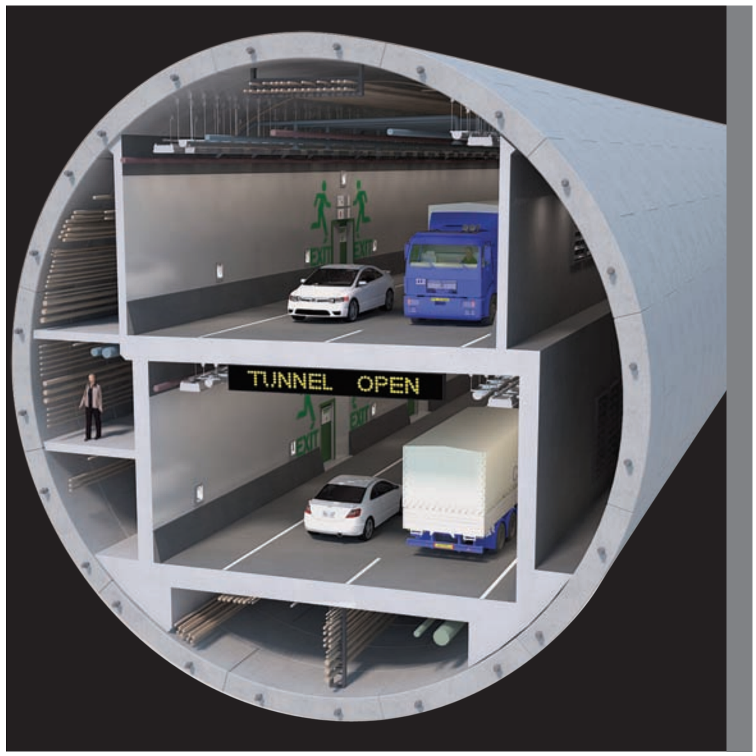
ALASKAN WAY VIADUCT REPLACEMENT PROJECT

2010 Supplemental Draft Environmental Impact Statement

APPENDIX N Wildlife, Fish, & Vegetation Discipline Report



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Federal Highway Administration

Washington State Department of Transportation

City of Seattle

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Alaskan Way Viaduct Replacement Project

Supplemental Draft EIS
Wildlife, Fish, and Vegetation Discipline Report

The Alaskan Way Viaduct Replacement Project is a joint effort between the Federal Highway Administration (FHWA), the Washington State Department of Transportation (WSDOT), and the City of Seattle. To conduct this project, WSDOT contracted with:

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Seattle, WA 98104

In association with:
Coughlin Porter Lundeen, Inc.
EnviroIssues, Inc.
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LIST OF ATTACHMENTS

List of Exhibits

ACRONYMS AND ABBREVIATIONS

μg/L	micrograms per liter
BMP	best management practice
City	City of Seattle
DNR	Department of Natural Resources
DPS	distinct population segment
Ecology	Washington State Department of Ecology
EFH	essential fish habitat
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
FHWA	Federal Highway Administration
I-5	Interstate 5
LID	low-impact development
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NPDES	National Pollutant Discharge Elimination System
PAH	polycyclic aromatic hydrocarbon
PGIS	pollutant-generating impervious surface
Program	Alaskan Way Viaduct and Seawall Replacement Program
project	Alaskan Way Viaduct Replacement Project
SODO	South of Downtown
SPCC	spill prevention, control, and countermeasures
SR	State Route
SWPPP	stormwater pollution prevention plan
TBM	tunnel boring machine
TESC	temporary erosion and sediment control
TSS	total suspended solids
USFWS	U.S. Fish and Wildlife Service
WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife
WRIA	Water Resource Inventory Area
WSDOT	Washington State Department of Transportation

Chapter 1 Introduction and Summary

1.1 Introduction

This discipline report evaluates the Bored Tunnel Alternative, the new alternative under consideration for replacing the Alaskan Way Viaduct. This report and the Alaskan Way Viaduct Replacement Project Supplemental Draft Environmental Impact Statement (EIS) that it supports are intended to provide new information and updated analyses to those presented in the March 2004 Alaskan Way Viaduct and Seawall Replacement Project Draft EIS and the July 2006 Alaskan Way Viaduct and Seawall Replacement Project Supplemental Draft EIS. The discipline reports present the detailed technical analyses of existing conditions and predicted effects of the Bored Tunnel Alternative. The results of these analyses are presented in the main volume of the Supplemental Draft EIS.

The Federal Highway Administration (FHWA) is the lead federal agency for this project, primarily responsible for compliance with the National Environmental Policy Act (NEPA) and other federal regulations, as well as distributing federal funding. As part of the NEPA process, FHWA is also responsible for selecting the preferred alternative. FHWA will base their decision on the information evaluated during the environmental review process, including information contained within the Supplemental Draft EIS and the subsequent Final EIS. FHWA can then issue their NEPA decision, called the Record of Decision (ROD).

The 2004 Draft EIS (WSDOT et al. 2004) evaluated five Build Alternatives and a No Build Alternative. In December 2004, the project proponents identified the cut-and-cover Tunnel Alternative as the preferred alternative and carried the Rebuild Alternative forward for analysis as well. The 2006 Supplemental Draft EIS (WSDOT et al. 2006) analyzed two alternatives—a refined cut-and-cover Tunnel Alternative and a modified rebuild alternative called the Elevated Structure Alternative. After continued public and agency debate, Governor Gregoire called for an advisory vote to be held in the city of Seattle. The March 2007 ballot included an elevated alternative and a surface-tunnel hybrid alternative. The citizens voted down both alternatives.

Following this election, the lead agencies committed to a collaborative process to find a solution to replace the viaduct along Seattle's central waterfront. This Partnership Process is described in Appendix S, the Project History Report. In January 2009, Governor Gregoire, King County Executive Sims, and Seattle Mayor Nickels announced that the agencies had reached a consensus and recommended replacing the aging viaduct with a bored tunnel.

The environmental review process for the Alaskan Way Viaduct Replacement Project (the project) builds on the five Build Alternatives evaluated in the 2004

Draft EIS and the two Build Alternatives evaluated in the 2006 Supplemental Draft EIS. It also incorporates the work done during the Partnership Process. The bored tunnel was not studied as part of the previous environmental review process, and so it becomes the eighth alternative to be evaluated in detail.

The Bored Tunnel Alternative analyzed in this discipline report and in the Supplemental Draft EIS has been evaluated both quantitatively and qualitatively. The Bored Tunnel Alternative includes replacing State Route (SR) 99 with a bored tunnel and associated improvements, such as relocating utilities located on or under the viaduct, removing the viaduct, decommissioning the Battery Street Tunnel, and making improvements to the surface streets in the tunnel's south and north portal areas.

Improvements at the south portal area include full northbound and southbound access to and from SR 99 between S. Royal Brougham Way and S. King Street. Alaskan Way S. would be reconfigured with three lanes in each direction. Two options are being considered for new cross streets that would intersect with Alaskan Way S.:

- New Dearborn Intersection – Alaskan Way S. would have one new intersection and cross street at S. Dearborn Street.
- New Dearborn and Charles Intersections – Alaskan Way S. would have two new intersections and cross streets at S. Charles Street and S. Dearborn Street.

Improvements at the north portal area would include restoring Aurora Avenue and providing full northbound and southbound access to and from SR 99 near Harrison and Republican Streets. Aurora Avenue would be restored to grade level between Denny Way and John Street; and John, Thomas, and Harrison Streets would be connected as cross streets. This rebuilt section of Aurora Avenue would connect to the new SR 99 alignment via the ramps at Harrison Street. Mercer Street would be widened for two-way operation from Fifth Avenue N. to Dexter Avenue N. Broad Street would be filled and closed between Ninth Avenue N. and Taylor Avenue N. Two options are being considered for Sixth Avenue N. and the southbound on-ramp:

- The Curved Sixth Avenue option proposes to build a new roadway that would extend Sixth Avenue N. in a curved formation between Harrison and Mercer Streets. The new roadway would have a signalized intersection at Republican Street.
- The Straight Sixth Avenue option proposes to build a new roadway that would extend Sixth Avenue N. from Harrison Street to Mercer Street in a typical grid formation. The new roadway would have signalized intersections at Republican and Mercer Streets.

For these project elements, the analyses of effects and benefits have been quantified with supporting studies, and the resulting data are found in the discipline reports (Appendices A through R). These analyses focus on assessing the Bored Tunnel Alternative's potential effects for both construction and operation, and consider appropriate mitigation measures that could be employed. The Viaduct Closed (No Build Alternative) is also analyzed.

The Alaskan Way Viaduct Replacement Project is one of several independent projects that improve safety and mobility along SR 99 and the Seattle waterfront from the South of Downtown (SODO) area to Seattle Center. Collectively, these individual projects are often referred to as the Alaskan Way Viaduct and Seawall Replacement Program (the Program). This Supplemental Draft EIS evaluates the cumulative effects of all projects in the Program; however, direct and indirect environmental effects of these independent projects will be considered separately in independent environmental documents. This collection of independent projects is categorized into four groups: roadway elements, non-roadway elements, projects under construction, and completed projects.

Roadway Elements

- Alaskan Way Surface Street Improvements
- Elliott/Western Connector
- Mercer West Project (Mercer Street improvements from Fifth Avenue N. to Elliott Avenue)

Non-Roadway Elements

- First Avenue Streetcar Evaluation
- Transit Enhancements
- Elliott Bay Seawall Project
- Alaskan Way Promenade/Public Space

Projects Under Construction

- S. Holgate Street to S. King Street Viaduct Replacement
- Transportation Improvements to Minimize Traffic Effects During Construction

Completed Projects

- SR 99 Yesler Way Vicinity Foundation Stabilization (Column Safety Repairs)
- S. Massachusetts Street to Railroad Way S. Electrical Line Relocation Project (Electrical Line Relocation Along the Viaduct's South End)

1.2 Summary

The Washington State Department of Transportation (WSDOT) is evaluating the alternative of replacing the Alaskan Way Viaduct with a bored tunnel under downtown Seattle. This report uses the information currently available to assess and describe the potential effects on the fish, wildlife, and vegetation resources in the study area. For detailed information on the Bored Tunnel Alternative as well as brief descriptions of the Program elements, see Appendix B, Alternatives Description and Construction Methods Discipline Report.

