of Seattle 2007).

Habitat suitable for bull trout in the action area is limited to open-water estuarine foraging habitat. The number of bull trout, as well as the timing and duration of their use of the Duwamish River estuary and Elliott Bay are uncertain. The identification of a few individuals in adjacent areas indicates that bull trout may occur within the action area. The aquatic portion of the action area includes the mouth of the east waterway of the Duwamish River, which may serve as a foraging area for bull trout produced in other Puget Sound streams. However, bull trout are not likely to be attracted to the project area as compared to other portions of Elliott Bay or farther upstream in the Green-Duwamish River, based on the absence of forage fish habitat or conditions likely to encourage forage fish to congregate within the project area.

4.5.1 Coastal/Puget Sound Bull Trout DPS Designated Critical Habitat

Critical habitat for bull trout was designated on September 26, 2005 (70 FR 56212), and includes the nearshore areas of Elliott Bay and the Duwamish River within the action area.

As with Pacific salmon and steelhead, critical habitat for bull trout is described in terms of PCEs. For marine nearshore areas, the inshore extent of critical habitat is the mean higher high water (MHHW) line. MHHW refers to the average of all the higher high-water heights of the two daily tidal levels. In nearshore marine areas, critical habitat thus includes the tidally influenced freshwater heads of estuaries. Adjacent shoreline riparian areas, bluffs, and uplands are not designated as critical habitat. However, the quality of marine habitat along shorelines is influenced by these adjacent features, and human activities that occur outside of the MHHW line can have major effects on physical and biological features of the marine environment (70 FR 56212).

The USFWS has defined PCEs for bull trout critical habitat in estuarine-marine areas to include:

- Permanent water having low levels of contaminants such that normal reproduction, growth, and survival are not inhibited. Habitat Indicators: sediment, chemical contamination and nutrients, change in peak/base flows.
- Migratory corridors with minimal physical, biological, or chemical barriers between spawning, rearing, overwintering, and foraging habitats, including intermittent or seasonal barriers induced by high water temperatures or low flows. Habitat indicators include: life history diversity and isolation, persistence and genetic integrity, temperature, chemical contamination/nutrients, physical barriers, average wetted width/maximum depth ratio in scour pools in a reach, change in peak/base flows, and refugia.
- An abundant food base including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish. Habitat indicators include: growth and survival, life history diversity and isolation, riparian conservation areas, and floodplain connectivity. The importance of aquatic habitat condition is indirectly covered by the previous two PCEs.
- Few or no predatory, interbreeding, or competitive non-native species are present. Habitat indicators include: persistence and genetic integrity, and physical barriers.

4.6 Marbled Murrelet

Marbled murrelets are diving sea birds that forage almost exclusively in the marine nearshore environment, usually within 0.6 to 1.2 miles from the shore, and nest in mature conifers, with nesting areas occurring up to 50 miles inland from the marine environment (USFWS 1997).

There is no suitable marbled murrelet nesting habitat in the action area and no mapped nesting sites have been documented within one mile of the highly urbanized project area. For this reason, no nesting marbled murrelets are expected to occur in the action area. Foraging may occur within the action area but not in proximity to construction activities.

PHS data do not contain any records of marbled murrelets within the action area (WDFW 2007). However, the WDFW conducted aerial surveys of seabirds, including marbled murrelets, in Puget Sound as part of the Puget Sound Ambient Monitoring Program (PSAMP). These surveys were conducted beginning in 1993 and continuing through 1999 for the summer surveys and 2004 for the winter surveys. They found low concentrations of marbled murrelets adjacent to the action area, with small groups of one to two birds observed off West Point during summer (Nysewander et al. 2005). Although West Point is located approximately 5 miles northwest of the project area, the action area includes only the underwater area within 105 feet of the West Point Treatment Plant's outfall.

Marbled murrelets are highly mobile birds. Their offshore distribution is linked to various environmental factors including proximity to mature forests, the distribution of rocky shorelines and substrates versus sandy shorelines and substrates, and the abundance of kelp. The presence of prey species also determines areas of regular marbled murrelet use (USFWS 1997). Marbled murrelets feed on a variety of small fish and invertebrates, including sand lance (*Ammodytes* spp.), Pacific herring (*Clupea pallasi*), northern anchovy (*Engraulis mordax*), smelt (*Spirinchus thaleichthys*), seaperch (family Embiotocidae), euphausiids, mysids, and gammarid amphipods (USFWS 1997), all of which may be present in the action area.

Marbled murrelets may occur within any portion of the action area during all times of the year. However, use of the area directly adjacent to the project area is not expected due to high levels of human activity on the waterfront and boat activity on the water.

4.6.1 Marbled Murrelet Designated Critical Habitat

The USFWS designated critical habitat for the marbled murrelet in 1996 (61 FR 26255). All designated critical habitat for this species occurs in areas containing potential current or future nesting habitat, and no foraging areas are included.

Although marine environments that support prey species are essential to marbled murrelets, none of these areas have been designated as critical habitat (61 FR 26255), or are included in a proposed change to marbled murrelet critical habitat designation (71 FR 53838), because specific marine areas that are essential for the conservation of the species have not been identified. All currently designated and proposed critical habitat is located in the terrestrial environment.

Under the proposed revisions, PCEs for marbled murrelet habitat would include:

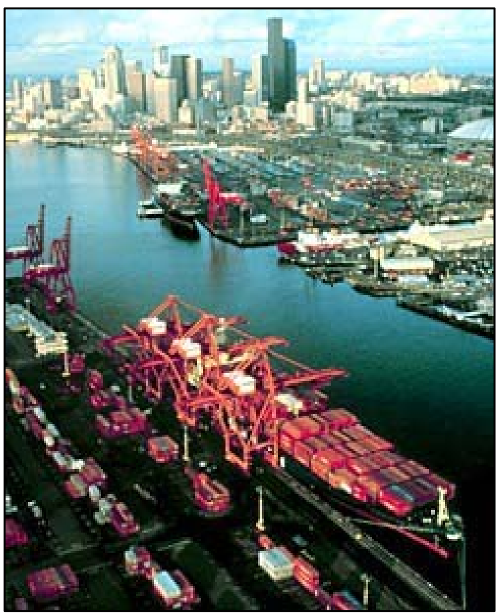
- forested stands containing large trees, generally more than 32 inches (81 centimeters) in diameter with potential nesting platforms at sufficient height, generally greater than or equal to 33 feet (10 meters); and
- the surrounding forested areas within 0.5 mile (0.8 kilometer) of these stands with a canopy height of at least half the site potential tree height.

The action area does not include any designated or proposed critical habitat for the marbled murrelet.

5.0 Environmental Baseline

The Elliott Bay and Duwamish Waterway shoreline is a highly modified portion of Puget Sound with significant commercial, industrial, and residential development (Figure 5-1). The lower end of the Duwamish River (downstream of River Mile 5.5) is the heavily industrialized portion known as the East and West Duwamish Waterways. The shoreline along the waterways is heavily riprapped and developed for industrial and commercial operations and the upland areas are heavily industrialized. The shoreline consists of a seawall backed by concrete sidewalks, paved roadways, and buildings, and fronted by piers. According to a survey by TerraLogic GIS and Landau Associates (2004) conducted in 2004 and confirmed by project biologist site visits, no riparian vegetation occurs along the shoreline. Aquatic vegetation consists of limited areas of algae. There is no documented eelgrass, forage fish spawning or extensive macroalgae present.

Figure 5-1. Elliott Bay and Duwamish East Waterway Shoreline in Action Area

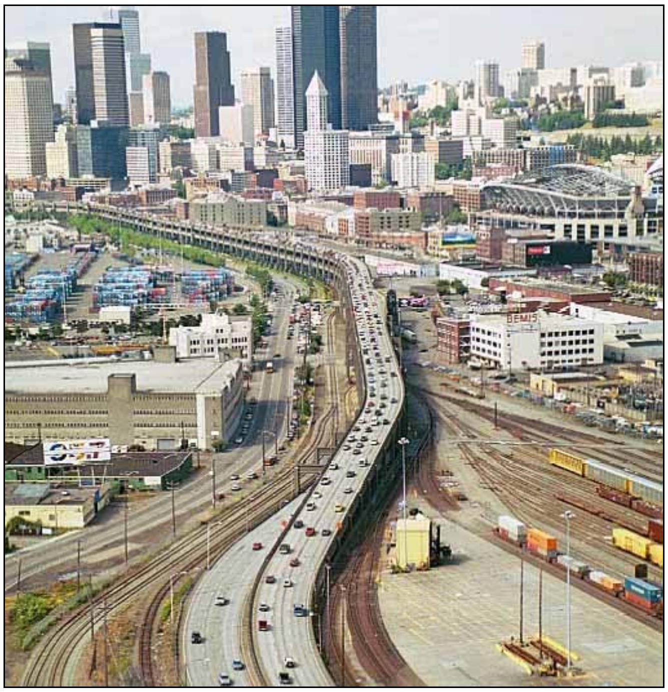


Ambient sound levels within the action area are elevated due to high levels of human activity along the waterfront, primarily roadway vehicle and boat traffic. Twenty-four hour day/night above-water sound levels measured in the project area ranged from 71 to 83 dB (Parsons Brinkerhoff Quade & Douglas 2004). Typical aquatic ambient noise levels in Elliott Bay at Pier 70 were found to be 147 dB_{PEAK} (Laughlin 2006).

Similar noise levels are likely present within the Duwamish Waterway, due to its highly industrialized nature and use as a major marine shipping route for containerized and bulk cargo.

Terrestrial habitat within the action area includes the industrial lands along either side of the viaduct, which include rail lines and cargo ship facilities, as well as the U.S. Coast Guard mooring slip, Qwest Field and Safeco Field. This area is densely developed for commercial, residential, and industrial uses, and contains very little natural vegetation (Figure 5-2).

Figure 5-2. Terrestrial Portion of Action Area



The following text provides definitions for each environmental baseline indicator as well as a discussion of the status, function, and expected changes of each indicator within the action area after project completion. When available, information for the West Point Treatment Plant outfall has been included because project stormwater will be treated and then discharged into Puget Sound via the outfall under most flow conditions.

5.1 Water Quality

5.1.1 Turbidity

Elliott Bay is not listed by Ecology as exceeding any turbidity standards or otherwise identified as having excessive turbidity; thus this indicator is properly functioning. The Duwamish River also is not identified by Ecology as overly turbid, but it provides the primary sediment input to Elliott Bay.

Water quality sampling data from the U.S. Geological Survey (USGS) gauge located at the Foster Golf Links golf course in Tukwila, Washington (Station No. 12113390) indicates that for the period of 1995 to 2004, the Duwamish River reached its maximum suspended sediment levels generally between December and March. Based on water quality data collected in the Duwamish River by King County between 1996 and 1999, average turbidity ranged from 2.0 to 6.4 nephelometric turbidity units (NTUs) during non-storm conditions and from 14 to 92 NTUs during storm events (King County DNR 2000b).

Springbrook Creek is a major contributor to turbidity levels in the lower Duwamish River due to its monthly average turbidity levels of between 12 and 23 NTUs, with higher average turbidity levels generally found between January and June (King County 2005). During and after construction, this indicator will be maintained in the action area, as the project will be managed so that turbid water generated during construction is not discharged to the Duwamish Waterway or to Elliott Bay as a result of implementation of BMPs. Any construction-related discharges will comply with the Project's NPDES construction permit.

5.1.2 Chemical Contamination/Nutrients

The waters of the Duwamish River (River Mile 11 to 0) are designated Class B waters (good) by the Department of Ecology (King County DNR 2000b). Pollutants within the Duwamish River are derived primarily from industrial point and non-point sources, storm water runoff, discharges from vessels, and resuspension of contaminated bottom sediments.

Elliott Bay and the Duwamish Waterway are on Ecology's 303(d) list of threatened and impaired waters. The Duwamish Waterway is listed on Ecology's 2004 303(d) water quality assessment list as impaired for the following chemical contaminants: PAHs, total PCBs, and pesticides and their metabolites (4,4'–DDD, 4,4'–DDE, 4,4'–DDT and alpha-BHC) (Ecology 2006). While the trend for water quality in the area is one of overall improvement as a result of efforts to address chemical sources along the Duwamish River, the high level of chemical contamination within the Duwamish River estuary and Elliott Bay indicates that the chemical contamination indicator is not properly functioning.

The area of Puget Sound surrounding the West Point Treatment Plant outfall is not listed on Ecology's 303(d) list as having impaired water quality for the surveyed parameters. Water quality at the West Point Treatment Plant deep-water outfall is monitored by King County Ambient Marine Monitoring Program (Station number KSSK02). In 2004 and 2006, as well as in previous years, the station met geometric mean and peak standards for fecal coliform bacteria concentrations (Stark et al 2006, King County 2007a). In 2004, the average bacteria count at the outfall averaged less than 1 CFU/100 mL, while maximum counts ranged from 0 to 7 CFUs/100 mL (Stark et al 2006). Wastewater released from the West Point Treatment Plant has the potential to contain metals, organic compounds, or other chemicals of concern such as aluminum, copper, mercury, chlorine, phthalates or phenols. However, it is unlikely that any of these compounds ever exceed standards beyond 105 feet (32 meters) of the outfall (Jones and Stokes 2001). Additionally, in the last five years, West Point has not had an exception to its NPDES permit, which stipulates that the chronic mixing zone must not exceed 430 feet (131 meters) and the zone of acute criteria exceedance must be less than 43 feet (13.1 meters).