Although the previous EIS alternatives included replacing the Elliott Bay Seawall along the central Seattle waterfront, which was needed to ensure the integrity of the Alaskan Way Viaduct replacement options, the Bored Tunnel Alternative is located farther from the waterfront and does not require the replacement of the seawall. However, the seawall needs to be replaced because of its poor structural integrity. The City of Seattle (the City) owns the seawall and will be responsible for its replacement as a separate project, which will occur under both the Bored Tunnel Alternative and Viaduct Closed (No Build Alternative).

The fish, wildlife, and vegetation resources potentially affected by the project occur in a highly developed urban environment. Because of the extensive urban development in the study area, the natural resources are concentrated along the Seattle shoreline and Elliott Bay, which support numerous fish and wildlife species. Washington Department of Fish and Wildlife (WDFW) Priority Habitats and Species maps (WDFW 2009a, 2010) indicate that the closest forage fish spawning is greater than 2 miles from the study area.

Potential effects of the Bored Tunnel Alternative on fish, wildlife, and vegetation species would primarily result from human disturbance during construction and potential temporary and localized sedimentation and turbidity in Elliott Bay. These disturbances would include a minor increase in marine traffic (typically, one or two barges per day) in Elliott Bay from barges used to transport construction materials to and from the project area. Such activities would occur at an appropriate existing facility, and it is assumed that no in-water or overwater construction would be required to allow barge loading or offloading activities. In addition, changes to the stormwater runoff system in the study area could affect water quality in Elliott Bay or Lake Union. Best management practices (BMPs) would be used to minimize these effects. For example, groundwater seepage into the tunnel, rainwater runoff from the two portals, water from the fire-fighting system, and water generated from tunnel washing operations would typically be collected and pumped to the combined sewer system.

Overall, the potential effects of construction and operation of the Bored Tunnel Alternative or the effects of the Viaduct Closed (No Build Alternative) on fish and wildlife species occurring along the Seattle waterfront or in Lake Union would likely be similar to existing conditions, because the area is already the site of heavy vehicle traffic and intense human activity, and the project would not substantially alter the extent or intensity of these uses. Potential indirect effects of the project may include changes to invertebrate and algal resources along the waterfront due to long-term alterations of stormwater management, which could slightly alter sediment and water quality conditions in the nearshore environments of Elliott Bay and Lake Union.

Cumulative effects are effects on the environment that result from the incremental impact of the proposed action when added to other past, present, and reasonably foreseeable future actions. The potential contribution of cumulative effects of the Bored Tunnel Alternative were qualitatively analyzed in combination with other Program elements and other projects in the study area. Cumulative effects on fish and wildlife would include continuation of the effects produced by the past and existing land use activities along the waterfront and the effects of lost or degraded intertidal habitat resulting from the presence of the existing seawall and extensive overwater piers. The separate Elliott Bay Seawall Project, which is discussed in this report as a Program element, has the potential for cumulative effects on aquatic species in Elliott Bay. It is assumed that the City will minimize potential effects of this in-water work by constructing the new seawall on the land side of the existing seawall where feasible.

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Chapter 2 METHODOLOGY

This chapter outlines the procedures used to evaluate (1) potential environmental effects of the Bored Tunnel Alternative and Viaduct Closed (No Build Alternative) and (2) possible mitigation measures to avoid or minimize adverse effects or enhance environmental quality.

Information review consisted of available published sources, particularly the information assembled for previous efforts related to the Program, as well as directly from resource agencies. This information was used to identify specific concerns and appropriate analyses for the project. The information was also used to describe the current biological baseline conditions in the study area, particularly the shoreline habitat along the Seattle waterfront that could potentially be altered by construction and operation of the Bored Tunnel Alternative or the effects of the Viaduct Closed (No Build Alternative).

Resource agencies having permitting or regulatory authority for the biota and habitat in the study area include National Marine Fisheries Service (NMFS), U.S. Fish and Wildlife Service (USFWS), U.S. Army Corps of Engineers, U.S. Environmental Protection Agency (EPA), Washington Department of Fish and Wildlife (WDFW), Washington State Department of Ecology (Ecology), Washington Department of Natural Resources (DNR), and City of Seattle.

2.1 Study Area

The proposed boundaries of the Bored Tunnel Alternative include the maximum extent of both the New Dearborn Intersection option and New Dearborn and Charles Intersections option in the south portal area, as well as the maximum extent of both the Curved Sixth Avenue option and the Straight Sixth Avenue option in the north portal area. The study area includes the areas that would be directly or indirectly affected by construction activities, including the immediate construction areas, associated staging areas, and stormwater runoff and dewatering processes. This would include the barge transport route for disposal of excavation and tunneling spoils. The study area also includes areas that would be directly or indirectly affected by the operation of the constructed facilities, including some nearshore areas adjacent to stormwater discharge outfalls in Elliott Bay and Lake Union. It encompasses portions of the drainage basins located within the project area and the associated surface water outfalls and receiving waters (refer to Appendix O, Surface Water Discipline Report). Refer to Exhibit 4-1 for a map of the study area.

The study area includes heavily urbanized upland habitat in the vicinity of the proposed project footprint and nearby shoreline and open water habitats of Elliott Bay and Lake Union (see Exhibit 4-1). This study area is the same for both the Bored

Tunnel Alternative and the Viaduct Closed (No Build Alternative), as well as for both temporary construction effects and long-term operational effects.

This study area encompasses the following project elements:

- Removal of the existing viaduct structure.
- Replacement of SR 99 through the existing viaduct corridor with a bored tunnel or other limited-access facility.
- Construction of the south and north portals of the bored tunnel.
- Modification of the surface streets at the south and north portals of the bored tunnel.
- Decommissioning of the existing Battery Street Tunnel.
- Use of an existing shoreline facility to transport construction material to and from the project area.
- Barge transport of tunnel boring spoils to an appropriate disposal site.

The study area also includes other non-project, or Program-level, elements that would provide additional transportation and other public functions. These Program elements would improve access and mobility to and through downtown while enhancing Seattle's waterfront and adjacent neighborhoods. These Program elements and other past, present, or future proposed projects in the vicinity in combination would result in potential cumulative effects on natural resources.

Other roadway elements of the Program are the following:

- Alaskan Way Surface Street Improvements (on the location of the former viaduct) from S. King Street to Pike Street
- Elliott/Western Connector from Pike Street to Battery Street
- Mercer West Project (Mercer Street improvements from Fifth Avenue N. to Elliott Avenue)

Non-roadway elements of the Program consist of the following:

- Elliott Bay Seawall Project
- Alaskan Way Promenade/Public Space
- First Avenue Streetcar Evaluation
- Transit Enhancements

2.2 Existing Conditions Information

Data were collected from available published sources providing information on the existing conditions of fish, wildlife, and vegetation resources in the study area. Information obtained was used to characterize and assess potential effects from the proposed project. Project engineers provided information on the physical aspects of the project that could potentially alter the existing habitat characteristics and the biota inhabiting the study area.

Existing conditions that could be altered by the proposed project are identified along the study area. Information on physical and biological habitat characteristics was collected to provide a description of existing baseline conditions for use in the analysis and discussion of potential effects through both existing data sources and previous reconnaissance surveys conducted as part of the overall Program evaluation process (Parametrix 2002; Taylor Associates 2006).

Numerous investigations have been conducted by the Port of Seattle, City of Seattle, local tribes, and other entities to identify characteristics of juvenile salmon and the habitat they use as they migrate through or rear in the study area. Information on the timing, habitat characteristics, prey resources utilized, potential predators, etc., was obtained from published and unpublished literature sources.

Overall habitat conditions identified in the 2004 Draft EIS included information from both existing data sources and several reconnaissance surveys conducted as part of the overall Program. Conditions have not substantially changed since the publication of the 2004 Draft EIS or the 2006 Supplemental Draft EIS. The physical and biological habitat data describe existing baseline conditions for the analysis and discussion of potential project-related effects. These previous documents identify the species of fish, wildlife, and vegetation known or likely to occur within the study area. However, additional information is presented in this report for species that have since been listed or proposed for listing under the Endangered Species Act (ESA).

The following federal regulations or statutes apply to fish, wildlife, and vegetation protection in the study area:

- Clean Water Act Sections 401 and 404
- Endangered Species Act (ESA)
- Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act)
- Marine Mammal Protection Act
- Bald and Golden Eagle Protection Act
- Migratory Bird Treaty Act
- Rivers and Harbors Act
- National Pollution Discharge Elimination System (NPDES) (Clean Water Act Section 402)
- Coastal Zone Management Act

State and local regulations that apply to these resources include the State Hydraulic Code, Shoreline Management Act, Growth Management Act, State Waste Discharge Individual Permit for Process and Storm Water, local sensitive/critical area ordinances, and applicable Seattle Municipal Code and King County Code requirements. The general goal of these regulations is to protect water quality, shorelines, aquatic habitat, wetlands, riparian areas, and associated terrestrial habitats, as well as the species that depend on these areas.

2.3 Endangered, Threatened, and Proposed Species and Habitat Occurrence

Species listed under the ESA by NMFS and USFWS were obtained from the NMFS and USFWS websites (NMFS 2010a; USFWS 2010). These resources also identify habitat requirements of these species, as well as specifically designated critical habitat. This information was used to assess the potential for ESA-listed or proposed species to occur in the study area, and the potential effects of project or Program activities on the species or their critical habitat.

2.4 Essential Fish Habitat

The Magnuson-Stevens Act requires proposed projects with a federal nexus (such as federal funding or the need to obtain a federal permit) to evaluate potential effects on habitat of commercially managed fish populations, including some salmon, groundfish, and pelagic fish species. Essential fish habitat (EFH) has been defined for the purposes of the Magnuson-Stevens Act as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity" (NMFS 1999). NMFS (Federal Register, Vol. 67, p. 2343 [67 FR 2343]) has further added the following interpretations to clarify this definition:

- "Waters" include aquatic areas and their associated physical, chemical, and biological properties that are used by fish, and may include areas historically used by fish where appropriate.
- "Substrate" includes sediment, hard bottom, structures underlying the waters, and associated biological communities.
- "Necessary" means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem.
- "Spawning, breeding, feeding, or growth to maturity" covers the full life cycle of a species.

Project biologists compiled lists of salmon, groundfish, and pelagic species potentially affected by the proposed project and identified for protection under the Magnuson-Stevens Act and evaluated these species to determine which are likely to use shoreline habitat within the project area. This report identifies the habitat supporting members of these groups and describes potential project-related effects.