Published data on background concentrations of constituents of concern in stormwater runoff from roadways (e.g., Total and Dissolved Copper, Total and Dissolved Zinc and Total Suspended Sediments) in Elliott Bay and the Duwamish Waterway is limited. The project team, however, was able to obtain water quality data from King County. The data was collected in 1996 and 1997 as part of the King County CSO Water Quality Assessment of Elliott Bay and the Duwamish River (King County Department of Natural Resources 1999). A summary of the data is presented in Table 5-1.

Table 5-1. Background Water Quality within the Vicinity of the SR 99 S. Holgate Street to S. King Street Viaduct Replacement Project Area

Sample Location	Depth Below Surface	Copper, Dissolved	Copper, Total	Total Suspended Solids	Total Suspended Solids, 0.45µm	Zinc, Dissolved	Zinc, Total
Units	***(m)***	***(µ/L)***	***(µ/L)***	***(mg/L)***	***(mg/L)***	***(µ/L)***	***(µ/L)***
Elliott Bay							
CON/C1[1]	1	0.73	1.20	8.88	18.16	1.83	2.04
CON/C2[1]	20	0.39	0.56	8.29	21.48	0.82	0.82
CON/E1[1]	1	0.73	1.22	8.13	19.40	2.06	2.53
CON/E2[1]	14	0.44	0.62	8.35	22.27	1.00	0.98
LTED04[2]		ND	ND	2.56	ND	ND	ND
Duwamish River							
HNF/C1[1]	1	0.65	1.17	10.03	19.18	2.17	2.59
HNF/C2[1]	9.8	0.50	0.74	8.47	19.27	1.18	1.33
HNF/E1[1]	1	0.69	1.20	9.15	19.45	2.20	2.62
HNF/E2[1]	6.7	0.45	0.73	8.10	19.45	1.37	1.53
HNF/W1[1]	1	0.80	**1.24***	9.14	18.07	**2.40***	2.79
HNF/W2[1]	14.7	0.45	0.69	7.87	19.06	1.20	1.33
State Water Quality Standards							
Units		***(µg/L)***	***(µg/L***			***(µg/L)***	***(µg/L)***
Acute[3]		4.80	5.80			90.00	95.10

[1]Samples collected between 10/1996 and 06/1997

[2]Samples collected at multiple depths at the same location between 02/1997 and 10/2007

[3]Values for dissolved metals from Table 240(3) of WAC 173-201A-240 Toxic Substances. Marine conservation factors have been applied to these concentrations to account for the difference between marine and freshwater per footnotes dd and II in Table 240(3).

*Bold values represent the maximum values observed

Presently, all stormwater within the project area in the King subbasin and a portion of the stormwater from the Royal Brougham subbasin (12.1 acres) is conveyed to the City's combined sewer system. Stormwater discharged to Elliott Bay from the project area does not receive any treatment. The Project will provide basic treatment for stormwater from the portion of the Lander subbasin within the project area and the portion of the Royal Brougham subbasin (14.5 acres) that will be conveyed to the low-flow diverter and discharged via Connecticut Outfall to Elliott Bay (see Appendix B for additional information on the low-flow diverter).

Considering the size of the project area relative to the total area of the King, Royal Brougham, and Lander subbasins[2] and the level of development within the watersheds of Elliott Bay and the Duwamish River, the improved quality of stormwater discharges from the Lander and Royal Brougham portion of the project area is not anticipated to measurably alter water quality in Elliott Bay. Thus, the chemical/contaminant indicator will be maintained, albeit slightly improved, in the action area.

5.1.3 Temperature

Elliott Bay is not listed as exceeding water temperature criteria (Ecology 2006). Water temperatures within Elliott Bay were collected during surveys for non-indigenous species at seven sites in 2001, and were recorded between 12°C and 16°C (WDNR 2001). Ecology also has conducted water quality monitoring in Elliott Bay about once a month from 1991 until 2002. This data shows that, at 5 meters depth, water temperature fluctuates between approximately 7.7°C and 16.4°C (Ecology 2006).

Temperatures in the lower Duwamish are primarily influenced by the relative temperatures of the warmer freshwater inflow on the surface and the cooler saltwater intruded from Elliott Bay (Warner and Fritz 1995). The lower Duwamish Waterway was not identified as impaired for this parameter on Ecology's 2002/2004 303(d) list.

King County conducted a water temperature study to characterize temperature conditions in the Green-Duwamish watershed. The downstream-most recording station (GRT01) was located at the South Park Marina between River Mile 4 and 5 and recorded a maximum temperature of 21°C and a minimum temperature of 4°C between July 2001 and February 2002 (King County 2002). Between 2001 and 2003, exceedances of water quality standards were observed at this station based on both the 1997 temperature criteria (21°C at the monitoring site) and 2003 temperature criteria (17.5°C 7-day average of the daily maximum temperature at the monitoring site) (Taylor Associates and King County 2004).

King County Water and Land Resources Division (WLRD) also has conducted ongoing monitoring of the Duwamish at several stations (0305, 0307, 0309, and

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[2] Based on information available from City of Seattle and Black&Veatch, the total area of the King and Royal Brougham basins is 144 and 852 acres, respectively. The total area of the Lander Subbasin was not available at the time this document was written.

0311). The maximum temperatures at these stations have increased by approximately 2ºC since the monitoring began in the 1970s. Over that time period, the 5-year moving mean temperature at the 14th Avenue recording station (0307) has increased from slightly warmer than 10ºC to approximately 12ºC (King County 2002).

Generally, the water temperature in Elliott Bay and the action area is functioning properly under existing conditions. The Project will not increase or decrease water temperature in the action area. Therefore, this indicator will be maintained in the action area.

5.1.4 Dissolved Oxygen

Elliott Bay is listed as a Category 1 waterbody for dissolved oxygen (DO) (Ecology 2006), meaning that it meets state standards. King County data collected in 2002 and 2003 show four instances of DO level lower than minimum criteria. However, staff from the Ecology Marine Unit reviewed this data and determined that the sample location is subject to incursions of upwelling with low DO bottom waters. This upwelling shows no evidence of human-caused sources and is therefore a natural condition (Ecology 2006). DO levels are thus properly functioning in Elliott Bay.

The Duwamish Waterway is listed on Ecology's 2004 303(d) water quality assessment list as impaired for DO in the west waterway. This listing is based on water quality monitoring by King County that shows excursions beyond the dissolved oxygen criterion in all years between 1998 and 2001. These excursions generally occur in mid- and late summer (Herrera 2005).

The King County Ambient Marine Monitoring Program also monitors DO levels at station number KSSK02 (West Point Treatment Plant Outfall). Measurements made in 2004 were similar to previous years, and found that DO concentrations at all offshore stations surveyed ranged from 4 to 13.9 mg/L throughout their depth, with mean concentrations of 6.8 mg/L (Stark et al 2006). Surface DO levels were often higher than levels at greater depths due to naturally occurring conditions. The lowest levels of DO were associated with deep samples in the late summer and fall and are attributed to influxes of oceanic waters and decomposition of earlier phytoplankton blooms. Higher levels were associated with increased primary production in the spring and summer in the upper 35 meters sampled. Little difference is seen between the DO measured at outfall and ambient offshore monitoring stations, indicating the effluent from the outfalls does not impact the level of DO (Stark et al 2006).

DO in construction water and operational stormwater discharges to Elliott Bay are expected to meet state standards. Considering the size of the project area subbasins (30.5 acres) relative to the watershed the Green-Duwamish River (492 square miles) and the level of development within the Elliott Bay watershed, the Project is not anticipated to measurably alter DO levels in Elliott Bay or the lower Duwamish River. Therefore, this indicator will be maintained in the action area.

5.2 Stormwater

5.2.1 Stormwater Quality and Quantity

Stormwater from the action area is either conveyed to the King County Combined Sewer System or it is discharged via three stormwater/Combined Sewer Overflow (CSO) outfalls to Elliott Bay or the Duwamish Waterways (Figure 2-2). From south to north, these outfalls include Lander, Royal Brougham/Connecticut and King. Little of the stormwater currently discharged to Elliott Bay and the Duwamish Waterways receives primary treatment and most of it is generated by pollution-generating impervious surfaces. Stormwater discharged to the King County combined sewer system is normally conveyed through the Combined Sewer System to a
large County conveyance pipe under Second Avenue known as the Elliott Bay Interceptor (EBI) The EBI conveys flows to King County's West Point Treatment Plant for treatment and then discharge to Puget Sound. However, when the combined sewer system exceeds capacity, CSO discharges occur directly into Elliott Bay and the Duwamish Waterways.

CSOs are a recognized source of water pollution that can result in temporary increases in bacterial counts and aesthetic degradation of shorelines. Over time, they can have adverse effects on sediment quality at discharge points (King County, 2007b). King County and the City have been implementing CSO control projects to improve water quality in the Seattle area. Compared to the 1982-1983 baseline average, the total volume of CSO discharges from the King County Wastewater conveyance and treatment system was reduced by 70.5 percent for the 2006-2007 reporting period (King County, 2007b).

Stormwater conveyance within the project area is complex and is different within each of the three basins. However, none of the stormwater from the project area currently discharged to Elliott Bay or the Duwamish Waterways receives primary treatment, and most of it is generated by pollution-generating impervious surfaces.

- ***Lander Subbasin:*** currently, stormwater runoff in the Lander Sub-basin is collected in a separated stormwater collection system and discharged to the Duwamish Waterway. The larger Lander Basin is still served by a combined sewer system, and King County manages the Lander outfall as an overflow for the combined sewer system.

- ***Royal Brougham Subbasin:*** Stormwater runoff in this subbasin is either collected in the combined sewer system or collected in a stormwater system, which flows to a low-flow diversion structure. The low-flow diversion structure diverts the first flush of stormwater (approximately 10 percent of the average annual volume) from approximately 11.1 acres to the combined sewer system; it is then conveyed to the West Point WWTP or discharged as part of a combined sewer overflow. The remainder of stormwater (from approximately 12.1 acres) is diverted to the shared stormwater/combined sewer Royal Brougham/Connecticut outfall, where it is discharged to Elliott Bay with no treatment.

- ***King Subbasin:*** Stormwater runoff in this subbasin is collected in the City of Seattle storm drainage system and conveyed it to the combined sewer system, where under normal conditions it is conveyed to the West Point WWTP for treatment and discharge to Puget Sound. During large storm events, stormwater runoff is discharged directly to Elliott Bay as part of an untreated combined sewer overflow

As mentioned above, under normal conditions, wastewater in the combined sewer system is conveyed to the West Point Wastewater treatment facility via the EBI. Stormwater conveyed to West Point receives treatment and is discharged to Puget Sound. However, during some storm events the capacity of the EBI is exceeded and a part of the stormwater is discharged to Duwamish Waterway and Elliott Bay as untreated CSOs.

In order to avoid bias from a particularly stormy or dry year, data for the number of CSO events and the volume discharged in millions of gallons by these events has been collected for 2002 to 2007 and averaged. The monthly averages of these events are presented in Table 5-2 below.

Table 5-2. Average Number of CSO events and the Discharge Volume by Month for 2002-2007

Month	King Street		Connecticut		Lander	
	# of occurrences	Volume (million gallons)	# of occurrences	Volume (million gallons)	# of occurrences	Volume (million gallons)
June	0.50	0.40	1.00	<0.01	0.60	0.23
July	0.00	0.00	0.00	<0.01	0.00	<0.01
August	0.75	2.78	0.00	<0.01	0.20	0.26
September	0.50	0.07	0.50	<0.01	0.00	<0.01
October	1.25	4.57	0.00	<0.01	0.60	36.26
November	3.25	5.52	2.67	<0.01	3.20	22.62
December	2.40	5.71	2.67	4.72	2.20	22.04
January	3.40	8.19	1.67	4.83	3.40	36.88
February	0.60	0.52	0.33	0.69	1.00	1.48
March	1.00	1.95	0.33	1.48	1.00	5.93
April	0.80	0.37	0.00	<0.01	0.40	0.55
May	1.60	0.59	1.00	0.07	0.20	1.30
Totals	**16.05**	**30.66**	**10.17**	**11.79**	**12.80**	**127.56**

Source: King County annual CSO control reports downloaded from http://dnr.metrokc.gov/wtd/cso/library.htm.

The majority of these events occur in November, December and January , although discharges have been recorded in all months except July. For more information on

CSO discharges, King County prepares annual CSO control reports, which can be downloaded from http://dnr.metrokc.gov/wtd/cso/library.htm. King County is not currently monitoring CSO discharge concentrations for pollutants of concern; however, the most recent data obtained from King County are provided in Table 5-3.