2.5 Mitigation and Habitat Enhancement

Potential Program-level mitigation and habitat enhancement options have been initially identified through coordination with resource agencies, and specific mitigation and habitat enhancement options will be identified through additional agency coordination, the evaluation of potential project effects, and development of the project design. While the project would likely have limited direct effects on the natural resources in the area, there is the potential to affect water quality conditions due to changes in the stormwater systems in the study area. However, the Bored Tunnel Alternative is expected to either improve or maintain the water quality of runoff being discharged from the project area by reducing the overall amount of pollutant-generating impervious surface (PGIS) relative to the existing conditions. These effects are summarized in Chapter 5, and a detailed pollutant loading analysis is discussed in Appendix O, Surface Water Discipline Report.

The shoreline habitat provided along the Seattle waterfront is highly modified from its natural historical condition. Vertical bulkheads in the intertidal zone and the extensive overwater pier structures are the least suitable habitat type for anadromous salmonids, as well as many other species of interest. Despite the highly modified conditions along the waterfront, the area is an important migratory and rearing corridor for juvenile salmonids, particularly the major salmon runs of the Green/Duwamish River. Juvenile salmonids produced in other watersheds also use the Elliott Bay shoreline habitat for rearing. Actions to enhance juvenile salmonid rearing and migrating functions as part of the overall Program (particularly the Elliott Bay Seawall Project) are expected to provide some benefits to these species.

In addition, the highly modified upland habitat limits the use of the project area by some avian and terrestrial species. The replacement of some of the existing impervious surfaces along the waterfront with trees and other vegetative landscaping features would likely improve habitat conditions for terrestrial and avian species over baseline conditions.

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Chapter 3 STUDIES AND COORDINATION

Existing conditions of habitat and species use of the study area have been extensively characterized in previous documents prepared for the Program and by recent and ongoing research projects in the area. Therefore, this chapter was developed by reviewing existing information that was not available previously, as described in Chapter 2, Methodology, but no additional surveys were conducted to gather specific study area data. Data were collected from available published sources or ongoing studies in the study area (e.g., seawall habitat enhancement research), as well as directly from resource agencies.

3.1 Studies

No new studies were conducted as part of this assessment, although information from previous studies conducted as part of the Program are included, where appropriate.

3.2 Coordination

In addition to the habitat and species use surveys conducted in support of the EIS process, information has been shared, and coordination continued with the following agencies and tribes:

- City of Seattle
- King County
- Muckleshoot Indian Tribe
- National Marine Fisheries Service (NMFS)
- Port of Seattle
- The Seattle Aquarium
- U.S. Army Corps of Engineers
- U.S. Environmental Protection Agency (EPA)
- U.S. Fish and Wildlife Service (USFWS)
- University of Washington, Fisheries Research Institute
- Washington Department of Fish and Wildlife (WDFW)
- Washington Department of Natural Resources (DNR)
- Washington State Department of Ecology (Ecology)

The following specific information was gathered from agencies and existing information sources:

- Species listed under the ESA.
- Priority habitats and species (WDFW and Washington Natural Heritage Program).
- Species habitat requirements, life stages, and timing within the study area.
- Habitat descriptions.

The resulting updated information consists of the following:

- Designated critical habitat for Southern Resident killer whale.
- Documentation for the ESA listing of the Puget Sound steelhead distinct population segment (DPS) as a threatened species.
- Documentation for the ESA listing of the Southern DPS of eulachon as a threatened species.
- Documentation for the ESA listing of three Puget Sound rockfish as threatened or endangered species.
- Documentation of habitat use along the Seattle waterfront.
- Potential effects on species from project construction and operation.
- Identification of appropriate avoidance, minimization, and conservation measures to limit project effects on aquatic species.
- Appropriate mitigation for project effects.

Chapter 4 AFFECTED ENVIRONMENT

This chapter summarizes available information characterizing the existing environmental conditions. The existing conditions describe the predominant species and relevant habitat conditions within the study area potentially affected by the proposed project. This specifically includes any ESA-listed species and their critical habitat; species protected under other legislation, such as the Magnuson-Stevens Act; and other prominent aquatic, wildlife, and vegetation species potentially affected by the project. The following sections summarize the status and use of the study area by fish, marine invertebrates, marine mammals, birds, and other wildlife species.

Many groups of biota use the shoreline and aquatic habitats in the study area. Elliott Bay supports a rich community of resident and transient fish species, including several species and stocks of anadromous salmonids. Resident fish species commonly observed in the shoreline area along the Elliott Bay Seawall include surfperch, bay pipefish, shiner perch, sculpin, greenling, various flatfishes, and a limited number of lingcod (refer to 2004 Draft EIS Appendix R, Fisheries, Wildlife, and Habitat Discipline Report, for more information).

4.1 Data Collection

The data collected and reviewed include information provided by resource agencies and other available published information. The project engineers developed information on the physical aspects of the project that could potentially alter existing habitat characteristics and biota in the study area. In addition, previous biological surveys conducted along the Seattle waterfront provide site-specific information on habitat conditions and species use of the shallow water habitat along the central waterfront (Parametrix 2002; Taylor Associates 2006).

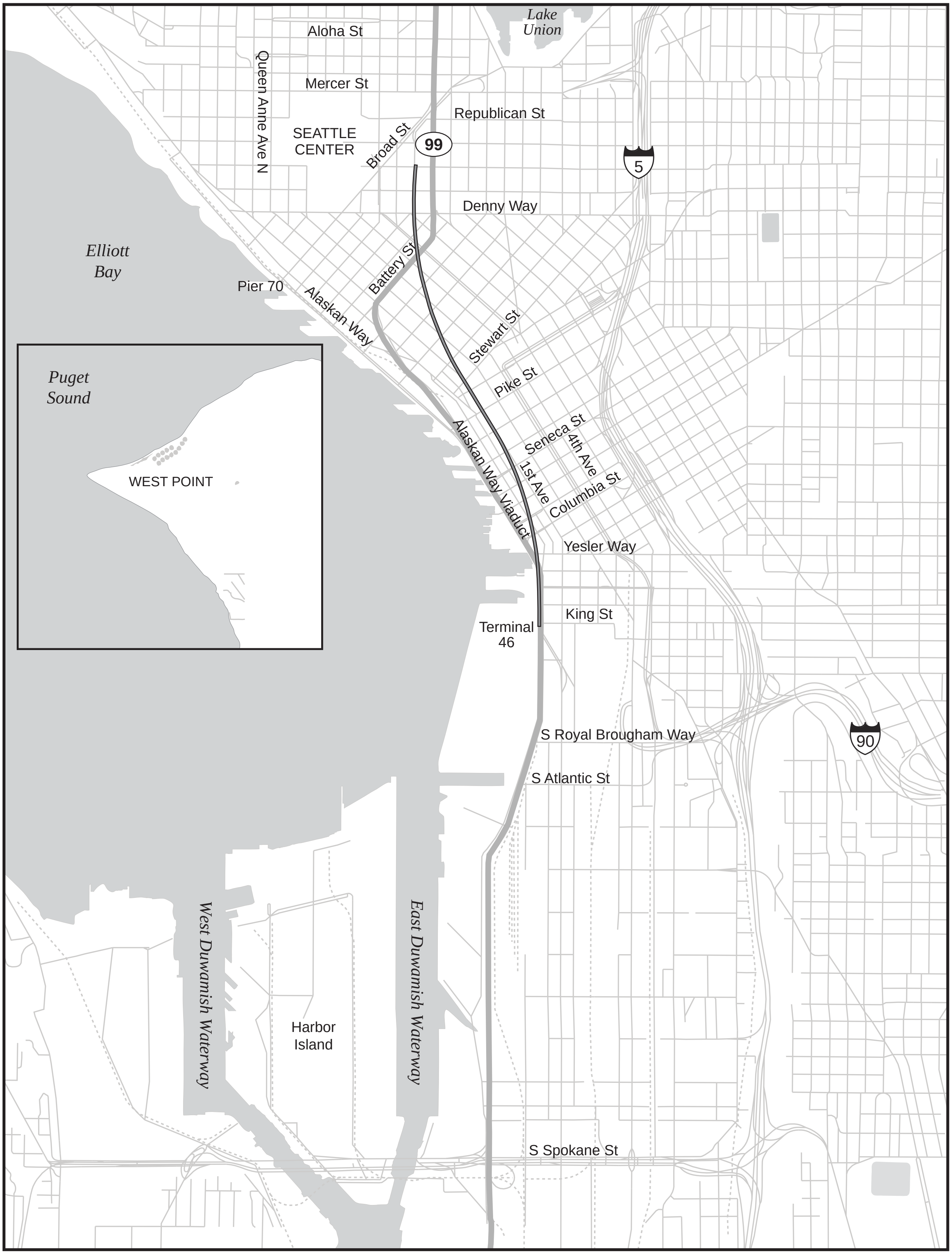
4.2 Study Area

The fish, wildlife, and vegetation resources potentially affected by the project occur in an urban environment resulting from the development of the shoreline and upland areas in the city of Seattle. Because of the extensive urban development in the study area, the natural resources are concentrated along the Seattle shoreline and Elliott Bay, as well as in Lake Union, all of which support numerous fish and wildlife species. However, even the Seattle shorelines have undergone substantial development, including the original construction of the existing seawall at a location seaward of the natural shoreline, the filling of intertidal and shallow subtidal areas landward of the seawall, and construction of piers over substantial portions of the remaining shallow water habitat. The bored tunnel alignment (which includes both bored and cut-and-cover tunnel segments) would extend from approximately S. Royal Brougham Way in the south to approximately Republican Street in the north. As shown in Exhibit 4-1, the marine shoreline in the study area extends along much of the Seattle central waterfront, from about Terminal 46 in the south to Pier 70 in the north.

The north end of the study area occurs in a completely urbanized corridor, just north of the existing Battery Street Tunnel. The extensive development throughout the area has eliminated nearly all the natural resource habitat in the area, except for occasional street trees (trees planted along roadways) and maintained landscaped areas. These habitat areas support typical urban wildlife species.