Table 5-3. Concentrations Used to Characterize Combined Sewer Overflows

Pollutant of Concern	Concentration in Combined Sewer Overflows	Data Source
Total Suspended Solids	71.8 (mg/L)	Average King Street CSO data (King County 1998)
Total Copper	47 (µg/L)	Average King Street CSO data (King County 1998)
Dissolved Copper	22 (µg/L)	Average King Street CSO data (King County 1998)
Total Zinc	143 (µg/L)	Average King Street CSO data (King County 1998)
Dissolved Zinc	55 (µg/L)	Average King Street CSO data (King County 1998)

[1]Data source: King County CSO monitoring program for King and Connecticut Outfalls 1996 - 1997
[2]Data source: King County Lander separation project monitoring program 1993 – 2002
[3]Concentration data for Lander is for stormwater runoff only, CSO concentration data not collected
[4]Data represents a single sampling event
ND = No data

The Project will decrease the area of pollution-generating impervious surface within the action area from approximately 26.1 acres under existing conditions to approximately 22.8 acres under proposed conditions, a reduction of 3.3 acres. The Project will also increase the pervious area from approximately 2.7 acres to, at a minimum, 4.7 acres, an increase of 2.1 acres (see Appendix B for a summary of these changes within each subbasin). The Project will provide basic treatment for stormwater from the Project area within the Lander subbasin and the portion of the Royal Brougham subbasin, which is routed to the low-flow diverter. Additionally, the proportion of the Royal Brougham basin conveyed to the low-flow diverter will increase from 11.1 acres to 14.5 acres resulting in less volume entering the combined sewer system. Although less water will enter the combined sewer system, it is unlikely this will result in a measurable decrease in the frequency or volume of CSO events in the system due to the comparatively small area in question relative to the total size of the Royal Brougham subbasin. While changes to stormwater management in this basin will increase the total volume of stormwater routed to the low-flow diverter and discharged to Elliott Bay, basic treatment will reduce the concentrations of copper, zinc, and total suspended solids in the stormwater; similarly, the total annual load of these constituents will be reduced compared to current conditions. Stormwater from the remainder of the Royal Brougham basin (8.6 acres) and the entire King subbasin will continue to be conveyed to the combined sewer system; however, stormwater detention facilities will be installed. Again, the detention facilities may help to reduce CSO events, but the beneficial effects of these facilities will not likely result in a measurable change due to the complexity of the system.

Any project stormwater that is conveyed to King County's regional treatment plant at West Point in Discovery Park in Seattle would be discharged via an existing permitted deepwater outfall after undergoing treatment. The outfall pipe is approximately 3,600 feet long and discharges at a depth of 240 feet into Puget Sound. Discharge is slowly released from a 500-foot long diffuser and rapidly mixed with surrounding waters.

In summary, because the size of the project area subbasins (30.5 acres) is negligible compared to the total area of the basins that drain into these water bodies[3], the Project is not expected to produce any measurable water quality improvement within the action area. In addition, although modifications within the project area to stormwater conveyance in a portion of the Royal Brougham subbasin and installation of stormwater detention in the King and a portion of the Royal Brougham subbasin will reduce and slow stormwater conveyed to the combined sewer system, the benefits will not likely be measurable given the size and complexity of the combined sewer system. Therefore, this indicator will be maintained within the action area. Additional information on stormwater analysis is presented in Appendix B.

5.3 Sediment

5.3.1 Sedimentation Sources and Rates

The ShoreZone mapping program, conducted by the Washington Department of Natural Resources, indicates that approximately 90 percent of Elliott Bay shoreline is riprapped or armored with rubble, and 16.2 percent has vertical bulkheads or seawalls (Nearshore Habitat Program 2001). Along much of the shoreline, bulkheads or seawalls are present in the upper intertidal zone, with riprap or rubble in the lower zone. It is reasonable to infer that based on these levels of shoreline modification, changes in the natural sediment transport processes have occurred.

Shoreline modifications in Elliott Bay have extensively altered both sediment supply and sediment transport processes. Sediment processes have also been dramatically altered for sediment flowing through the Green-Duwamish River system into Elliott Bay through the straightening of the river, the construction and operation of Howard Hanson Dam, and periodic maintenance dredging of the lower river.

[3] Based on information available from City of Seattle and Black&Veatch, the total area of the King and Royal Brougham basins is 144 and 852 acres, respectively.

Therefore sediment transport processes are not properly functioning within the action area.

The Project does not entail any activities that will alter sediment supply or the storage or transport processes and conditions described above. Thus, this indicator will be maintained within the action area.

5.3.2 Sediment Quality

Sediments in Elliott Bay and the lower Duwamish Waterway are contaminated with a variety of substances. Studies indicate that several organic compounds such as PCBs and PAHs, as well as metals such as mercury, cadmium and zinc, are present in the sediments of some areas of Elliott Bay and the Duwamish Waterway at levels that exceed state standards. Chemicals of concern found at elevated concentrations in Elliott Bay include low and high molecular weight polynuclear aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs) and tributyltin (NMFS and USFWS 2005).

In 2001, the U.S. Environmental Protection Agency (EPA) placed the Lower Duwamish Waterway on its National Priorities List, also known as the Superfund List, for contaminants in the waterway sediments. These contaminants include polychlorinated biphenyls (PCBs), polyaromatic hydrocarbons (PAHs), mercury and other metals, and phthalates. The highest concentration of contaminated sediments is within the east and west waterways and west of Harbor Island, which are all EPA Superfund sites. In 2003, The Lower Duwamish Waterway Group (LDWG), a local public private partnership, proposed and EPA approved seven early action sites for sediment cleanup. Cleanups are already completed at some sites while work continues at others.

In the years immediately prior to 1998, offshore sediments within the King County wastewater service area met regulatory threshold toxicity limits for organic pollutants and metals (King County WTD 1998). The Puget Sound Ambient Monitoring Program (PSAMP) also conducted sediment monitoring at the Shilshole monitoring station (station number 29), located approximately 3 miles to the north of the West Point Treatment Plant diffuser. PSAMP surveyed the levels of over 180 priority pollutant metal and organic contaminants, including polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), pesticides, and other compounds. These samples, taken from 1989 to 1996 and also in 2000, did not exceeded Washington State's Sediment Quality Standards and Clean-up Screening Levels (Chapter 173-204 WAC) for that particular site (Partridge et al 2005).

Sediment quality indicators are not properly functioning based on the level and extent of pollution within Elliott Bay and the lower Duwamish River.

The Project will not excavate or remove any contaminated sediments from the Elliott Bay shoreline or the Lower Duwamish Waterways. The Project is not anticipated to have any measurable effect on overall sediment quality within Elliott Bay or the lower Duwamish River. Thus, this indicator will be maintained within the action area.

5.4 Habitat Condition

5.4.1 Fish Access/Refugia

Substantial habitat alteration and loss has occurred in the lower Duwamish River and Elliott Bay during the historical period. By 1940, all tidal swamps formerly bordering the Duwamish River had been filled (King County DNR 2001). To create new land for development and deeper channels for navigation, 98 percent of shallow areas, flats, and tidal marshes in the Duwamish were eliminated by 1986. Over the last 100 years, the braided flows of the lower river have been extensively channelized and reduced to a single permanent channel (the Duwamish Waterway) through dredging and construction of levees. Dredging has resulted in the replacement of 9.3 miles of meandering tidal channel habitat with the 5.5 miles of deeper channel habitat that exists today (Bloomberg et al. 1988). Although some recent projects in the Duwamish have tried to create or restore refugia, this indicator is still not properly functioning.

Due to the depth of the diffuser (240 feet), no salmonids habitat is associated with the West Point Treatment Plant outfall pipe.

The Project does not entail any activities that will alter the level of shoreline armoring, overwater surface area or nearshore habitat available and accessible to juvenile salmonids. Thus, this indicator will be maintained within the action area.

5.4.2 Depth

Currently most shorelines around Elliott Bay and the Duwamish Waterways consist of seawalls, bulkheads and/or riprap, with the result that almost no shallow water habitat remains. Remaining littoral habitats are further limited due to shading by overwater structures, which line much of the Elliott Bay shoreline and the Duwamish Waterways. Littoral habitat depth is therefore not properly functioning.

The Project does not entail any activities that will alter habitat depths in Elliott Bay and the Duwamish Waterways. Thus, this indicator will be maintained within the action area.

5.4.3 Substrate

Littoral habitat substrates consist of riprap, cobble, gravel and mud in Elliott Bay. Littoral habitat substrates are also dominated by riprap and other artificial substrates (such as bulkheads, seawall, rubble and pilings) along the lower Duwamish River waterways. Littoral habitat substrates are not properly functioning.

The Project does not entail any activities that will alter the nature, amount, or configuration of littoral habitat substrate. Thus, this indicator will be maintained within the action area.

5.4.4 Slope

Historical and current changes to shoreline slopes are described above under the "depth" indicator. This condition is not expected to improve in the near term and could potentially become further degraded, although this Project will cause no further degradation. Shoreline slope is not properly functioning.

The Project does not entail any activities that will alter littoral habitat slope conditions. Thus, this indicator will be maintained within the action area.

5.4.5 Shoreline

All habitat condition indicators discussed above document the altered and degraded condition of the Elliott Bay shoreline and littoral zone. Shoreline armoring has decreased the area of the littoral zone, and overwater structures impair light penetration to the water. The ratio of shoreline length to littoral zone area is not known, but based on the level of development and modifications to the nearshore areas of Elliott Bay, it can be assumed that shoreline length has decreased as nearshore habitats have been eliminated or straightened. On the Duwamish River, no natural shoreline occurs downstream of River Mile 6.0. Shoreline conditions are not properly functioning along Elliott Bay and lower Duwamish River waterways.

The Project does not entail any activities that will alter shoreline conditions. Thus, this indicator will be maintained within the action area.

5.4.6 Riparian Conditions

ShoreZone mapping indicates that approximately 11 percent of shoreline of Elliott Bay has native riparian vegetation (Kerwin and Nelson 2000). Due to intensive development along the Elliott Bay shoreline and resulting loss of natural riparian vegetation, riparian habitat is not properly functioning.

The eastern shoreline of the east waterway has widely scattered and sparse patches of riparian vegetation comprised mainly of opportunistic/invasive species such as Himalayan blackberry (*Rubus armeniacus*) and Scott's broom (*Cytisus scoparius*).

The Project does not entail any activities that will remove or otherwise modify any riparian vegetation. Thus, this indicator will be maintained within the action area.

5.4.7 Flow and Hydrology/Current Patterns/Saltwater-Freshwater Mixing Patterns

The hydrology and influx of fresh water to Elliott Bay has been altered by human-caused changes within the Green-Duwamish River watershed, the Lake Washington watershed and the Puyallup River watershed.

By 1996 the mean annual flow to the Duwamish had been reduced to about 1,700 cubic feet per second, with substantially lower flow variability compared to natural conditions (Kerwin and Nelson 2000). Flow in the Duwamish River is controlled by the U.S. Army Corps of Engineers through releases from the Howard Hanson Dam.

These alterations have affected the Duwamish River in a number of ways. The severe reduction in drainage area and management of floods has eliminated the large floods that historically created side channels and sloughs, deposited large woody debris, formed deltas, and transported sediment deposits. The diversion of the White River removed the largest sediment source in the basin. Reductions in fresh water input, coupled with dredging of the Duwamish Waterway, allow salt water to penetrate further up the estuary than it did previously. Based on these changes to the salt water-fresh water mixing patterns, current patterns and flow and hydrology are now not properly functioning.

The Project does not entail any activities that will alter currents and hydrology or measurably alter salinity mixing patterns. Thus, this indicator will be maintained within the action area.

5.4.8 Overwater Structures

Littoral habitat adjoining the project area is more than 75 percent covered by overwater structures. Thus the indicator is not properly functioning for the action area.

The Project does not entail any activities that will alter the number or extent of overwater structures. Thus, this indicator will be maintained within the action area.

5.4.9 Disturbance

Disturbance sources in Elliott Bay include propeller scour, boat mooring, and overwater structures such as piers, debris deposition, and shoreline armoring (Kerwin and Nelson 2000). The east and west waterways are also a major shipping route for containerized and bulk cargo and are consequently subject to high volumes of marine traffic. Based on the level of disturbance to flow patterns from all activities, natural flow patterns are likely not properly functioning.

The Project does not entail any activities that will alter the number or extent of overwater structures or sources of flow pattern disturbance. Thus, this indicator will be maintained within the action area.

5.5 Biota

5.5.1 Prey—Epibenthic and Pelagic Zooplankton

A considerable amount of nearshore habitat has been lost in Elliott Bay and the tidally-influenced portions of the Duwamish River. Historic changes to the nearshore environment include shoreline armoring, removal of riparian vegetation, construction of overwater structures, discharges of wastewater, placement of thousands of piles, and vessel operations. Such pervasive changes to the physical and chemical habitat of the bay are assumed to have caused substantial changes in the numbers and species of epibenthic and pelagic zooplankton.

Moreover, some of these changes have eliminated important resource inputs such as sunlight, nutrients from nearshore riparian communities, and longshore transport of materials, while other changes have delivered pollutants to the sediments and water column. Such changes are severely detrimental to ecosystem productivity. Therefore epibenthic and pelagic zooplankton populations are not properly functioning.

The Project does not entail any activities that will alter nearshore or shoreline habitat or could affect epibenthic or pelagic zooplankton populations. Thus, this indicator will be maintained within the action area.

5.5.2 Prey—Riparian and Terrestrial Insects

As described previously, due to intensive development along the shorelines of Elliott Bay and lower Duwamish River waterways, nearly all natural riparian vegetation has been destroyed. Thus the habitat for many traditional riparian and terrestrial insects that serve as salmonid prey has been removed and this prey resource is now not properly functioning.

The Project does not entail any activities that will alter riparian habitat or could affect riparian or terrestrial insect production. Thus, this indicator will be maintained within the action area.

5.5.3 Benthic Species and Infauna

Localized impacts on benthic infauna have been documented in the Duwamish Waterway, and are associated with CSO outfalls. In 1999, King County DNR looked at the benthic infaunal communities at three CSO outfalls and three reference points not located near a CSO outfall in the Duwamish River waterway, near Kellogg Island. Benthic infaunal abundance was significantly higher at the reference points than at the points near the CSO outfalls (King County DNR 1999).

Benthic infauna abundance within Elliott Bay is likely somewhat lower than in other, less urbanized Puget Sound inlets. Overwater structures, CSO outfalls, contaminated sediments and treated pilings, commercial and recreational boating activity, and upland development all create environmental impacts that will impair benthic ecosystem productivity and diversity. Thus benthic infauna communities are likely not properly functioning under current conditions.

PSAMP conducted benthic infauna surveys between 1989 and 2000 at the Shilshole monitoring station (station number 29) located approximately 3 miles to the north of the West Point Treatment Plant diffuser. These surveys found that, on average, the monitoring station had a moderate total abundance of benthic infauna between 200 and 700 organisms per 0.1 square mile. The benthic community was not very diverse, with molluscs, mainly *Macoma carlottensis*, composing more than 50 percent of the infauna (Partridge et al. 2005).

The Project will utilize the existing stormwater outfalls at Lander Street, S. King Street, and Royal Brougham/Connecticut Street. The Project will decrease the area of pollution-generating impervious surface within the action area from approximately 26.1 acres under existing conditions to approximately 22.8 acres under proposed conditions, a reduction of 3.3 acres. The Project will also increase the pervious area from approximately 2.7 acres to 4.7 acres, an increase of 2.1 acres (see Appendix B for a summary of these changes within each subbasin). The Project will provide primary treatment for stormwater from the project area within the Lander basin and the Royal Brougham basin which is routed to the low-flow diverter and the portion of the Royal Brougham conveyed to the low-flow diverter will increase from 11.1 acres to 14.5 acres. Changes to stormwater management in the Royal Brougham basin will increase the total volume of stormwater routed to the low-flow diverter thereby reducing volumes entering the combined system and lessening the potential for a combined sewer overflow. Additionally, basic treatment in both basins will reduce the concentrations of copper, zinc and total suspended solids in the stormwater which is routed to the Connecticut outfall and the total annual load of these constituents will be reduced compared to current conditions.

In summary, the Project will increase the amount of operational stormwater that receives primary treatment before being discharged to Elliott Bay, the Duwamish Waterway, and Puget Sound and will provide treatment for construction stormwater.

Currently, the stormwater discharged to Elliott Bay in the project area receives limited or no primary treatment, so the Project will result in a beneficial change. However, considering the size of the project area (30.5 acres) relative to the basins that drain to Elliott Bay and the level of development within the watersheds of Elliott Bay and the Duwamish River, the improved quality of stormwater discharges from the Project is not anticipated to measurably alter benthic infauna communities near the outfalls. Thus, this indicator will be maintained in the action area.

5.5.4 Prey—Forage Fish

The nearest documented forage fish spawning occurs west of Elliott Bay on the northwest shoreline of Alki Point, outside of Elliott Bay. Pacific sand lance (*Ammodytes hexapterus*) and surf smelt (*Hypomesus pretiosus*) spawn in this area. No forage fish spawning has been documented in Elliott Bay (Kerwin and Nelson 2000). Historically, forage fish spawning may have occurred in Elliott Bay; however, the virtual absence of beaches effectively precludes forage fish spawning along the Seattle waterfront.

Forage fish populations are thus not properly functioning in Elliott Bay or the lower Duwamish River.

The Project does not entail any activities that will alter the nearshore environment nor alter potential forage fish habitat. Thus, this indicator will be maintained within the action area.

5.5.5 Aquatic Vegetation

The depths, substrate types, and steep slopes of the intertidal and shallow subtidal portions of the shoreline do not provide appropriate habitat characteristics for eelgrass (*Zostera marina*). The nearest documented eelgrass is several miles to the west of the project area at Duwamish head on the south end, and several miles away on the north end of West Point (but at depths much shallower than the outfall pipe).

Macroalgae are present on suitable hard substrates within the littoral zone. However, the majority of the action area extends below depths where aquatic vegetation occurs. The foremost limit on macroalgal production is overwater structures, which although common near the project area are scarce enough in the action area to be "properly functioning." However, the presence of additional stressors such as vessel operations and pollutants are likely also impairing aquatic vegetation productivity, so that it is likely functioning at risk.

Lower intertidal and shallow subtidal habitat along the shorelines of Elliott Bay and Duwamish Waterways includes a variety of species of green, red and brown algae commonly found in Puget Sound. Table 5-4 below provides a list of macroalgae species identified during dive and shoreline surveys in 2002. These algae were observed covering the shallow water bottom along the waterfront (0–30 feet MLLW) in the larger open areas where sufficient light reaches to support their photosynthetic activity and where hard substrates or debris provide attachment surfaces.

The Project does not entail any activities that will alter littoral zone substrates or overwater structures which could affect macroalgae. Thus, this indicator will be maintained within the action area.

Table 5-4. Species of Macroalgae Identified in Shallow Subtidal and Intertidal Areas along the Seawall

Type/Common Name	Scientific Name	Occurrence
Green Algae		
sea hair	*Enteromorpha intestinalis*	common
sea lettuce	*Ulva fenestrata*	common
sea cellophane	*Monostroma grevillei*	common
Red Algae		
crisscross network	*Polyneura latissima*	common
red ribbon	*Palmaria mollis (palmata)*	common
bull-kelp laver	*Porphyra nereocystis*	common
Turkish towel	*Chondracanthus exasperatus*	common
splendid iridescent seaweed	*Mazzaella splendens*	common
winged rib	*Delesseria decipiens*	occasional
violet sea fan	*Callophyllis violacea*	occasional
Turkish washcloth	*Mastocarpus papillatus*	occasional
sea spaghetti	*Gracilaria sjoestedtii* or *pacifica*	occasional
Brown Algae		
sugar kelp	*Laminaria saccharina*	common
wireweed	*Sargassum muticum*	common
seersucker	*Costaria costata*	common
rockweed	*Fucus gardneri (distichus)*	common
ribbon kelp	*Alaria marginata*	common
bull kelp	*Nereocystis luetkeana*	occasional

Source: Weitkamp et al. 2002.

5.5.6 Non-indigenous Species

Non-indigenous species have been introduced to Puget Sound through a variety of means, including discharges of ballast water from ships, packing materials for seafood shipped from overseas, and intentional or unintentional establishment by the mariculture industry. Non-indigenous species may compete with or displace indigenous species, inflicting severe damage on the food web and the nearshore ecosystem (Kerwin and Nelson 2000).

The 2000 Washington State Exotics Expedition identified 15 non-indigenous species in the waters of Elliott Bay and the Duwamish River estuary (WDNR 2001). Several of the species are native to the north Atlantic, six are from the northwest Pacific Ocean, one to the Black and Caspian seas, and one is of unknown origin. The species observed are identified in Table 5-5 below (WDNR 2001). Based on the presence of these species, coupled with the amount of industrial, commercial and recreational shipping traffic, which provides a mode for the introduction of additional non-indigenous species within Elliott Bay and the Duwamish Waterway, the non-indigenous species indicator is functioning at risk.

The Project does not entail any activities that will alter the potential modes for introduction of non-indigenous species, and will not alter habitat conditions such that habitat conditions may favor non-indigenous species. Thus, this indicator will be maintained within the action area.

5.5.7 Ecological Diversity

Elliott Bay habitats have increased amounts of pollutants, more habitat fragmentation, and highly altered disturbance regimes in comparison with the early historic conditions. The diversity of pelagic and groundfish species, infauna, and epifauna in Elliott Bay is relatively unknown. Exotic or non-indigenous species have been documented in Elliott Bay, as discussed in the preceding section. Pelagic fish, groundfish, infauna, and epifauna populations are likely smaller and less diverse than in other similar bays and estuaries that do not have such intensive development or human activity, either in upland or aquatic areas.

PSAMP conducted benthic infauna surveys between 1989 and 2000at the Shilshole monitoring station (station number 29), located approximately 3 miles to the north of the West Point Treatment Plant diffuser. These surveys found that, on average, the monitoring station had a moderate total abundance of benthic infauna, between 200 and 700 organisms per 0.1 square mile. The benthic community was not very diverse, with molluscs, mainly *Macoma carlottensis*, composing more than 50 percent of the infauna (Partridge et al. 2005).

Ecological diversity in and around Elliott Bay, including the lower Duwamish Waterways, is thus not functioning properly.

The Project will use the existing stormwater outfalls at Lander Street, S. King Street, and Royal Brougham/Connecticut Street. As discussed above, the Project will increase the amount of operational stormwater that receives treatment before being discharged to Elliott Bay and the Duwamish Waterway.

Table 5-5. Exotic Species Collected in Elliott Bay

General Taxon	Species	Sites Collected
Protoctista: Algae: Phaeophyta	*Sargassum muticum*	Myrtle Edwards Park, Pier 90 Beach, Magnolia Park, Seacrest Park
Cnidaria: Hydrozoa	*Cordylophora caspia*	Turning Basin
Annelida: Polychaeta	*Hobsonia floridana*	Kellogg Island Passage, Turning Basin
Annelida: Polychaeta	*Pseudopolydora kempi japonica*	Kellogg Island Passage
Mollusca: Bivalvia	*Mya arenaria*	Magnolia Park, Kellogg Island Passage,
Mollusca: Bivalvia	*Venerupis philippinarum*	Kellogg Island Passage
Arthropodia: Crustacea: Cumacea	*Nippoleucon hinumensis*	Magnolia Park, Kellog Island Passage, Seacrest Park
Arthropodia: Crustacea: Tanaidacea	*Sinelobus stanfordi*	Turning Basin
Arthropodia: Crustacea: Amphipoda	*Corophium acherusicum*	Pier 90 Beach
Arthropodia: Crustacea: Amphipoda	*Corophium insidiosum*	Bell Harbor Marina, Pier 90 Beach, Kellogg Island Passage
Arthropodia: Crustacea: Amphipoda	*Grandidierella japonica*	Kellogg Island Passage
Bryozoa:Cheilostomata	*Cryptosula pallasiana*	Bell Harbor Marina, Myrtle Edwards Park
Bryozoa:Cheilostomata	*Schizoporella unicornis*	Bell Harbor Marina, Myrtle Edwards Park, Seacrest Park
Urochordata: Ascidiacea	*Botrylloides violaceus*	Myrtle Edwards Park
Urochordata: Ascidiacea	*Botryllus schlosseri*	Bell Harbor Marina

6.0 Effects Analysis

This chapter describes the mechanisms of potential effects on the federally listed species described in Chapter 4. Direct effects are divided into effects on species and effects on critical habitat, and the discussion of effects on species is organized around the principal effects (e.g., noise, turbidity, etc.). Subsequent sections discuss indirect effects, effects of interrelated and interdependent actions, and cumulative effects. Effects were analyzed using information compiled from literature reviews, professional knowledge and experience, review of engineering drawings, and discussions with project engineers and permitting agencies.

Six federally listed species are known to occur, or could potentially occur, within the action area; critical habitat has been designated for four of these species. Effects determinations for these species are presented in Chapter 7.

6.1 Direct Effects on Organisms

The direct effects attributable to the Project are the impacts of construction, including noise associated with terrestrial pile-driving and other construction activities; discharge of post-construction stormwater produced in the project area; water turbidity associated with discharge of construction stormwater and dewatering waters, and modification of groundwater conveyance.

6.1.1 Noise Effects

The Project requires terrestrial pile driving and construction using heavy equipment for prolonged periods, both of which will generate noise that will be transmitted through the air within the action area.

The installation of the 2-foot diameter concrete piles to an average depth of 150 feet would entail driving a closed-end, steel pipe pile and casting a concrete pile within the steel pile. The installation of the steel pipe piles would occur with an impact hammer and would produce air and ground vibrations during the pile driving operation. Pile driving and heavy equipment operation can affect fish, marine mammals, birds, and other wildlife, depending on their likely presence and proximity to the area of increased noise and vibration. Because of the distance of the terrestrial pile driving to the nearest water (greater than 280 feet), various infrastructure located in the soils (e.g., foundations, utility conduits, etc.), and the presence of the seawall and armoring around the waterway, underwater noise effects are not expected to occur. The nearest water to the project is the Coast Guard slip, which is approximately 285 feet from the area of terrestrial pile driving. The nearest shoreline area to the north of the slip is approximately 1,440 feet from the area of pile driving while the nearest water to the south of the slip is approximately 1,280 feet from the area of pile driving. Underground structures such as the storm drain system, building foundations, the Elliott Bay seawall, and sheet piles in the Coast Guard slip are all expected to contribute to attenuation of noise in soils in the project vicinity, further minimizing the potential for terrestrial pile driving to contribute to underwater noise levels in Elliott Bay or the Duwamish Waterway. The remainder of this section focuses on airborne/terrestrial noise.