Stormwater runoff from the north end of the project area currently drains to Lake Union, which supports numerous freshwater fish species and anadromous fish species of the greater Lake Washington watershed. As a result, Lake Union is part of the study area (see Exhibit 4-1). The lake represents a transitional area between the fresh waters of the Lake Washington watershed and the marine waters of Puget Sound. Lake Union has been listed on Ecology's 303(d) Category 5 list for exceeding the criteria for aldrin, fecal coliform bacteria, lead, and total phosphorus (Ecology 2009). It has also exceeded the sediment bioassay criteria. Lake Union is designated by Ecology as core summer habitat for aquatic life uses, excellent primary contact recreation, water supply uses, wildlife habitat, harvesting, commerce and navigation, boating, and aesthetic values (Washington Administrative Code, Chapter 173-201A [WAC 173-201A]).

The sediments in Lake Union are generally soft and contain substantial organic material. As microorganisms in the sediment break down this organic material, they consume much of the oxygen in the lower part of the lake, reducing dissolved oxygen levels to near zero by the end of the summer. This low dissolved oxygen condition is likely intensified by the intrusion of salt water into Lake Union from operation of the Hiram M. Chittenden Locks (Ballard Locks), particularly during the high-use summer period. The denser saline water remains along the bottom of the Lake Washington Ship Canal and Lake Union and resists mixing forces, thereby trapping the low oxygen water at depth (CH2M Hill 1999; Seattle 2003; Hansen et al. 1994). The lack of oxygen and the warm summer surface water temperatures limit the habitat available for coldwater fish species such as salmon and trout and provide habitat more suitable for warmwater species such as bass, northern pikeminnow, and



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SCALE IN FEET

Species discussed occur within this area and beyond.

Bored Tunnel

Exhibit 4-1
Study Area

crappie. The extensive historical industrial land uses around the lake have also contributed to increased contamination levels in the substrate.

Similar to the Seattle waterfront, most (76 to 80 percent or more) of the Lake Union shoreline has been developed and modified by installation of bulkheads or other types of bank stabilization materials (Toft et al. 2003). Areas with partially undeveloped shoreline include Gas Works Park and a protected cove in the southwestern end of Lake Union, although little of the Lake Union shoreline and riparian zone retains natural vegetation (Seattle 2000). Eurasian watermilfoil is present in Lake Union. The species contributes a large amount of organic material to Lake Union, which can affect dissolved oxygen levels (WDNR 1999).

The aquatic portion of the study area also includes the Seattle waterfront from the mouth of the Duwamish East Waterway in southeastern Elliott Bay to Myrtle Edwards Park (Township 24N, Range 4E, Section 32). The existing Seattle waterfront was filled and had bulkheads and overwater piers constructed from the late 1800s through the early 1900s. The marine waterfront in the study area is predominantly used for commerce and transportation.

A variety of fishes, invertebrates, and marine algae either live within or use the shoreline habitat within the study area for a portion of their life cycle. Lists of fish, bird, mammal, and algal species potentially present or known to occur in the study area are provided, including some species that are listed under the ESA (see Exhibit 4-3) or state-listed and priority species (i.e., western grebe, common loon, great blue heron, cavity-nesting ducks, bandtailed pigeon, and pileated woodpecker). None of these species are known to nest in the Seattle portion of the study area; consequently, construction disturbance would not be likely to affect nesting success. EFH, as defined by the Magnuson-Stevens Act, is identified for species likely to occur within the study area. A general review of commercially managed fish populations and habitat likely to occur in the project vicinity and potentially be affected by the project is provided.

Despite the extensive urban development and commercial uses of Elliott Bay, it is designated by Ecology as an excellent marine water body that should be protected for salmonid and other fish migration, rearing, and spawning; shellfish rearing and spawning; shellfish harvesting; primary contact recreation; wildlife habitat; harvesting; commerce and navigation; boating; and aesthetic values (WAC 173-201A; Ecology 2005). However, the bay is also on the 2008 Ecology 303(d) List of Impaired and Threatened Water Bodies for exceeding fecal coliform criteria (Ecology 2009). Water and sediment quality information is provided in greater detail in Appendix O, Surface Water Discipline Report.

4.2.2 Fish and Marine Invertebrates

The numerous marine fish species that occur along the Seattle shoreline in the study area are similar to those that occur throughout Elliott Bay and Puget Sound (Exhibit 4-2). These include the ESA-listed fish species of Puget Sound Chinook salmon (*Oncorhynchus tshawytscha*), steelhead (*O. mykiss*), and bull trout (*Salvelinus confluentus*) (Exhibit 4-3). At times, the Seattle waterfront is a migration corridor and rearing area for these and other juvenile anadromous salmonids. Nearshore marine areas of Elliott Bay are designated as Chinook salmon and bull trout critical habitat (USFWS 2005; NMFS 2005), although steelhead critical habitat has not yet been designated. Although not identified during previous project-related surveys, Elliott Bay is also expected to support the three Georgia Basin rockfish species recently listed under the ESA: bocaccio (*Sebastes paucispinis*), and canary (*S. pinniger*), and yelloweye (*S. ruberrimus*) rockfish (NMFS 2010b). While there are some references to the recently listed Pacific eulachon (*Thaleichthys pacificus*) occurring in Puget Sound, there are no known spawning populations and only rare instances of individual fish occurrences (NMFS 2010c).

Exhibit 4-2. Functional Groupings of Fish Occurring in Elliott Bay and Along the Seattle Shoreline

Functional Group[1]	Common Name[1]	Scientific Name
Salmonids	Chinook salmon[2,, 3]	*Oncorhynchus tshawytscha*
	Coho salmon[2]	*Oncorhynchus kisutch*
	Chum salmon	*Oncorhynchus keta*
	Cutthroat trout	*Oncorhynchus clarki*
	Steelhead[3]	*Oncorhynchus mykiss*
	Bull trout[3]	*Salvelinus confluentus*
Forage Fish	Surf smelt	*Hypomesus pretiosus pretiosus*
	Pacific sand lance	*Ammodytes hexapterus*
	Pacific herring	*Clupea harengus pallasi*
	Pacific eulachon[c]	*Thaleichthys pacificus*
Other Nearshore Fishes	Bay pipefish	*Syngnathus griseolineatus*
	Tube-snout	*Aulorhynchus flavidus*
	Three-spine stickleback	*Gasterosteus aculeatus*
	Six-gill shark	*Hexanchus griseus*
	Spiny dogfish	*Squalus acanthias*
Surfperch	Striped seaperch	*Embiotoca lateralis*
	Pile perch	*Rhacochilus vacca*
	Shiner perch	*Cymatogaster aggregata*
	Kelp perch	*Brachyistius frenatus*

Exhibit 4-2. Functional Groupings of Fish Occurring in Elliott Bay and the Seattle Shoreline (continued)

Functional Group[1]	Common Name[1]	Scientific Name
Flatfish	English sole[2] Starry flounder[2] Rock sole[2] Sand sole[2] Pacific sanddab[2]	*Pleuronectes (Parophrys) vetulus* *Platichthys stellatus* *Pleuronectes (Lepidopsetta) bilineata* *Psettichthys melanostictus* *Citharichthys sordidus*
Other demersal	Pacific staghorn sculpin Fluffy sculpin Padded sculpin Buffalo sculpin Great sculpin White-spotted Greenling Lingcod[2] Rockfish[2] Spotted ratfish[2] Prickleback Northern clingfish Wolf eel	*Leptocottus armatus* *Oligocottus snyderi* *Artedius fenestralus* *Enophrys bison* *Myoxocephalus polyacanthocephalus* *Hexagrammos stelleri* *Ophiodon elongatus* *Sebastes* spp. *Hydrolagus colliei* Stichaeidae spp. *Gobiesox maeandricus* *Anarrhichthys ocellatus*
Gunnels	Penpoint gunnel Saddleback gunnel Crescent gunnel Rockweed gunnel	*Apodichthys flavidus* *Pholis ornata* *Pholis laeta* *Xererpes fucorum*

Sources: Taylor Associates 2006; Parametrix 2002.
[1] Phylogenetic conventions and common names according to the American Fisheries Society.
[2] Species with designated essential fish habitat.
[3] ESA-listed fish species.

Exhibit 4-3. Federal ESA-Listed Species Potentially Occurring in the Project Area

	Common Name	Scientific Name	Listing Status
Fish	Chinook salmon	*Oncorhynchus tshawytscha*	Threatened
	Steelhead	*Oncorhynchus mykiss*	Threatened
	Bull trout	*Salvelinus confluentus*	Threatened
	Pacific eulachon	*Thaleichthys pacificus*	Threatened
	Canary rockfish	*Sebastes pinniger*	Threatened
	Yelloweye rockfish	*Sebastes ruberrimus*	Threatened
	Bocaccio	*Sebastes paucispinis*	Endangered
Wildlife	Killer whale	*Orcinus orcas*	Endangered
	Humpback whale	*Megaptera novaeangliae*	Endangered
	Steller sea lion	*Eumetopias jubatus*	Threatened
	Marbled murrelet	*Brachyramphus marmoratus*	Threatened

In addition to the federally ESA-listed species identified in Exhibit 4-3, a number of Washington species of concern are identified as occurring in King County and could also potentially occur in the project area (Exhibit 4-4).

Exhibit 4-4. Washington State Species of Concern Potentially Occurring in the Project Area

Common Name			
Fish	Black rockfish	Brown rockfish	Canary rockfish
	China rockfish	Copper rockfish	Greenstriped rockfish
	Quillback rockfish	Redstripe rockfish	Tiger rockfish
	Widow rockfish	Yellowtail rockfish	Pacific cod
	Pacific hake	Pacific herring	River lamprey
	Walleye pollock		
Birds	Common loon	Common murre	Peregrine falcon
	Purple martin	Western grebe	Bald eagle
	Brandt's cormorant		
Mammals	Dall's porpoise	Gray whale	Harbor seal
	Pacific harbor porpoise	California sea lion	Townsend's big-eared bat

Source: WDFW 2009d.

Elliott Bay is a migratory route for large numbers of anadromous salmonids originating from the Green/Duwamish River Watershed, which flows into the bay (Seattle 2003). Salmonids originating in other basins (e.g., Lake Washington/ Cedar River, Puyallup River, and Snohomish River) may also migrate into Elliott Bay and through the study area (Brennan et al. 2004).