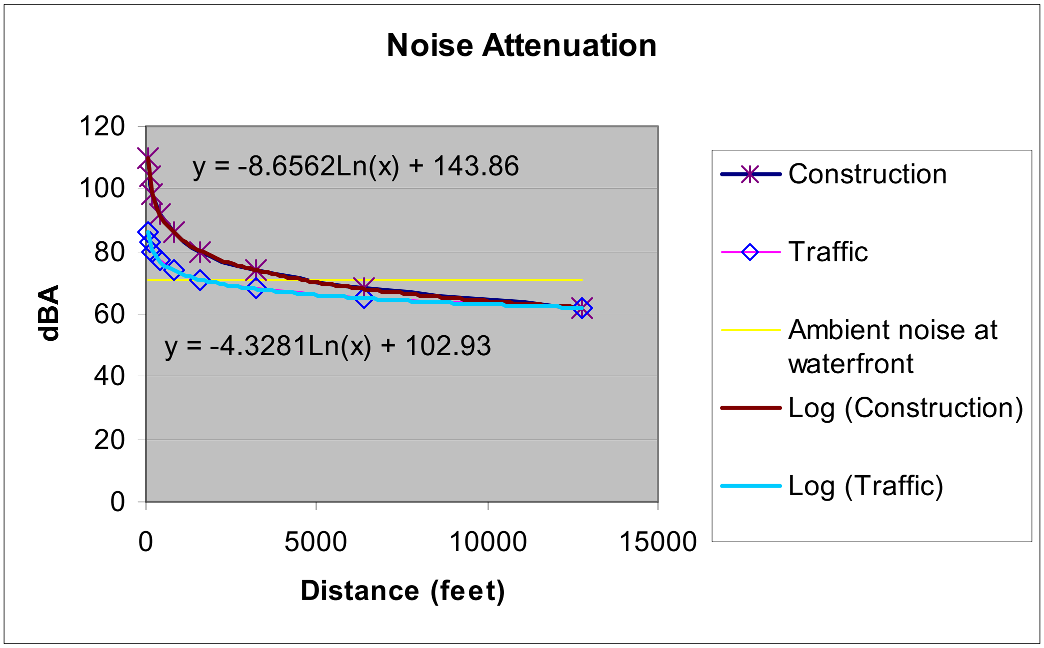
6.1.1.1 Disturbance Potential

In this report, the noise assessment methods developed for WSDOT projects and described in the WSDOT Biological Assessment manual (WSDOT 2007) were used to calculate terrestrial sound attenuation.

Typical terrestrial ambient noise levels in the downtown Seattle area near the waterfront are in the range of 71 – 83 dBA, which is consistent with the typically elevated noise levels of urban and downtown major metropolitan areas (Parsons Brinkerhoff Quade and Douglas 2004). For this project, an ambient noise level of 71 dBA at the Seattle waterfront (i.e. the portion of the action area capable of supporting listed species) was used to calculate the extent of the Action Area for noise effects. The low end of the range of ambient noise was assumed to maximize the Action Area, a conservative approach.

Construction equipment that will be used during project construction (Chapter 2) is expected to generate a terrestrial sound level of anywhere from 85 to 110 dBA at 50 feet (WSDOT 2007), with pile driving being the loudest source of construction noise. Project construction noise is estimated to attenuate at a rate of –6dBA per doubling of distance, a standard rate for point sound sources in an acoustically "hard" site that lacks trees and shrubs. Noise from pile driving (110 dBA at 50 feet) is, therefore, expected to attenuate to ambient levels (71 dBA) at approximately 4,537 feet. Noise attenuation is shown graphically in Figure 6-1.

Figure 6-1. Attenuation of Project Construction and Traffic Noise



The distance at which noise from pile driving would equal ambient noise levels is determined by solving the following equation for *x:*

Eq. 1 $y = -8.6562\mathrm{Ln}(x) + 143.86$

The distance at which traffic noise levels associated with the existing viaduct was also analyzed. For this analysis, it was assumed that existing traffic noise is 86dBA at 50 feet and as a line source of noise it attenuates at a rate of 3dBA per doubling of distance (WSDOT 2007). Traffic noise is expected to attenuate to ambient levels within 1,603 feet of the project area. Because the project is a replacement in kind, and will not result in an increase in traffic capacity on SR 99, this is not expected to change following project construction.

6.1.1.2 Effects of Noise on Marbled Murrelets

Currently, no terrestrial noise injury and disturbance thresholds based on scientific observations are available for marbled murrelets on the water. Marbled murrelets may be able to detect noise over background levels within approximately 4,537 feet (1,383 meters) of pile driving. The WDFW Puget Sound Ambient Monitoring Program (PSAMP) (Nysewander et al. 2005) recorded marbled murrelets in Puget Sound during monitoring efforts conducted annually since 1992 (winter surveys stopped in 1999). No marbled murrelets were recorded within Elliott Bay during these monitoring surveys, and the numbers of marbled murrelets during both summer and winter surveys were relatively low; however, because this species is highly mobile and difficult to observe from the air due to its cryptic coloring, it may have been undercounted (Nysewander et al. 2005).

For these reasons, it is possible that one or more marbled murrelets could be present in the action area during project work and may be able to detect above-water sound that is above ambient from Project pile driving. However, given that there are no records of murrelets foraging in the vicinity of the piers along the Seattle waterfront and there are no documented nesting sites in the action area, it is unlikely that any murrelet would be at risk of injury or disturbance from pile driving.

6.1.2 Water Quality Effects

The volume of water discharged to Elliott Bay has no effect on aquatic use of the bay, which is very large relative to the volume of potential inputs from sources other than the Duwamish River. For this reason, the bay is a flow-control-exempt waterbody.

However, water quality in Duwamish Waterway and Elliott Bay could potentially be temporarily affected by the Project as a result of the following mechanisms:

- stormwater discharge;
- construction stormwater discharge; and
- construction dewatering water discharge.

Measures to minimize these potential effects are detailed in Chapter 2 and in Appendix B. Effects of stormwater discharges are separately addressed below (Section 6.1.3). Implementation of avoidance and minimization measures described in Chapter 2 is expected to render the risk of contaminant spills negligible. The remaining mechanism, dewatering water discharges, can have the following effects on water quality:

- increased turbidity;
- exposure to particulate contaminants;
- altered dissolved oxygen; and
- altered pH.

Turbidity effects on diving marbled murrelets, killer whales, and Steller sea lions are largely unknown; however, project effects—if any—on turbidity will be highly localized due to associated BMPs and will be limited to occurring within a few feet of the project area, and thus have minimal potential to affect murrelets or mammals, or to measurably affect their prey base.

Increases in turbidity have been shown to affect salmonid physiology, behavior, and habitat. Physiological effects of turbidity on salmonids include gill trauma, altered blood sugar levels, and impaired osmoregulatory function. Behavioral effects include avoidance, altered foraging behavior, altered response to predation risk, and reduced territoriality (Meehan 1991).

The potential effects of temporary increases in turbidity on salmonids have been investigated in a number of dredging studies (Servizi and Martens 1987 and 1992;

Emmett et al. 1998; Noggle 1978; Simenstad 1988; Redding et al. 1987; Mortensen et al. 1976; Berg and Northcote 1985).

The principal source of turbidity will be the discharge of dewatering waters. Such discharge will be subject to NPDES permit requirements protective of beneficial uses in the receiving water, including protection of salmonid habitat. BMPs will be employed, as described in Chapter 2 and detailed in a TESC Plan, to ensure that NPDES permit requirements are met. Thus, turbidity effects, if any, will be minimized and have only very localized, temporary effects to salmonids that may cause fish to avoid the work or discharge area.

A secondary consequence of turbidity is that it reduces light transmission. Periods of reduced light transmission will be sufficiently short in duration that suppression of primary production is not likely to reduce aquatic macrophyte survival.

Dewatering waters often have low DO, but the NPDES permit for discharge is expected to require aeration sufficient to ensure that the discharged waters meet state DO criteria. The Project does not propose to discharge any waters having a high biochemical oxygen demand, and sediments in the project area generally have a low organic component. Therefore, no portion of the action area is likely to experience even localized low-DO conditions as a result of Project activities.

Waters that have been in contact with curing concrete can have pH values above state criteria. Dewatering waters may have elevated pH if they have been exposed to curing concrete from jet grouting or secant pile wall construction, but if so, those waters will be treated in accordance with NPDES permit requirements prior to discharge. This will ensure that discharged waters have a pH meeting state water quality criteria.

Therefore, Project compliance with all water quality and NPDES permits and implementation of avoidance and minimization measures and BMPs (as described in Chapter 2), is expected to render the risks of construction-related water quality degradation negligible and to render the discharge of construction dewatering water and stormwater insignificant and discountable.

6.1.3 Stormwater Discharge Effects

Land use within the action area is urban, with substantial amounts of impervious surface in the form of city streets, sidewalks, parking lots, and buildings. Based on the character of the action area, it is assumed that contaminants (i.e., dissolved metals such as copper, zinc, cadmium, and chromium; PAHs; and suspended solids) are consistently represented in stormwater in the area.

As detailed in Chapter 5 Environmental Baseline, the project area is nearly 100 percent impervious surface, and stormwater is released untreated into Elliott Bay or is discharged to the combined sewer system for treatment at the West Point Treatment Plant. The Project will provide additional basic stormwater treatment and BMPs, resulting in a net reduction in pollutant-loading discharged to receiving waters, including the Duwamish River and Elliott Bay. These receiving waters are flow exempt water bodies, thus no flow control is proposed.

The Project is considered to be at high risk of producing runoff with high concentrations of pollutant because the average daily traffic (ADT) is greater than 60,000 (WSDOT 2008).

Appendix B provides analyses of the pollutant loading resulting from project stormwater discharges. Those results are summarized here.

The Project will decrease the area of pollution-generating impervious surface within the action area from approximately 26.1 acres under existing conditions to approximately 22.8 acres under proposed conditions, a reduction of at least 3.3 acres. The Project will also increase the pervious area from approximately 2.7 acres to 4.7 acres, an increase of at least 2.1 acres (see Appendix B for a summary of these changes within each subbasin). The Project will provide basic treatment for stormwater from the Lander subbasin and the portion of the Royal Brougham subbasin routed to the low-flow diverter. Additionally, the portion of the Royal Brougham basin conveyed to the low-flow diverter will increase from 11.1 acres to 14.5 acres resulting in less volume entering the combined sewer system. Although less water will enter the combined sewer system, it is unlikely that this will result in a measurable decrease in the frequency or volume of CSO events downstream in the system due to the comparatively small area in question relative to the large basins outside of the project area otherwise entering the system. While changes to stormwater management in this basin will increase the total volume of stormwater routed to the low-flow diverter and discharged to Elliott Bay, basic treatment will reduce the concentrations of copper, zinc and total suspended solids in the stormwater and the total annual load of these constituents will be reduced compared to current conditions. Stormwater from the remainder of the Royal Brougham basin (8.6 acres) and the entire King subbasin will continue to be conveyed to the combined sewer system; however, stormwater detention facilities will be installed at a point prior to discharge into the combined system. Again, the detention facilities may help to reduce CSO events, but the beneficial effects of these facilities will not likely result in a measurable change due to the complexity of the system.

Tables 13, 14 and 15 in Appendix B present the dimensions and size of the mixing zone at each outfall pre- and post-project needed to dilute stormwater discharges from the project area to less than the threshold of effect above background concentrations for dissolved copper and dissolved zinc (2.0 μg/L and 5.6 μg/L, respectively) (Grady pers. com 2007). As shown in these tables, the dilution zone will be reduce by at least 57 percent for dissolved copper and 98 percent for dissolved zinc within the Lander subbasin and by at least 32 percent for dissolved copper and 71 percent for dissolved zinc within the Royal Brougham subbasin during the largest storms of the year. The mixing zone associated with discharges from the King subbasin will not change given that there will be no change and stormwater treatment approach. The mixing zone for the existing, pre-project conditions are markedly larger than for post-project conditions.

Figure 2-2 illustrates the locations of existing major stormwater outfalls along the Seattle shoreline.

Stormwater associated with highway runoff may contain low levels of cadmium, lead, chromium, and PAH compounds. Often, these compounds are at or below levels that can be detected with current analytical methods and may be effectively filtered or settled out in stormwater BMPs prior to being discharged to nearby waterbodies. Based on the environmental chemistry and biological fate of these compounds in an aquatic system, exposure to ESA listed species is expected to be small.

6.1.3.1 Species Presence

Chinook salmon. Migration of returning adult Green-Duwamish River fall-run Chinook salmon begins in June, peaks in August, and is completed by November (Weitkamp and Ruggerone 2000). Adult Puget Sound Chinook salmon could be in the action area during November when stormwater or CSO events frequently discharge through the existing outfalls. However, during the peak of their migration in August, CSO events are unlikely to occur.

Adults generally do not extensively utilize the marine nearshore during their return migration, but juveniles do use the nearshore environments during outmigration. The juvenile fall-run Chinook salmon out-migration occurs from January through mid-July, with a peak in outmigration from mid-February to mid-March and again in May and June (Corps 2005a; Nelson et al 2004; City of Seattle 2007). Some Puget Sound Chinook salmon may rear in Puget Sound over their first summer and fall before migrating to the open ocean (Cramer et al. 1999). Juvenile Chinook have been observed during all months of the year rearing in marine areas of the Duwamish River (City of Seattle 2007). Therefore, some life stage of Puget Sound Chinook salmon may occur within the action area year round and could be exposed to CSO events. The two peak out-migrations of juveniles correspond with times of relatively low risk of CSO events. The smaller numbers of early outmigrants in January or juveniles who utilize the lower Duwamish estuary to rear over the winter could be exposed to the highest volumes of CSO discharge.

Bull trout. The lower Green/ Duwamish River system is considered foraging, migrating and overwintering habitat for bull trout, with individuals observed in the lower Duwamish likely originating from other watersheds (City of Seattle 2007). Bull trout may forage on juvenile salmonids that occur along the nearshore of Elliott Bay. Therefore, sub-adult and adult bull trout could be in the action area at any time of the year and could be exposed to CSO events. The most recent captures of bull trout in the lower Duwamish have occurred in May, August and September. The majority of the char were captured in the late summer and would therefore be unlikely to be exposed to CSO events.

Steelhead. Both a summer and winter stock of steelhead are present in the Green-Duwamish River. Adult summer-run steelhead return to the Green-Duwamish River watershed from April through October (WDFW et al 1994; City of Seattle 2007), while winter-run steelhead return to the system from November through May (Grette and Salo 1986; City of Seattle 2007). Steelhead smolts emigrate from the

Green-Duwamish River watershed from the middle of March to the middle of July for both winter and summer stocks (City of Seattle 2007). During the migration from fresh to saltwater, steelhead may spend a considerable amount of time in Puget Sound (Puget Sound Steelhead Biological Review Team 2005) and extensively use nearshore habitats for rearing after leaving fresh water. Additionally, both winter and summer steelhead from the Duwamish River and other river systems in the area may occur within the action area year round Therefore, steelhead could be present in the action area during periods of both high and low risk for CSO events. Juvenile out-migration is not correlated to the period of high likelihood for CSO events from November to January, but juveniles who rear in the area might still be present during those winter months. However, returning winter-run adults would pass through the area during times of high likelihood for CSO events.

Southern resident killer whales. Southern resident killer whales (SRKWs) frequent Puget Sound, especially in the summer months, at various locations typically for periods ranging from a few days to longer than a month. They tend to remain outside Elliott Bay or along its western edge as they move through the central Puget Sound area. Commonly, they are only present in the Elliott Bay vicinity for 1 or 2 days, several times each year. Although killer whales may enter Elliott Bay, they rarely enter shallow shoreline areas such as those found along the Seattle waterfront. Therefore, it is highly unlikely that SRKW will be within the action area and exposed to any conditions that may be considered harmful.

Stellar sea lions. The occurrence of a Steller sea lion within the action area is unlikely. Steller sea lions have not been sighted in Elliott Bay. Steller sea lions occur year round in Washington waters, but populations decline during the summer breeding season as they return to rookeries in California, Oregon, British Columbia, and Southeast Alaska. There are no rookeries or haul-out areas in or near the action area, but Steller sea lions have occasionally been spotted on buoys in various parts of Puget Sound, and it is possible that they could enter Elliott Bay, but unlikely that will be within the action area for any significant length of time and exposed to any conditions that may be considered harmful.

6.1.3.2 Effects to Salmonids

The primary pollutants of concern from stormwater generated by roadways, with respect to salmonids, include dissolved copper and zinc. Copper has been shown to affect olfactory sensory responsiveness and behavioral reduction in predator avoidance at relatively low concentrations (2.0 micrograms per liter (μg/L) above background concentrations of 3.0 μg/L or less for dissolved copper) (Baldwin et al. 2003 and Sandahl et al. 2007). These values are based on laboratory studies with hatchery-reared juvenile Coho salmon in freshwater aquaria.

NMFS has articulated interim thresholds for dissolved metals including a threshold of 2.0 μg /L above a background level of 3.0 ug/L or less; and a threshold of 5.6 μg/L above background concentrations between 3.0 μg /L and 13.0 μg /L or less for dissolved zinc (Grady pers. comm 2007).

Given that one or more life history stage of listed salmonids may be present in the action area year round, it is likely that salmonids will be exposed to concentrations of dissolved copper and zinc in excess of the threshold concentrations identified above. However, the occurrence of the highest numbers of juvenile salmonids does not coincide with the period when CSO events are most likely to occur. It should also be noted that these exposures are attributable to the baseline conditions as described in Chapter 5 Environmental Baseline. The project will reduce both loads and concentrations of dissolved copper and zinc that are conveyed into the existing systems. Appendix B provides details about the specific project related stormwater contributions for pre and post project conditions. However, because the total contribution of stormwater from the project area is small, relative to the volume of water in the existing conveyance system, the improvement will likely not be measurable at the point where waters are discharged into water bodies with listed species. . That is to say that the fish will be exposed to concentrations reflective of the entire basin discharge, not simply discharges attributable to the project area; and although the project represents a substantial improvement in stormwater management for the project area, as reflected by modeled dilution areas in Appendix B, these changes will likely not be measurable as actual changes the fish would experience.

6.1.4 Modified Groundwater Conveyance

A groundwater flow model was constructed for the entire Alaskan Way Viaduct and Seawall Replacement Program to compare baseline and post-construction groundwater conditions as a result of the Program. The model was based on existing soil and groundwater information as well as field and laboratory testing for the Program (WSDOT 2003). This model analyzed effects from injection of grout into soils to improve their stability. The model results indicate that less than 2 feet of groundwater buildup will likely occur behind the grouted zone above average pre-construction groundwater levels. This range of fluctuation is within the range of normal groundwater fluctuations (0 to 2 feet) observed in shallow monitoring wells in the project area.

Therefore, impacts from the Project associated with groundwater buildup and the volume of groundwater discharging to Elliott Bay are expected to be non-measurable. Because post-construction groundwater conditions are not greatly different from pre-construction conditions, impacts on groundwater quality are anticipated to be insignificant as well. The changes to groundwater conveyance will not affect water temperature or habitat quality in Elliott Bay, and will not affect any listed or proposed species.

6.2 Direct Effects on Critical Habitat

6.2.1 Salmonids

Chinook salmon and bull trout critical habitat present in the Project action area includes intertidal and shallow subtidal portions of the Elliott Bay shoreline. PCEs that may require special management considerations or protection within this zone include feeding sites and aquatic vegetation. Feeding sites for young Chinook salmon appear to be protected shoreline areas.

NMFS has defined PCEs for critical habitat designated for Chinook salmon. The PCEs that apply to critical habitat for Chinook salmon in estuarine-marine areas include:

- Estuarine areas free of obstruction with water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh and salt water; natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels; and juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation.
- Nearshore marine areas free of obstruction with water quality and quantity conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation; and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels.
- Offshore marine areas with water quality conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation.

Similarly, USFWS has defined PCEs for designated critical habitat for bull trout. The PCEs applicable to designated critical habitat for bull trout in estuarine-marine areas include:

- Permanent water having low levels of contaminants such that normal reproduction, growth, and survival are not inhibited. Habitat indicators: sediment, chemical contamination/nutrients, change in peak/base flows.
- Migratory corridors with minimal physical, biological, or water quality impediments between spawning, rearing, overwintering, and foraging habitats, including intermittent or seasonal barriers induced by high water temperatures or low flows.
- An abundant food base including terrestrial organisms of riparian origin, aquatic macroinvertebrates, and forage fish.
- Permanent water of sufficient quantity and quality such that normal reproduction, growth, and survival are not inhibited.

The Project will not affect freshwater, estuarine, and nearshore marine habitat, so no changes to PCEs will occur for either Chinook salmon or bull trout.

As described in Chapter 5, the baseline conditions in the project area related to Chinook critical habitat PCEs are compromised in both estuarine and nearshore marine areas, as the area is widely urban and developed. Obstructions are present to juveniles in the form of commercial piers and the seawall that alter fish behaviors.

Water quality is degraded, with high levels of toxic chemicals found in sediments. Also, untreated stormwater is discharged into the bay. In the estuarine areas, water salinity is adequate. There is also adequate water quantity in the project area. Most of the shoreline is straightened and armored, therefore natural cover, overhanging wood, and side channels are not present. In the action area, there is no natural riparian vegetation left, and macroalgae is the only form of aquatic vegetation. It is also important to note that forage for all life stages is reduced.

The baseline conditions for bull trout PCEs are the same as those discussed for Chinook. Bull trout critical habitat also experiences high levels of sediment contamination, blocked juvenile migratory corridors by overwater structures, reduced forage, lack of natural shoreline and reduced water quality in the action area.

The Project will maintain the water quality of the area. Construction activities have been designed so that, when implemented, the potential to degrade water quality will be minimized or avoided. Furthermore, the Project will provide treatment for stormwater generated both during construction and from a portion of the project area during operation (details are provided in Appendix B). The Project will not create or destroy any natural shoreline vegetation, overhanging wood, or side channels.

The Puget Sound steelhead DPS was listed as a threatened species in May of 2007. Critical habitat designation is currently under review and has not yet been designated (NMFS 2007). It is likely; however, that critical habitat will be proposed and then designated during the timeframe of the Project. Designated critical habitat for Puget Sound steelhead will likely have similar PCEs as those identified above for Chinook salmon, since these same PCEs apply to other listed steelhead DPSs (e.g., Upper Columbia River steelhead DPS). As such, the effects analysis for Chinook salmon designated critical habitat would be applicable for Puget Sound steelhead as well.

6.2.2 Birds

The action area is not within designated critical habitat for the marbled murrelet. Therefore, the Project will have no effect on designated critical habitat for this species.

6.2.3 Marine Mammals

6.2.3.1 Southern Resident Killer Whales

Critical habitat for SRKWs has been designated within the area potentially affected by the Project. This area includes all portions of Elliott Bay in the action area with a depth greater than 20 feet MLLW.

NMFS uses the following definitions of PCEs for the SRKW DPS critical habitat:

- water quality to support growth and development;

- prey species of sufficient quantity, quality and availability to support individual growth, reproduction and development, as well as overall population growth; and
- passage conditions to allow for migration, resting, and foraging.

The baseline conditions in Elliott Bay are such that water quality is impaired, with a high level of chemical contaminants found in the sediments, as well as bioaccumulated in area biota. Currently, untreated stormwater is also being discharged into Elliott Bay and the Duwamish River.

Current prey conditions for SRKWs in Elliott Bay are reduced compared to their historical condition. Killer whales' preferred prey is Pacific salmon, specifically Chinook salmon (71 FR 34573), but they are also known to eat other species of fish such as rockfish, halibut, lingcod, and herring as well as one species of squid (NMFS 2005a). The Puget Sound Chinook salmon ESU is currently listed as threatened. Chinook salmon in Puget Sound are reduced in quality when compared to fish found in other, less industrial locales, because they contain high concentrations of the toxic chemicals PCBs (O'Neill et al. 2005, cited in NMFS 2005a), which can bioaccumulate in the whales and possibly damage their health (NMFS 2005a). These and other chemicals are also found in the other fish species that regularly use Elliott Bay and the Duwamish River.

There are also currently no structures in place in Elliott Bay that would restrict the passage of killer whales through the area. However, the current volume of vessel traffic in the bay could discourage their use of the area.

The Project will maintain the water quality of the area. Construction activities have been designed so that, when implemented, the potential to degrade water quality will be minimized or avoided. Furthermore, the Project will provide treatment for stormwater generated both during construction and from a portion of the project area during operation (details are provided in Appendix B).

The Project will have an insignificant and discountable effect on SRKW prey. As mentioned above, the Project will not cause a decrease in water quality in the area, and therefore, will not increase exposure of SRKW prey to toxins that could bioaccumulate in the whales. Therefore, the Project will not have a significant negative effect on the PCE concerning SRKW prey quantity or quality.

The Project will not create any overwater structures in SRKW critical habitat, nor will it have a significant effect on the amount of vessel traffic in Elliott Bay. Therefore, the Project will have no effect on the SRKW PCE regarding obstruction of passage.

Therefore, for all the reasons listed above, there will be no effect to SRKW critical habitat.

6.2.3.2 Steller Sea Lions

Critical habitat has been designated for Steller sea lions off the Washington coast, but not within Puget Sound. Therefore, the Project will have no effect on critical habitat for Steller sea lions.

6.3 Beneficial Effects

The Project will decrease the area of pollution-generating impervious surface within the action area and will also increase the pervious area. The project will reduce both loads and concentrations of dissolved metals coming from the project area and which are conveyed into the existing systems (see Appendix B for a summary of these changes within each subbasin). However, because the total contribution of stormwater from the project area is small, relative to the volume of water in the existing conveyance system, these changes are not likely to result in measurable reductions in CSO event volumes or frequency. However when considering stormwater contributions from the project area, the project will significantly reduce the mixing zone required to achieve dilution of stormwater from the project area to 2.0 μg/L above background for dissolved copper and 5.6 μg/L above background for dissolved zinc.