Juvenile salmonids typically migrate and rear along the Seattle waterfront during spring and early summer. Juvenile salmon are commonly present during the spring and early summer in the surface waters near the Elliott Bay Seawall and other modified shoreline areas in Elliott Bay (Taylor Associates 2006; Toft and Cordell 2006; Parametrix 2002). Juvenile Chinook salmon are known to enter Elliott Bay as early as January (Nelson et al. 2004) and have been documented in the marine nearshore as late as October (Brennan et al. 2004). Juvenile coho (*O. kisutch*) are generally present in mid-February to mid-June, with some numbers remaining until October (Warner and Fritz 1995; Brennan et al. 2004). Steelhead are not expected to rear in nearshore habitat areas of Elliott Bay for extensive periods of time, as they migrate out of fresh water at a larger size than other anadromous salmonids. Steelhead migrate into salt water between February and August, with peak migration in May through July (Seattle Public Utilities and U.S. Army Corps of Engineers 2008).

Available information indicates that juvenile salmonids likely spend limited time in Lake Union as they migrate to Puget Sound in the spring. Tagging studies indicate that most juvenile Chinook salmon do not enter the Lake Washington Ship Canal until late in the migration period and spend days to weeks between Lake Washington and the Ballard Locks (Tabor and Pisakowski 2002; Celedonia et al. 2008). Therefore, juvenile salmonids are not expected to spend substantial periods of time in Lake Union, where they could potentially be affected by runoff from the proposed project.

While small juvenile salmonids orient themselves relatively close to shore and then move offshore as they increase in size, adult salmon migrating through Elliott Bay would typically occur in deeper areas. Adult Chinook salmon migrate along the Seattle shoreline from late June through mid-November, peaking between late September and late October, although resident Chinook salmon likely occur in Elliott Bay throughout the year (Grette and Salo 1986; Williams et al. 2001). Adult coho salmon are present from early August to late January (Taylor 1995; Warner and Fritz 1995). Adult steelhead typically enter fresh water from November through February (WDF et al. 1993).

Early arriving adult salmonids appear to spend little time in Lake Union because of the relatively high water temperatures in late summer and early fall. Adult Chinook and sockeye salmon use the Ship Canal (including Lake Union) primarily as a migratory corridor, typically spending only a few days passing through the Ship Canal (Fresh et al. 1999, 2000; Quinn and terHart 1987). However, species that migrate into fresh water later in the fall or winter (i.e., coho salmon or steelhead) would experience cooler water temperatures and could spend a longer period (weeks) passing through the canal. Overall, adult salmonids are not expected to spend substantial periods of time in Lake Union as they migrate back to their natal streams to spawn, thereby limiting the potential to be affected by runoff from the proposed project.

Although adult Chinook salmon occurring in Elliott Bay likely consist primarily of fish returning to the Green/Duwamish River system, fish from other watersheds are also expected to occasionally occur in the area. Chinook salmon spawn in the Green/Duwamish River upstream from river mile 11 (WDF et al. 1993), which is many miles from the study area. Duwamish River Chinook salmon are part of the Green River fall Chinook salmon stock. This stock is currently listed as healthy based on escapement levels, with escapement levels of over 10,000 fish between 1999 and 2003 (WDFW 2009b). The nonnative Green River summer steelhead stock is rated as depressed, based on a long-term negative trend and short-term severe decline in harvest in 1999 and 2000 (WDFW 2009b). However, the native winter steelhead stock is considered healthy, with escapement levels typically over 1,000 fish between 1986 and 2003. Limited information is available on the stock status of the other Green/Duwamish River salmonid species.

Little information exists regarding the current distribution of bull trout in the Duwamish River basin, but some bull trout do occur in the Duwamish River mainstem or its major tributaries (King County DNR 2000). Spawning populations have not been identified in the Green/Duwamish River or its tributaries, although adult bull trout have been identified in the lower Duwamish River, Elliott Bay, and the surrounding area (Goetz et al. 2004). Bull trout produced in other river systems also potentially forage along the Elliott Bay shoreline. Few bull trout occur in Lake Union or Lake Washington, as only 34 have been captured near the Ballard Locks since 1949, and these are believed to have originated in other watersheds (Port of Seattle 2005).

As shown in Exhibit 4-5, macroinvertebrates commonly occurring along the Seattle waterfront include starfish, barnacles, crabs, and shrimp, some of which provide larvae consumed by juvenile salmonids (Taylor Associates 2006; Parametrix 2002). The giant Pacific octopus (*Octopus dofleini*) is occasionally found in the area, and the Seattle Aquarium releases several annually under the aquarium pier. A wide variety of small invertebrates also commonly occur on the macroalgae and open substrates typical of Elliott Bay and Puget Sound.

Exhibit 4-5. Marine Invertebrate Species Commonly Occurring Along the Seattle Waterfront

Common Name	Scientific Name
Dungeness crab	*Cancer magister*
Red rock crab	*Cancer productus*
Kelp crab	*Cancer gracilis*
Yellow shore crab	*Hemigrapsis oregonensis*
Purple shore crab	*Hemigrapsus nudus*
Hairy crabs	*Telmessus cheiragonus*
Coon-stripe shrimp	*Pandalus danae*
Sunflower sea star	*Pycnopodia helianthoides*
Common sea star	*Asterias forbesi*
Purple sun star	*Solaster endeca*
Sea anemone	*Metridium* sp.
Giant Pacific octopus	*Octopus dofleini*

Sources: Taylor Associates 2006; Parametrix 2002.

While most of the project area currently drains to Elliott Bay, the northern portion of the area drains to Lake Union, which is part of the Lake Washington basin. More than 50 freshwater and anadromous fish species are found within the Lake Washington basin, including over 20 nonnative freshwater species (Warner and Fresh 1999; Kerwin 2001). In addition to the freshwater and anadromous species, some estuarine and marine species occur in Lake Union due to the saltwater intrusion through the Ballard Locks. Native freshwater species include threespine stickleback, peamouth chub, northern pikeminnow, and sculpin; anadromous species include longfin smelt, river and Pacific lamprey, and various trout and salmon species; and marine species include starry flounder, shiner perch, striped seaperch, and Pacific staghorn sculpin (Kerwin 2001). Nonnative species include yellow perch, black crappie, bluegill, and smallmouth and largemouth bass (Warner and Fresh 1999).

4.2.3 Wildlife

The extensive urban development in the study area has eliminated nearly all the natural wildlife habitat in the area, resulting in few species occurring in the upland portion of the study area (Exhibits 4-6 and 4-7). The shorelines of both Elliott Bay and Lake Union are highly modified with little or no natural habitat available to support wildlife species. The species that occur in these areas are typically accustomed to urban environments and frequent disturbances. However, the offshore aquatic habitat in both these water bodies continues to provide natural habitat conditions to support species that occur or use these areas.

Exhibit 4-6. Terrestrial Mammals That May Occur Within Urban Habitat in the Study Area

Common Name	Scientific Name	Common Name	Scientific Name
Common opossum	*Didelphis marsupidlis*	Muskrat	*Ondatra zibethicus*
Little brown myotis	*Myotis lucifugus*	House mouse	*Mus musculus*
Yuma myotis	*Myotis yumanensis*	Pacific jumping mouse	*Zapus trimtatus*
California myotis	*Myotis califomicus*	Norway rat	*Rattus norvegicus*
Silver-haired bat	*Lasionycteris nociivagans*	Black rat	*Rattus rattus*
Big brown bat	*Eptesicus fuscus*	Coyote	*Canis latrans*
Hoary bat	*Lasiurus cinereus*	Raccoon	*Procyon lotor*
Townsend's big-eared bat	*Plecotus townsendii*	Ermine	*Mustela erminea*
Long-eared myotis	*Myotis evotis*	Mink	*Mustela vison*
Domestic rabbit	*Oryctolagus cuniculus*	River otter	*Lutra canadensis*
Eastern gray squirrel	*Sciurus carolinensis*	Domestic dog	*Canis familiaris*
Deer mouse	*Peromyscus maniculatus*	Domestic cat	*Felis domesticus*

Exhibit 4-7. Birds Commonly Found in Moderately and Poorly Vegetated Urban Habitats of Seattle

Common Name			
House finch	Bewick's wren	Mallard	Golden-crowned kinglet
Double-crested cormorant	American goldfinch	Rock dove	Bufflehead
Great blue heron	American robin	Spotted towhee	Bushtit
Northern flicker	Glaucous-winged gull	Northern flicker	American wigeon
Downey woodpecker	Cedar waxwing	Song sparrow	Red-breasted nuthatch
Steller's jay	Ring-billed gull	Lesser scaup	Violet-green swallow
American crow	Spotted towhee	Green-winged teal	European starling
Black-capped chickadee	American coot	House sparrow	

The shoreline and open water areas of Elliott Bay and Puget Sound continue to support wildlife species (Exhibit 4-8). Marine mammal species that occur along Elliott Bay's Seattle shoreline include harbor seal (*Phoca vitulina*) and California sea lion (*Zalophus californianus*). These marine mammals feed on flatfish, rockfish, cod, squid, and octopus. They occasionally feed on salmon (adult and juvenile), although salmon are not a major part of their diet (Osborne et al. 1988). However, harbor seals have been reported to feed on juvenile salmon (Olesiuk et al. 1995; Yurk and Trietes 2000). Gray whales and Dall's porpoise could potentially occur within Elliott Bay, but they are typically not observed close to the urban shoreline.

Exhibit 4-8. Species of Marine Mammals Potentially Occurring in Elliott Bay

Common Name	Scientific Name
Harbor seal	*Phoca vitulina*
California sea lion	*Zalophus californianus*
Steller sea lion	*Eumetopias jubatus*
Killer whale	*Orcinus orcas*
Dall's porpoise	*Phocoenoides dalli*
Gray whale	*Eschrichtius robustus*
Pacific harbor porpoise	*Phocoena phocoena*

Marbled murrelet (*Brachyramphus marmoratus*), Steller sea lion (*Eumetopias jubatus),* humpback whale (*Megaptera novaeangliae*), and Southern Resident killer whale (*Orcinus orcas*) are the four ESA-listed wildlife species addressed (see Exhibit 4-3). Marbled murrelets may occasionally occur in the general area (Li 2009); however, it is unlikely that they commonly forage along the Seattle shoreline near the project due to existing high levels of human activity on the shoreline and in open water areas (USFWS 2004). While the project area occurs within the known range of marbled murrelets, the nearest nesting area is in the Cascade Mountains, some 30 miles from the study area (USFWS 2009).