6.4 Indirect Effects

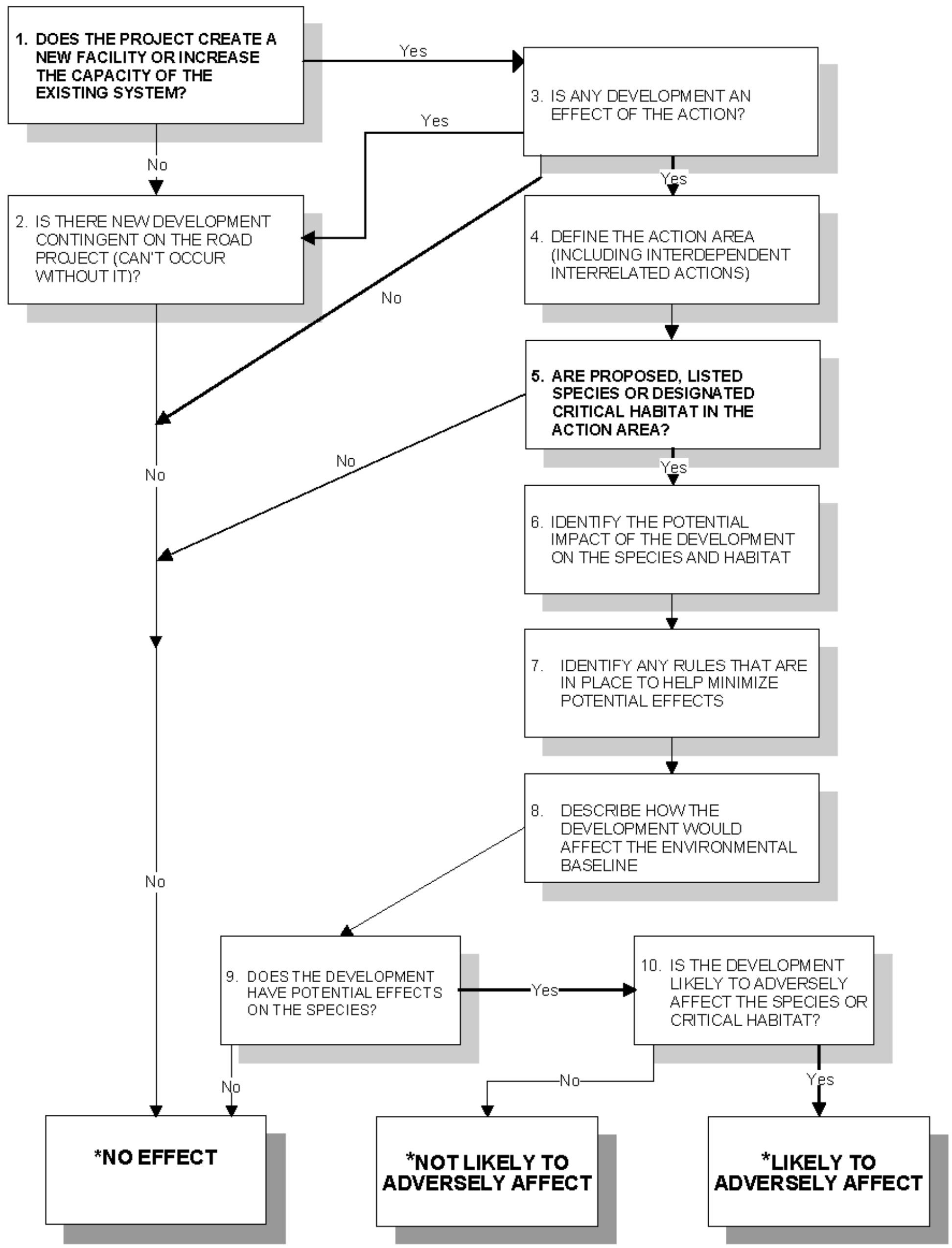
The discussion below addresses the potential for changes in human activities, such as land use and development, to affect listed species. Based on discussions with USFWS, NMFS, FHWA, the Office of Community Development, and local agencies, WSDOT has developed guidance for assessing indirect effects that poses a series of questions about the Project (Figure 6-2). Relevant questions from that guidance are presented below.

1. Does the Project construct a new facility or increase the capacity of the existing system?
   The Project will replace existing structures to improve traffic flow and safety for motorists, as well as provide structural integrity of the roadway during an earthquake. It will not increase the capacity of the existing system or result in higher traffic volumes.

2. Is there new development contingent on the Project?
   No new development is contingent on the Project, nor is the Project expected to result in any new development. The Project will not increase capacity and the action area is currently built out to capacity. Any new development in the project area or within areas served by the Project would require reconstruction of an existing developed area.

Based on this analysis, there will be no indirect effects from land use changes as a result of the Project.

Figure 6-2. Indirect Effects Determinations Based on Transportation and Land Development



*This process is for the assessment of indirect effects only and presumes that the project is analyzed for direct effects before a final effect determination is made.

Reference: WSDOT. 2007. Biological Assessment Preparation for Transportation Projects, Advanced Training Manual. Olympia, WA.

6.5 Effects of Interrelated and Interdependent Actions

An interrelated action is an action that is part of a larger action and depends upon the larger action for its justification. An interdependent action is one that has no independent utility apart from the Project. Interrelated/interdependent actions relevant to the Project been identified by WSDOT and are shown in Table 6.1.

Interrelated projects (those that are shaded in Table 6-1) will improve alternative traffic corridors, provide information to the public regarding alternative routes, and improve traffic flow in the vicinity of the Project. Thus these interrelated projects will likely provide traffic congestion relief during the Project construction period, but would likely occur even if the Project did not.

It is likely that the interrelated projects presented in Table 6.1 will involve federal actions such as federal funding or permitting, which would make these projects subject to consultation. Projects which would involve road widening or result in changes to the amount of impervious and/or pollution generating surfaces would also include the development of stormwater treatment plans and an analysis of such plans as part of consultation.

The interdependent projects (unshaded rows in Table 6.1) involve improvements such as dynamic messaging signs, closed circuit cameras, traffic advisory radio, and real-time traffic time signs to improve traffic information specifically in anticipation of the Project. They are designed to divert traffic off of the SR 99 corridor during Project construction and to improve transportation system operations, and to improve transit speeds and transit schedule reliability.

These interdependent projects are not expected to increase the volume of traffic and will rely on the existing network of impervious surfaces within the action area to route traffic through and around Project construction. As such, these interdependent projects will not change the degree or nature of stormwater generation, treatment, or discharge from baseline conditions.

Table 6.1 Interrelated and Interdependent Actions

No	Project Name	Functional Goals	Relationship to Project
1	SR 519 Phase II	• Highway & Street System Reliability • Freight Connectivity	Provide traffic relief for project construction; improve capacity and safety and reduce delays
2	S. Spokane St. Widening Project	• Highway & Street System Reliability • Traffic Redistribution	Improve connections for West Seattle trips to downtown, which will help reduce demand on the 1st Avenue S. off-ramp and street, which is expected to draw additional traffic during the Project
3	Elliott Ave. W./15th Avenue W. Corridor Improvements (ITS and transit support)	• Highway & Street System Reliability • Traveler Information • Transit Speed & Reliability	Provide information to help divert traffic off of SR 99 corridor during major construction and improve transportation system operations; improve transit speeds and schedule reliability
4	West Seattle Corridor Improvements (ITS and transit support)	• Highway & Street System Reliability • Traveler Information • Transit Speed & Reliability	Provide information to help divert traffic off of SR 99 corridor during major construction and improve transportation system operations; improve transit speeds and schedule reliability
5	SODO / Integrated Corridor Management Improvements (ITS and transit support)	• Highway & Street System Reliability • Traveler Information • Transit Speed & Reliability	Provide information to help divert traffic off of SR 99 corridor during major construction and improve transportation system operations; improve transit speeds and schedule reliability
6	I-5 Travel Time Signs	• Traveler Information	Improve overall traffic flow through the city
7	Secure Use of New Buses and Transit Service Hours	• Increased Transit Capacity • Increased Transit Frequency	Maintain bus schedules and provide additional capacity, which will encourage mode shift and reduce vehicle demand in the SR 99 corridor
8	Bus Travel Time Monitoring System	• System Monitoring and Adjustment • Traveler Information	Helps bus system respond to changes in traffic flow due to construction
9	I-5 Active Traffic Management	• Freeway system reliability • Reduced incidents / incident severity	Improve I-5 traffic flow and reduce collisions, which will reduce motivation of drivers to switch to SR 99
10	Ballard & SODO Arterial Travel Time System*	• Traveler Information • Street system reliability	Reduce delay and congestion on surface streets, including in areas adjacent to the Project
11	Denny Way Corridor ITS Improvements	• Street system reliability	Improve flow on Denny Way, a likely detour route for construction

No	Project Name	Functional Goals	Relationship to Project
12	Southend Transportation Demand Management (TDM)	• Traveler information • SOV trip reduction	Implement programs to provide incentives that will help reduce vehicle demand on SR 99 during Project construction
13	Downtown TDM	• Traveler information • SOV trip reduction	Implement programs to provide incentives that will help reduce vehicle demand on SR 99 during Project construction

6.6 Cumulative Effects

Cumulative effects are those effects associated with future local, state, or private actions not involving federal actions, that are reasonably certain to occur within the action area of the federal action subject to consultation (50 FR 402.02). If cumulative effects reduce the ability of a listed species to meet its biological requirements, there will be an increased risk that project effects will result in jeopardy to the species or adverse modification of its critical habitat (NMFS 2005b).

State, tribal, and local government actions will likely be in the form of legislation, administrative rules, or policy initiatives. Government or private actions may include changes in land use, including ownership, which could adversely affect listed species or their habitat. While specific government actions are subject to political, legislative, and fiscal uncertainties, trends in the economy that have occurred over the previous 15 to 20 years are likely to continue. These trends, which include increases in commercial/industrial shipping, recreational cruise line operations, and recreational boating activities along the waterways of Puget Sound in general and Elliott Bay in particular, will require upgrades to existing facilities and/or construction of new facilities. Additionally, infrastructure to accommodate the land-based support of these operations will require improvements and upgrades (e.g., ports, roadways, rail, and electricity).

Population growth in Washington will likely continue to increase in the future as well, requiring additional development of housing and services to support the increasing population such as roads, telephone, sewer, electricity and water. How such non-federal actions will shape or adapt to the future growth of the state is somewhat subjective and dependent upon legislative action at the local and state level.

It should be noted that the area served by the Project is already highly developed and the Project is not designed to address additional growth needs.

It is likely that the interrelated projects presented in Table 6-1 above will involve federal actions such as federal funding or permitting which would make these projects subject to consultation (and thus not cumulative effects).

7.0 Effect Determinations

The purpose of this section is to integrate the various potential effects as described in Chapter 6 Effects Analysis in order to make "effects determinations" for each listed species and designated critical habitat. To facilitate these determinations, it is important to identify those effects attributable to the proposed action versus those related to the environmental baseline[4]. According to NMFS guidance[5], this is best achieved using a three-step approach:

- Step 1 – Describe the base conditions of the listed resources at the time of the consultation. This serves as the "reference point" for the next two steps.
- Step 2 – Project from the reference point the anticipated future base conditions of the listed resources in light of past, present, and future effects that will exist assuming the action is not authorized, funded , or carried out. This projection serves as the control or the baseline for discerning the effects of the proposed action.
- Step 3 – Project, again from the reference point, the anticipated future base conditions of the listed resource in light of all future effects considered in Step 2, as well as adding the stressors associated with the proposed action.

The difference between the two projections is considered to be the effects of the proposed action. Step 1 and Step 2 of this approach have been described in Chapter 5, *Environmental Baseline*. The conditions arising from Step 3 are included in Chapter 6, *Effects Analysis* and in Appendix B. The following sections detail the resultant effects determinations for each listed species and any designated critical habitat.

7.1 Southern Resident Killer Whales: May Affect, Not Likely to Adversely Affect

The Project ***may affect*** SRKWs because:

- Killer whales have been documented in the vicinity of the action area (Elliott Bay), albeit rarely, where they hunt for prey (including Chinook salmon).
- Sound generated during project construction activities may disturb killer whales if they are at the water surface and they are in the action area during terrestrial pile driving.

[4] The environmental baseline includes the past and present impacts of all federal, state, or private actions and other human activities in the action area, the anticipated impacts of all proposed federal projects in the action area that have already undergone formal or early Section 7 consultation, and the impact of state or private actions which are contemporaneous with the consultation in process (50 CFR 402.02.

[5] NMFS Advanced Interagency Consultation Training Study Guide

- Construction stormwater and dewatering water discharged into Elliott Bay and the lower Duwamish River could affect killer whale prey resources (including Chinook salmon).
- Stormwater generated during project operation routed into existing conveyance and ultimately discharged into Elliott Bay and the Duwamish Waterway could affect killer whale prey resources (including Chinook salmon).

The Project is ***not likely to adversely affect*** SRKWs because:

- Killer whales are not commonly observed within the heavily trafficked and shallower portion of Elliott Bay or the Duwamish Waterway encompassed by the action area (i.e. areas within 200 feet of the shoreline.
- No significant underwater noise would be generated by the Project, as all pile driving would be terrestrial. Terrestrial noise from the pile driving may be audible to killer whales while surfacing in the action area. However, no significant sound pressure waves will be generated underwater that could approach the injury or disturbance thresholds for killer whales.
- Construction stormwater and dewatering water would be discharged to Elliott Bay and/or the lower Duwamish Waterway only in accordance with federal and state permits, including the NPDES permit, specifically designed to minimize the potential for water quality effects to aquatic species.
- Effects to prey species (including Chinook salmon) from stormwater discharged by the Project are improved over baseline (loads and concentrations); however, this beneficial effect would likely not be measurable and thus insignificant and discountable in terms of food resource for SRKW.

7.1.1 Southern Resident Killer Whale Designated Critical Habitat: May Affect, Not Likely to Adversely Affect

The Project ***may affect*** designated critical habitat for SRKW because:

- The action area includes designated critical habitat for Chinook salmon, which are SRKW preferred prey species.

The Project is ***not likely to adversely affect*** SRKW critical habitat because:

- There will be no long-term degradation of water quality or installation of any permanent structures that would obstruct passage of Chinook salmon.
- Any effects to primary prey (including Chinook salmon) will not be on a scale that would impact killer whales, and therefore will be insignificant and discountable.

7.2 Steller Sea Lion: May Affect, Not Likely to Adversely Affect

The Project ***may affect*** Steller sea lions because:

- Steller sea lions have been documented hauling out on buoys near the action area.
- Sound generated during project construction activities may disturb Steller sea lions if they are in the action area during terrestrial pile driving.
- Construction stormwater and dewatering water discharged into Elliott Bay and the lower Duwamish Waterway could affect Steller sea lion prey resources (including Chinook salmon).
- Stormwater generated during Project operation routed into existing conveyance and ultimately discharged into Elliott Bay and the lower Duwamish Waterway could affect Steller sea lion prey resources (including Chinook salmon).