Steller sea lions have only occasionally been sighted in southern Puget Sound (Jeffries et al. 2000). In southern Puget Sound, Steller sea lions are occasionally observed on buoys or haulout sites off Toliva Shoals, south of Steilacoom, off McNeil and Eagle Islands, and in Dalco Passage (Gearin et al. 1999).

Killer whales commonly occur in Puget Sound but infrequently occur in Elliott Bay (Seattle 2009). However, critical habitat for killer whales is designated for marine water in Elliott Bay greater than 20 feet deep, relative to extreme high water (NMFS 2006).

Bald eagles (*Haliaeetus leucocephalus*), recently delisted as a threatened species under the ESA, occur in the study area. Bald eagle nests have been identified within the greenbelt on the hillside along the west side of the Duwamish River (more than 1 mile from the southern terminus of the project area), at Duwamish Head, and in Discovery Park (WDFW 2009c). The Seattle shoreline is a foraging area for resident eagles but is not known to be a wintering area for bald eagles.

Ospreys (*Pandion haliaetus*) may be found foraging along Seattle's waterways, including the Elliott Bay shoreline. Recent information indicates a total of six nest sites in the south Elliott Bay and Duwamish Waterway area, with several within 0.5 mile of the project corridor (WDFW 2009a, 2010). A peregrine falcon aerie is located on top of one of the high-rise buildings within several blocks of the Alaskan Way Viaduct in downtown Seattle (Falcon Research Group 2009). Peregrine falcons are also known to nest on other buildings in the area, as well as near the Battery Street Tunnel and along the Duwamish River (WDFW 2009a).

A variety of waterfowl use the nearshore habitat of Elliott Bay, including the Seattle shoreline (Exhibit 4-9). Many of these species occur only occasionally or seasonally in the nearshore area, while others (such as several of the gulls) are nearly always present.

Exhibit 4-9. Waterfowl and Water-Related Birds Potentially Found Along the Seattle Shoreline

Common Name			
Common loon	Double-crested cormorant	Common goldeneye	Herring gull
Yellow-billed loon	Brandt's cormorant	Bufflehead	California gull
Pacific loon	Pelagic cormorant	American coot	Western gull
Red-throated loon	Greater scaup	Hooded merganser	Bonaparte's gull
Western grebe	Lesser scaup	Red-breasted merganser	Ring-billed gull
Red-necked grebe	Black scoter	Pigeon guillemot	Mew gull
Horned grebe	Surf scoter	Belted kingfisher	Glaucous-winged gull
Eared grebe	White-winged scoter	Great blue heron	Barrow's goldeneye
Shorebirds			

4.2.4 Vegetation

The urbanized setting of the study area has little or no remaining natural vegetated habitat. The upland and shoreline areas are entirely artificial, consisting of concrete sidewalks, paved roadways, and buildings. Little natural riparian vegetation remains along the Elliott Bay or Lake Union shorelines, although some occurs in the newly restored pocket beach in the Olympic Sculpture Park and at isolated parcels around Lake Union. Approximately 90 percent of Elliott Bay shoreline is riprapped or armored with rubble, including about 16.2 percent with vertical bulkheads or seawalls (Nearshore Habitat Program 2001). In addition, approximately 82 percent of the Lake Union shoreline has been similarly altered, with the south side of Portage Bay, portions of the Gas Works Park shoreline, and small areas at the south end of Lake Union the only areas that have retained any seemingly natural shoreline characteristics (Weitkamp and Ruggerone 2000). However, various street trees, ornamental vegetation in planters, and other landscaped areas are present at scattered upland locations within the study area. Therefore, there are no ESA-listed or sensitive plant species in the study area.

The primary vegetation potentially affected by the project is marine macrophytes (algae) in the shallow subtidal and intertidal habitat along the Seattle waterfront (Exhibit 4-10). Red, green, and brown macroalgae are abundant along the waterfront, with red/green algal communities more common, particularly along the substrate bottom, and brown algae such as kelp more likely associated with pilings or attached to substrate in deeper open water (Taylor Associates 2006). Smaller algal complexes occur on the Elliott Bay Seawall and riprap in the area. Macroalgae are predominantly associated with the unshaded portions of the water between piers and growing opportunistically and nonselectively on any hard substrate or surface such as cobble/gravel, riprap, and anthropogenic debris (Taylor Associates 2006). In

Lake Union, the macrophytes typically consist of nonnative invasive species, such as Eurasian watermilfoil (*Myriophyllum spicatum*).

Exhibit 4-10. Species of Marine Macrophytes (Algae) Observed Along the Seattle Waterfront

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	*Chondracantbus 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 sjoesttedtii* 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 marginat*	Common
Bull kelp	*Nereocystis luetkeana*	Occasional

Source: Parametrix 2002.

Chapter 5 Operational Effects, Mitigation, and Benefits

Some beneficial and negative operational effects are expected to occur due to changes in the physical characteristics of habitat and habitat buffers along the project corridor. Changes in the water quality conditions in the marine and lake environments are expected to be the primary cause of potential effects on the natural resources in the project area. Therefore, the evaluation of effects focuses on potential changes in stormwater volumes and stormwater treatment facilities or procedures along the project corridor (see Appendix O, Surface Water Discipline Report).

The proposed Bored Tunnel Alternative provides some additional opportunities to minimize the potential effects of the project, compared to typical highway construction projects. The location, deep below the ground, would minimize the potential for disturbing natural resources, and the confined setting would minimize the extent of the effects that do occur.

Indirect effects would likely be confined to potential changes in land use activities and population growth in the study area. Compared to existing conditions, the Bored Tunnel Alternative would reduce the overall amount of PGIS that drains to the area receiving waters. This is expected to improve water quality. Also, some portions of the project area currently discharge to Elliott Bay and Lake Union without treatment. The Bored Tunnel Alternative would provide water quality treatment for these areas. While the PGIS would be reduced with the Bored Tunnel Alternative, the overall impervious surface area would actually increase compared to existing conditions. However, the additional impervious surface area would be non-pollutant-generating, resulting from new and wider pedestrian and bicycle facilities and the tunnel operations buildings at each portal. Stormwater detention would be provided in certain areas to mitigate the potential for increases in overflows from the combined sewer system that might occur because of these increases in impervious surface area. Detailed evaluations of stormwater management issues are provided in Appendix O, Surface Water Discipline Report.

5.1 Operational Effects of the Viaduct Closed (No Build Alternative)

Both federal and Washington State environmental regulations require agencies to evaluate a No Build Alternative to provide baseline information about existing conditions in the project area. For this project, the No Build Alternative is not a viable alternative because the existing viaduct is vulnerable to earthquakes and structural failure due to ongoing deterioration. Multiple studies of the viaduct's current structural conditions, including its foundations in liquefiable soils, have determined that retrofitting or rebuilding the existing viaduct is not a reasonable alternative. At some point in the future, the roadway will need to be closed.

The Viaduct Closed (No Build Alternative) describes what would happen if the bored tunnel or another build alternative is not implemented. If the existing viaduct is not replaced, it will be closed, but it is unknown when that would happen. However, it is highly unlikely that the existing structure could still be in use in 2030.

The Viaduct Closed (No Build Alternative) describes the consequences of suddenly losing the function of SR 99 along the central waterfront based on the two scenarios described below. All vehicles that would have used SR 99 would either navigate the Seattle surface streets to their final destination or take S. Royal Brougham Way to Interstate 5 (I-5) and continue north. The consequences would be short-term and would last until transportation and other agencies could develop and implement a new, permanent solution. The planning and development of the new solution would have its own environmental review.

Two scenarios were evaluated as part of the Viaduct Closed (No Build Alternative):

- Scenario 1 – An unplanned closure of the viaduct for some structural deficiency, weakness, or damage due to a smaller earthquake event.
- Scenario 2 – Catastrophic failure and collapse of the viaduct.

Under Scenario 1 of the Viaduct Closed (No Build Alternative), the existing Alaskan Way Viaduct would continue to function as habitat for the relatively few avian species that are adapted to such conditions, while other species would continue to have limited ability to inhabit or use the area. However, most of the existing natural habitat in the study area occurs in Elliott Bay, which is not substantially affected by the viaduct, other than from stormwater runoff and vehicle exhaust emissions. Under this scenario, untreated stormwater would continue to be released to Elliott Bay, as it is under existing conditions.

Scenario 2, involving total collapse of the existing viaduct, would likely have significant effects on fish, wildlife, and vegetation. As discussed in Appendix P, Earth Discipline Report, there is a high liquefaction hazard along the downtown Seattle waterfront. Therefore, this scenario would likely result in the collapse of the viaduct and the seawall, and the liquefaction of the ground in the vicinity. Nearshore areas of Elliott Bay would be seriously affected by the influx of debris and contaminated soil from beneath the viaduct, and existing contaminated sediments currently resting beneath Elliott Bay would potentially be resuspended. A collapse of the existing viaduct would also result in a dramatic disruption to existing stormwater conveyance systems. All of these events would disturb natural resources in the area.

5.2 Operational Effects of the Bored Tunnel Alternative

The Bored Tunnel Alternative would largely be built deep beneath downtown Seattle, substantially minimizing potential disturbances to the limited natural resources that currently exist in this urban setting. The confined setting of the bored tunnel and its limited overlap with natural resource habitat or species would reduce potential effects on fish, wildlife, and vegetation resources compared to the Viaduct Closed (No Build Alternative) and existing conditions.

The analysis of potential operational effects of the Bored Tunnel Alternative assumes that applicable PGIS would be retrofitted with water quality BMPs selected from the *Highway Runoff Manual* (WSDOT 2008) and required by the Seattle Stormwater Code. In general, runoff from streets and highways, particularly in urban environments, contains pollutants that can affect the water quality of the receiving water body. Such pollutants (i.e., copper, zinc, cadmium, chromium, polycyclic aromatic hydrocarbons [PAHs], and suspended solids) vary by the amount and type of PGIS, traffic volumes and average speed, duration and intensity of a storm event, time of year, antecedent weather conditions, and several other factors.

Dissolved copper is known to affect neurological and behavioral responses of trout and salmon at very low concentrations (Hecht et al. 2007). Low levels of copper can also reduce the olfactory response (ability to smell) in fish, potentially affecting their ability to locate prey, avoid predators, and avoid areas with other contaminants, as well as altering migratory behavior (Pacific EcoRisk 2007). Sandahl et al. (2007) reported a 50 percent reduction in olfactory signal response and a 40 percent reduction in predator avoidance response in salmonids exposed to increases in dissolved copper as low as 2.0 micrograms per liter (μg/L) above a background concentration of 0.3 μg/L. As with copper, dissolved zinc can have potentially adverse effects on fish behavior. Sprague (1968) reported that salmonids exhibited significant avoidance responses to increases in zinc concentrations of 5.6 μg/L above background concentrations of 3 to 13 μg/L.

Stormwater associated with highway runoff may also contain low levels of cadmium, lead, chromium, and PAH compounds. However, these compounds are often 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 discharge to nearby water bodies. Based on the environmental chemistry and biological fate of these compounds in an aquatic system, species exposure could be small.

In general, it is expected that the Bored Tunnel Alternative would either improve or maintain the water quality of runoff being discharged from the project area by reducing the overall amount of PGIS relative to the existing conditions and diverting most of the runoff to the combined sewer system. A detailed pollutant loading analysis is presented in Appendix O, Surface Water Discipline Report.

The overall surface water runoff volumes would not be increased by the Bored Tunnel Alternative, because most of the project area already consists of impervious surfaces. The road surface in the bored tunnel would not be considered PGIS because it would not receive direct rainfall, although the portal areas would still be considered PGIS. Therefore, the confined tunnel configuration would reduce the surface area that can intercept rainfall, thereby reducing the runoff volumes. The reduced volume of stormwater runoff is expected to increase the efficiency and effectiveness of collecting and treating stormwater and controlling the discharge volumes to reduce the frequency and volume of combined sewer overflow events. Some stormwater is expected to enter the tunnel at each portal area, although this water would be collected and gravity-fed or pumped to the combined sewer system (RoseWater GHD 2009). In addition, any groundwater seepage, fire-fighting system water, and water generated from tunnel washing operations would be collected and pumped to the combined sewer systems. The potential benefits to stormwater management are expected to generally improve the quality and reduce the volume of water discharged through the existing storm drain systems directly to Elliott Bay and Lake Union, thereby reducing the potential effects on aquatic resources.

Analysis of annual pollutant loads in stormwater under existing conditions, the Viaduct Closed (No Build Alternative), and the Bored Tunnel Alternative showed that the existing pollutant loads would be reduced by approximately 20 percent under the Viaduct Closed (No Build Alternative) and between 30 and 50 percent under the Bored Tunnel Alternative. These reductions would occur because basic stormwater treatment would be provided by discharging runoff from most of the project area to the combined sewer system and applying water quality BMPs selected from WSDOT's *Highway Runoff Manual* (WSDOT 2008) to the remainder of the area. Also, in accordance with the requirements of the Seattle Stormwater Code, peak flow control would be provided in the north portal area, most likely by the installation of one or more detention facilities. The reduced pollutant loading would reduce the potential effects on fish and other species occurring in the aquatic habitat adjacent to the project area.

Under both existing conditions and the Viaduct Closed (No Build Alternative), stormwater sub-basins discharge untreated runoff directly to Elliott Bay and Lake Union. Under all the alternatives, sub-basins with combined sewer systems would continue to discharge runoff to the West Point Wastewater Treatment Plant for treatment before discharge to Puget Sound, while the Bored Tunnel Alternative would also direct most of the runoff from proposed PGIS areas to the combined sewer system. This would reduce the pollutant loading to Puget Sound and Elliott Bay compared to existing conditions. Detailed results of the analysis are provided in Appendix O, Surface Water Discipline Report.

Potential reductions in the frequency and/or volume of combined sewer system overflow events are also expected in the north portal area through the use of one or more detention facilities. However, modeling results indicate that detention facilities would not reduce the potential frequency or volume of overflows from the combined sewer system in the south portal area. Therefore, an exemption from the peak flow control requirements has been granted by the City for the south portal area.

Despite the potential benefits to stormwater management provided by a tunnel configuration, the location of the project in a highly urbanized environment is expected to restrict the use of some stormwater treatment facilities, particularly those requiring relatively large areas, such as open stormwater detention ponds. This could limit the stormwater treatment options, or BMPs, to options with smaller footprints like bioswales and cartridge media filtration vaults. The evaluation of appropriate stormwater treatment options is provided in Appendix O, Surface Water Discipline Report.

Overall, the Bored Tunnel Alternative is expected to reduce pollutant loading to the project area waterways, as a result of generally lower concentrations of the contaminants known to affect fish and other aquatic species (i.e., total suspended solids [TSS], dissolved and total zinc, and dissolved and total copper) in runoff discharged from the project area roadways. However, it is unlikely that such improvements would result in a measurable change in species populations or their use of the aquatic habitat in the project area.

Removal of the Alaskan Way Viaduct is likely to eliminate some roosting, perching, and nesting habitat for birds and bats, as well as potential nesting and rearing habitat for other common urban wildlife species.

5.3 Operational Mitigation

Given the modified and degraded condition of natural resources in the study area, the primary mitigation measures would be associated with BMPs during project construction and operation. Moreover, habitat conservation measures and other forms of mitigation may also be necessary to meet specific environmental permit conditions and ESA requirements, developed in cooperation with resource agency representatives.

Although it is assumed that the Bored Tunnel Alternative would result in improvements in stormwater quality by reducing the overall amount of pollutant-generating surfaces and providing basic water quality treatment for new PGIS, additional stormwater BMPs or low-impact development (LID) design concepts beyond those required under current regulations could be implemented. The proposed stormwater management approach for the Bored Tunnel Alternative would treat pollutant-generating surfaces by discharging most of the runoff from PGIS to the combined sewer system. These measures would result in improvements in overall water quality compared to existing conditions. As indicated above, however, such improvements are unlikely to be substantial enough to measurably change the aquatic species populations or their use of the aquatic habitat in the project area.

Per the revised 2009 Seattle Stormwater Code (Seattle Municipal Code, Section 22.800), green stormwater infrastructure, similar to LID designs, would be implemented to the maximum extent feasible. Such BMPs may include technologies that provide more pollutant removal and/or concepts that decrease the overall pollutant load to Puget Sound. These actions are expected to further improve aquatic habitat in Elliott Bay and Lake Union compared to existing conditions; descriptions of the proposed measures are provided in Appendix O, Surface Water Discipline Report.

Removing the viaduct would also enhance the natural light in the area, which would improve the growth and health of street trees planted as part of a mitigation landscaping plan for the surface streets. Any increases in vegetation would improve natural resource habitat conditions in the area.

5.4 Operational Benefits

The removal of the Alaskan Way Viaduct would substantially reduce the existing traffic noise occurring along Seattle's central waterfront. While most species occupying the study area are expected to be accustomed to the existing noise, reducing these noise levels could potentially reduce the stress levels and improve the overall environmental conditions for wildlife species occurring in the area.

The Bored Tunnel Alternative is expected to improve the water quality of the stormwater discharged either directly or indirectly into Puget Sound, because no stormwater treatment is provided to runoff from the existing viaduct. Aquatic habitat along portions of the Seattle waterfront is currently impaired with respect to sediment, toxins, pathogens, and large woody debris due to combined sewer and stormwater outfalls, proximity of the road to the shoreline, large amounts of impervious surfaces, and lack of riparian vegetation (Seattle 2009). The Bored Tunnel Alternative would provide opportunities and requirements for treating a greater proportion of stormwater runoff from the project area roadways, which is expected to reduce pollutant levels in runoff discharged to the storm drain or combined sewer systems. Stormwater runoff from the project area would be treated at the West Point Wastewater Treatment Plant when discharging to the combined sewer system. Some detention would also be provided (primarily at the north portal area) for stormwater runoff discharged to the combined sewer system, and treatment would be provided for any runoff discharged to Lake Union.

Following the design criteria in the WSDOT *Highway Runoff Manual* (WSDOT 2008) and Seattle Municipal Code is expected to reduce potential effects of water quality conditions in Elliott Bay and Lake Union on fish and other aquatic resources, compared to existing conditions. However, other existing habitat impairments in the area are not expected to change substantially as a result of the Bored Tunnel Alternative. Detailed descriptions and discussions of stormwater treatment options are provided in Appendix O, Surface Water Discipline Report.

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Chapter 6 CONSTRUCTION EFFECTS AND MITIGATION

6.1 Construction Effects

Construction effects on natural resources in the study area would most likely be associated with construction noise, handling and transporting the excavation and tunneling spoils (including stockpiling and dewatering processes. Potential effects from erosion and any associated pollutants are also among the effects considered here. These potential effects would be avoided, minimized, and/or mitigated by implementing appropriate BMPs, which would also include monitoring for contamination and proper disposal of these waste materials, as discussed in Appendix Q, Hazardous Materials Discipline Report. If not properly controlled through the use of temporary construction BMPs, construction-related pollutants could affect water quality and, therefore, species that use the associated habitat.

Tunneling operations would begin from the south end. Construction staging areas would be established to include facilities needed to support tunnel boring machine (TBM) excavation and internal construction (e.g., laydown areas for materials, a bentonite slurry separation plant, an electrical substation, maintenance workshops, areas for spoils to accumulate before being hauled to the disposal site, parking and field offices for on-site personnel, and a potential concrete batch plant). This would include the use of the upland area of Pier 48, primarily for contractor parking, and Terminals 25 and 106 for staging and storage areas.

While most delivery and removal of construction material from the project area would be land-based, some water-based activities might be necessary. These activities would likely occur at Pier 46 (the north apron of Terminal 46), to support construction activities for both the south portal and the bored tunnel. No new overwater structures or in-water construction activities would be required for the use of Pier 46 as a barge loading site. This analysis assumes that dredging activities are not required to allow these barge-based activities. There are no eelgrass beds in the areas where barge moorage would occur, and shallow draft barges or existing loading facilities would prevent the grounding of barges and the disturbance of subtidal or intertidal habitat.

Barge operations at this location would be similar to existing vessel navigation movements along the shoreline and would not represent a new or different effect. Similarly, the number of barge trips (one or two per day) to and from the disposal site would not represent a substantial increase in the total number of vessels navigating through the Puget Sound shipping lanes, or increase the noise or disturbance levels on species occurring in these offshore marine areas. The potential risk of collisions with any marine mammals would also be negligible due to the slow towing speeds of the barges and the mobility of these species.