The Project is ***not likely to adversely affect*** Steller sea lions because:

- Steller sea lions are rarely encountered and have not been observed within the heavily trafficked and shallower portion of Elliott Bay or the lower Duwamish Waterway encompassed by the action area (i.e. areas within 200 feet of the shoreline).
- No significant underwater noise would be generated by the Project, as all pile driving would be terrestrial. Terrestrial noise from the pile driving may be audible to Steller sea lions surfacing or hauled out in the action area. However, no significant sound pressure waves will be generated underwater which could approach the injury or disturbance thresholds for Steller sea lions.
- Construction stormwater and dewatering water would be discharged to Elliott Bay and/or the lower Duwamish River only in accordance with federal and state permits, including the NPDES permit, specifically designed to minimize the potential for water quality effects to aquatic species.
- Effects to prey species (including Chinook salmon) from stormwater discharged by the Project are improved over baseline (loads and concentrations), however this beneficial effect would likely not be measurable and thus insignificant and discountable in terms of food resource for Steller sea lions.

7.3 Puget Sound Chinook Salmon ESU: May Affect, Not Likely to Adversely Affect

The Project ***may affect*** Chinook salmon because:

- Adult and juvenile Chinook salmon have been documented in the action area and may occur in the action area during project construction.

- Construction stormwater and dewatering water discharged into Elliott Bay and the lower Duwamish Waterway could affect Chinook salmon and their prey in the nearshore environment.
- Stormwater generated during project operation routed into existing conveyance and ultimately discharged into Elliott Bay, the lower Duwamish Waterway, and Puget Sound (via West Point Wastewater Treatment Plant) could affect Chinook salmon and their prey resources due to the pollutant loads and concentrations of dissolved metals such as zinc and copper.

The Project is ***not likely to adversely affect*** Chinook salmon because:

- No significant underwater noise would be generated by the Project, as all pile driving would be terrestrial and greater than 280 feet from the nearest waterbody (i.e., Coast Guard slip). No significant sound pressure waves will be generated underwater that could approach the injury or disturbance thresholds for Chinook salmon. There are no thresholds for injury or disturbance sound levels transmitted through the air.
- Construction stormwater and dewatering water would be discharged to Elliott Bay and/or the lower Duwamish Waterway only in accordance with federal and state permits, including the NPDES permit, specifically designed to minimize the potential for water quality effects to aquatic species.
- Operational stormwater from the project will be discharged through existing outfalls, however the highest frequency of stormwater discharges do not coincide with the time period when the majority of juvenile Chinook are expected to migrate through the action area.
- Stormwater discharged by the Project is improved over baseline conditions for volumes, loads, and concentrations (see Appendix B, Stormwater Analysis). Use of the three-step approach, detailed above, identifies that the future base condition with the proposed action would be better than the future base condition without the proposed action, therefore representing a beneficial effect. However, because of the small areas and volumes associated with the project relative to the entire conveyance system basins, as well as the complexities of the conveyance systems, this beneficial effect would not be measurable at the point where Chinook salmon occur (existing outfalls). The effects from the proposed action would therefore be considered insignificant and discountable.
- Stormwater from the project, routed into existing conveyance and ultimately discharged to Puget Sound after secondary treatment at West Point Wastewater Treatment Plant, would be improved over baseline conditions for volumes and loads. Chinook salmon exposure to any concentrations of dissolved metals

would not occur due to the depth of the outfall (240 feet) and resultant mixing before reaching depths where Chinook salmon occur.

7.3.1 Puget Sound Chinook Salmon ESU Designated Critical Habitat: May Affect, Not Likely to Adversely Affect

The Project ***may affect*** designated critical habitat for Chinook salmon because:

- The action area includes nearshore areas that are designated critical habitat for Chinook salmon.
- Construction stormwater and dewatering water will be discharged into Elliott Bay and the lower Duwamish Waterway, both of which encompass areas designated as nearshore critical habitat.
- Stormwater generated during Project operation will be routed into existing conveyance and ultimately discharged into nearshore portions of Elliott Bay and the lower Duwamish Waterway, both of which encompass areas designated as nearshore critical habitat.

The Project is ***not likely to adversely affect*** Chinook salmon critical habitat because:

- There will be no long-term degradation of water quality or installation of any structures that would obstruct passage of Chinook salmon.
- Construction stormwater and dewatering water would be discharged to Elliott Bay and/or the lower Duwamish Waterway only in accordance with federal and state permits, including the NPDES permit, specifically designed to minimize the potential for water quality effects to aquatic species.
- Any effects to Chinook prey species (i.e., terrestrial insects and benthic invertebrates) will not be on a scale that would impact Chinook salmon, and therefore will be temporary, insignificant and discountable.
- Stormwater discharged by the Project is improved over baseline conditions for loads and concentrations (see Appendix B, Stormwater Analysis). Use of the three-step approach, detailed above, identifies that the future base condition with the proposed action would be better than the future base condition without the proposed action, therefore representing a beneficial effect for nearshore habitat PCEs (i.e., water quality, sediment contamination, and benthic invertebrate populations). However, because of the small areas and volumes associated with the project relative to the entire conveyance system basins, as well as the complexities of the conveyance systems, this beneficial effect would not be measurable for the nearshore habitat PCEs. The stormwater effects of the project on Chinook salmon critical habitat would therefore be insignificant and discountable.

7.4 Puget Sound Steelhead DPS: May Affect, Not Likely to Adversely Affect

The Project ***may affect*** Puget Sound steelhead because:

- Adult and juvenile steelhead have been documented in the action area and may occur in the action area during project construction.
- Construction stormwater and dewatering water discharged into Elliott Bay and the lower Duwamish Waterway could affect steelhead and their prey in the nearshore environment.
- Stormwater generated during Project operation routed into existing conveyance and ultimately discharged into Elliott Bay and the lower Duwamish Waterway could affect steelhead and their prey resources due to the pollutant loads and concentrations of dissolved metals such as zinc and copper.

The Project is ***not likely to adversely affect*** Puget Sound steelhead, because:

- No significant underwater noise would be generated by the Project, as all pile driving would be terrestrial. No significant sound pressure waves will be generated underwater which could approach the injury or disturbance thresholds for steelhead. There are no thresholds for injury or disturbance sound levels transmitted through the air.
- Construction stormwater and dewatering water would be discharged to Elliott Bay and/or the lower Duwamish Waterway only in accordance with federal and state permits, including the NPDES permit, specifically designed to minimize the potential for water quality effects to aquatic species.
- Stormwater discharged by the Project is improved over baseline conditions for volumes, loads, and concentrations (see Appendix B, Stormwater Analysis). Use of the 3-step approach, detailed above, identifies that the future base condition with the proposed action would be better than the future base condition without the proposed action, therefore representing a beneficial effect. However, because of the small areas and volumes associated with the project relative to the entire conveyance system basins, as well as the complexities of the conveyance systems, this beneficial effect would not be measurable at the point where steelhead occur (existing outfalls). The effects from the proposed action would therefore be considered insignificant and discountable.
- Stormwater from the project, routed into existing conveyance and ultimately discharged to Puget Sound after secondary treatment at West Point Wastewater Treatment Plant, would be improved over baseline conditions for volumes and loads. Steelhead exposure to any concentrations of dissolved metals would not occur due to the depth of the outfall (240 feet) and resultant mixing before reaching depths where steelhead occur.

7.5 Coastal/Puget Sound Bull Trout DPS: May Affect, Not Likely to Adversely Affect

The Project ***may affect*** bull trout because:

- Adult and sub-adult bull trout may forage within or migrate through the action area during project construction.
- Construction stormwater and dewatering water discharged into Elliott Bay and the lower Duwamish Waterway could affect bull trout and their prey in the nearshore environment.
- Stormwater generated during Project operation routed into existing conveyance and ultimately discharged into Elliott Bay and the lower Duwamish Waterway could affect bull trout and their prey resources due to the pollutant loads and concentrations of dissolved metals such as zinc and copper.

The Project is ***not likely to adversely affect*** bull trout because:

- No significant underwater noise would be generated by the Project, as all pile driving would be terrestrial. No significant sound pressure waves will be generated underwater which could approach the injury or disturbance thresholds for bull trout. There are no thresholds for injury or disturbance sound levels transmitted through the air.
- Construction stormwater and dewatering water would be discharged to Elliott Bay and/or the lower Duwamish Waterway only in accordance with federal and state permits, including the NPDES permit, specifically designed to minimize the potential for water quality effects to aquatic species.
- Operational stormwater from the project will be discharged through existing outfalls, however the highest frequency of stormwater discharges do not coincide with the time periods when bull trout are expected to be present in the action area based on sampling done to date.
- Stormwater discharged by the Project is improved over baseline conditions for volumes, loads, and concentrations (see Appendix B, Stormwater Analysis). Use of the three-step approach, detailed above, identifies that the future base condition with the proposed action would be better than the future base condition without the proposed action, therefore representing a beneficial effect. However, because of the small areas and volumes associated with the project relative to the entire conveyance system basins, as well as the complexities of the conveyance systems, this beneficial effect would not be measurable at the point where bull trout occur (existing outfalls). The effects from the proposed action would therefore be considered insignificant and discountable.
- Stormwater from the project, routed into existing conveyance and ultimately discharged to Puget Sound after secondary treatment at West Point Wastewater

Treatment Plant, would be improved over baseline conditions for volumes and loads. Bull trout exposure to any concentrations of dissolved metals would not occur due to the depth of the outfall (240 feet) and resultant mixing before reaching depths where bull trout occur.

- Research on the potential effects of dissolved metals in stormwater has focused on exposure scenerios with *juvenile* hatchery coho salmon. Only sub adult and adult bull trout are occasionally present in the action area. It is uncertain what relevant effects thresholds would be for the exposure of sub adult and adult bull trout to dissolved metals.

7.5.1 Coastal/Puget Sound Bull Trout Designated Critical Habitat: May Affect, Not Likely to Adversely Affect

The Project ***may affect*** designated critical habitat for bull trout because:

- The action area includes nearshore areas that are designated critical habitat for bull trout;
- Construction stormwater and dewatering water will be discharged into Elliott Bay and the lower Duwamish Waterway, both of which encompass areas designated as nearshore critical habitat; and
- Stormwater generated during Project operation will be routed into existing conveyance and ultimately discharged into nearshore portions of Elliott Bay and the lower Duwamish Waterway, both of which encompass areas designated as nearshore critical habitat.

The Project is ***not likely to adversely affect*** bull trout critical habitat because:

- There will be no long-term degradation of water quality or installation of any structures that would obstruct passage of bull trout.
- Construction stormwater and dewatering water would be discharged to Elliott Bay and/or the lower Duwamish Waterway only in accordance with federal and state permits, including the NPDES permit, specifically designed to minimize the potential for water quality effects to aquatic species.
- Any effects to sub-adult and adult bull trout prey species (i.e. salmonids) will not be on a scale that would impact bull trout, and therefore will be temporary, insignificant and discountable.
- Stormwater discharged by the Project is improved over baseline conditions for loads and concentrations (see Appendix B, Stormwater Analysis). Use of the three-step approach, detailed above, identifies that the future base condition with the proposed action would be better than the future base condition without the proposed action, therefore representing a beneficial effect for water quality PCEs

(i.e., chemical contaminant). However, because of the small areas and volumes associated with the project relative to the entire conveyance system basins, as well as the complexities of the conveyance systems, this beneficial effect would not be measurable for the water quality PCEs. The stormwater effects of the project on bull trout critical habitat would therefore be insignificant and discountable.

7.6 Marbled Murrelets: May Affect, Not Likely to Adversely Affect

The Project ***may affect*** marbled murrelets because:

- Marbled murrelets occasionally forage within the action area and could do so during construction.
- Sound generated during project construction activities may disturb marbled murrelets if they are foraging in the action area during terrestrial pile driving.
- Construction stormwater and dewatering water discharged into Elliott Bay and the lower Duwamish Waterway could affect marbled murrelet prey resources (including Chinook salmon).
- Stormwater generated during Project operation routed into existing conveyance and ultimately discharged into Elliott Bay and the lower Duwamish Waterway could affect marbled murrelet prey resources (including juvenile Chinook salmon).

The Project is ***not likely to adversely affect*** marbled murrelets because:

- Marbled murrelets are rarely encountered and have not been observed within the heavily trafficked and shoreline portion of Elliott Bay or the lower Duwamish Waterway encompassed by the action area (i.e., areas within 200 feet of the shoreline).
- No significant underwater noise would be generated by the Project, as all pile driving would be terrestrial. Terrestrial noise from the pile driving may be audible to marbled murrelets floating on the water's surface in the action area. However, no significant sound pressure waves will be generated underwater which could approach the injury or disturbance thresholds for diving marbled murrelets. There are no thresholds for injury or disturbance sound levels transmitted through the air applicable to this project.
- Construction stormwater and dewatering water would be discharged to Elliott Bay and the lower Duwamish Waterway only in accordance with federal and state permits, including the NPDES permit, specifically designed to minimize the potential for water quality effects to aquatic species.

- Effects to prey species from stormwater discharged by the Project are improved over baseline (loads and concentrations), however this beneficial effect would likely not be measurable and thus insignificant and discountable in terms of food resource for marbled murrelets.

7.6.1 Critical Habitat for the Marbled Murrelet: No effect

The Project will have ***no effect*** on designated critical habitat for the marbled murrelet because designated critical habitat (i.e. old growth forests for nesting) does not occur within the action area.

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