Potential effects on surface water quality could result from construction activities such as staging, inadvertent equipment leaks or spills, material transport, earthwork, paving, excavation spoils stockpiling and dewatering, and storm drainage and/or combined sewer utility work. If not properly controlled through the use of temporary construction BMPs, construction-related pollutants could increase turbidity and affect other water quality parameters, such as dissolved oxygen, in the receiving waters. Such changes could reduce the use of these waters by aquatic species but are unlikely to be severe enough to result in direct or indirect mortality.

Construction activities can also affect pH in receiving waters if runoff comes in contact with curing concrete, grout, soil amendments, or bentonite drilling slurry. Contact with these substances can produce pH values above state criteria. Fugitive dust from concrete demolition activities can also result in increased pH levels in project-related discharge water. Changes in pH could have serious effects on aquatic species. These effects include damage to outer surfaces like gills, eyes, and skin and an inability to dispose of metabolic wastes. The pH of water also performs a critical role in cell functions, particularly with respect to maintaining and regulating gas, water, and ion balances. It also plays an important role in determining the bioavailability of other contaminants. However, given the expected short-lived nature of a pulse of low pH from construction area runoff, and the overall size of Elliott Bay and Lake Union, brief reductions in ambient water pH are not expected to impair aquatic species in any meaningful way. Water from the project area will be monitored and treated in accordance with the specifications of any required discharge permit (e.g., King County Wastewater Discharge Authorization or Permit) prior to discharge, ensuring that discharged waters have a pH that meets state water quality criteria prior to discharging to the existing storm drainage and combined sewer systems.

Soil improvements, drilled shafts, and slurry wall construction would mix existing soil with cement and/or a bentonite slurry. The mixing would create spoils, which would need to be dewatered on site prior to being disposed of at an off-site location. Water recovered during the dewatering process would also be treated to meet appropriate permit requirements, prior to discharging to the existing storm drainage and combined sewer system. Additional construction effects associated with spoils removal and hazardous materials are discussed in Appendix Q, Hazardous Materials Discipline Report.

Both Elliott Bay and Lake Union are flow-control-exempt water bodies, indicating that the volume of water discharged to these water bodies would not have a measurable effect on aquatic uses. These water bodies are very large relative to the volume of potential inputs from sources other than the natural drainage areas (i.e., Lake Washington or Duwamish River). However, water quality in these water bodies could be affected by stormwater discharge during project construction, should any resulting combined sewer overflow events occur. Such discharge will be subject to King County Wastewater Discharge Authorization or Permit or NPDES permit requirements, where applicable, to protect beneficial uses in the receiving water, including protection of aquatic species and habitat.

Runoff from construction areas could transport silt and sediment to receiving water, if not contained. The highest probability for such effects during construction is typically at staging or excavation areas. Since these areas are generally located near natural water bodies, there is a greater potential to affect water quality from spills during refueling or servicing equipment and stormwater runoff from stockpiled soil or other materials. However, it is assumed that appropriate BMPs will be effectively implemented to minimize or eliminate such occurrences.

The plan is to discharge the water from the dewatering processes into the existing combined sewer system. Therefore, detention of this water may be necessary to meet the requirements of the King County Wastewater Discharge Permit or Authorization and to avoid overwhelming these conveyance systems. Depending on the volumes and timing, if discharging dewatering flows to the combined sewer system would not be feasible, off-site disposal would be required (see Appendix O, Surface Water Discipline Report and Appendix Q, Hazardous Materials Discipline Report).

Subsurface contaminants, including total petroleum hydrocarbons and trace organics, could migrate toward the excavation areas and increase pollutant concentrations in dewatering water (Parsons Brinckerhoff 2009). Any water found to be contaminated would have to be either treated to acceptable standards of the King County Wastewater Discharge Permit or Authorization before discharge to a City or King County system or disposed of off-site at an approved hazardous waste facility. Dewatering would likely continue until construction of the tunnel and portal retaining walls are completed.

Sediment and contaminants could also fall onto roadways and be captured in stormwater runoff along the routes where construction materials and excavation spoils are. In addition, because most of the construction and excavation spoils would be transferred over water by barge, there is an increased risk of potential effects on Elliott Bay during material transfer from the project area. However, the implementation of avoidance and minimization measures is expected to substantially reduce or eliminate the risk of water quality or aquatic habitat effects.

Dewatering activities and suspended sediment discharges can result in increased turbidity, altered concentrations of dissolved oxygen, and altered pH. If it's not adequately contained, increased turbidity can distress fish and aquatic organisms in the vicinity and affect fish physiology, behavior, and habitat use. Physiological effects include gill trauma, altered blood sugar levels, and impaired osmoregulatory function. Behavioral effects include altered foraging and predation risk behavior. Effects on habitat use include habitat avoidance and reduced habitat functions and productivity (Meehan 1991). Similar effects are also expected on other aquatic species that occur in nearshore habitats, although the potential would decrease with increasing distance from shore. These effects are also expected to be temporary and unlikely to measurably affect other wildlife species. The implementation of temporary erosion and sediment control (TESC) and spill prevention, control, and countermeasures (SPCC) plans is expected to minimize the intensity or extent of turbidity in project area waters. Any required discharge permit (e.g., King County Wastewater Discharge Authorization or Permit) would identify specific BMPs to ensure that the discharged waters meet state water quality criteria.

Dewatering waters can also have low dissolved oxygen levels, which can reduce productivity in aquatic habitat. However, any required discharge permit will contain requirements for maintaining adequate dissolved oxygen levels in project area water bodies.

Contaminants in the project area soils are likely to include metals and persistent organic toxins, which could be released to the aquatic environment through increased suspended sediment concentrations in construction site runoff. The primary mechanisms for effects on aquatic organisms include ingestion of contaminants or particles to which contaminants have adsorbed, and ingestion of prey that have been exposed to the contaminants. Exposure to these contaminants would likely result in largely sublethal effects, similar to those discussed above for turbidity, and on-site BMPs are expected to minimize or eliminate the release of these upland contaminants to the aquatic environment.

6.1.1 South Portal

The south portal requires construction of a braided structure from about S. Royal Brougham Way to the bored tunnel, including on/off connections to the tunnel from First Avenue S. The south portal would be constructed with the cut-and-cover method, resulting in about 1,030 feet of covered roadway, with walls supported by secant piles. Construction of the south portal would require some local dewatering to control minor leakage through the walls prior to constructing the base slab once the excavation of the access points reaches full depth. Detailed discussions of the construction runoff and dewatering water disposal measures are presented in Appendix O, Surface Water Discipline Report. This disposal would be performed according to the King County Industrial Wastewater Discharge Authorization or Permit. The TESC plan would also satisfy the requirements of any required discharge permit and WSDOT Standard Specifications.

Construction activities also have the potential for chemical releases (fuels, oils, paints, and solvents), potentially reducing the quality of the receiving waters or causing operational difficulty at the wastewater treatment plant. However, an SPCC plan will be prepared for the project to define an action plan in case of the release of petroleum or other toxic substances. In addition, adequate spill response kits will be maintained on site in accordance with typical construction BMPs. Typical construction BMPs addressed in the SPCC and TESC plans are expected to minimize or prevent such spills from occurring or reaching the receiving water untreated. In addition, most of the work would be conducted below grade, allowing more effective containment of inadvertent spills.

Construction activities that involve moving soils, such as tunnel spoils, cut-and-cover work, utility relocations, grading and paving, and transport of spoils, would likely generate dust. Such activities would occur over a prolonged period lasting nearly 6 years, and the resulting dust could reach Elliott Bay, potentially affecting water quality conditions. However, the proximity of Elliott Bay and the expected groundwater in the excavation area would likely result in moist spoils material, which would minimize the potential to generate fugitive dust. In addition, the implementation of standard construction BMPs would minimize the extent of fugitive dust dispersal, thereby minimizing the potential effects on water quality and fish and wildlife species occurring in the project vicinity. Such BMPs would include wetting down concrete during demolition, washing tires, and routinely sweeping streets.

Spoils from excavations could be stockpiled on site for up to several days for dewatering and treatment of water as required (see Appendix O, Surface Water Discipline Report). If stockpiling is needed, this material would be covered to minimize the dispersal of dust or runoff from rain events. Excavation spoils would be transported to an approved disposal site, such as in Mats Mats Quarry in Port Ludlow, Washington, while potentially contaminated spoils would be tested and disposed of at approved upland facilities.

The disturbance and use of staging areas also has a substantial potential to generate fugitive dust, as these areas would typically occur at the surface elevation where dry exposed soils would be located. The demolition of the viaduct would also generate concrete dust, which has the potential to affect the water quality (e.g., pH and turbidity) in adjacent water bodies. However, standard demolition BMPs would be applied to minimize the potential and the extent of fugitive dust dispersal.

Aboveground construction activities would result in noise effects from heavy equipment, such as pile drivers, jackhammers, pavement breakers, hoe rams, auger drills, bulldozers, backhoe excavators, loaders, and haul trucks. Other construction equipment would include air compressors and electric generators. These construction activities could disturb wildlife species occurring in the area, although such disturbances are not unusual for the industrial waterfront area of Seattle, and urban wildlife species would likely not be particularly disturbed.

It is also likely that some of the construction activities would require the use of a nearshore loading and unloading facility to transport construction materials to the construction site and to remove excavation spoils. This operation would use existing facilities, and no in-water construction would be required. The operation of these facilities, if needed, would be covered under separate environmental review processes.

6.1.2 Bored Tunnel

The proposed bored tunnel would be roughly 1.7 miles long, with an inside diameter of 49 feet and an outside diameter of approximately 54 feet. It would be bored using a state-of-the-art pressurized-face TBM. Construction activities would begin at the south portal and would require laydown areas for materials, a bentonite slurry separation plant (if necessary), maintenance workshops, storage areas for excavated spoils and precast concrete segments, a potential concrete batch plant, and parking and field offices for on-site personnel. The tunneling is estimated to take approximately 1 year, assuming an average rate of advancement of approximately 30 to 35 feet per day.

The potential construction effects of the tunnel boring process are expected to be similar to, but substantially less than, those described above for the south portal. The actual tunnel boring activity would occur below ground, within the confines of the tunnel. This would minimize or eliminate the potential for affecting natural resources in the area. However, the aboveground activities needed to support the boring process and remove excavated soils would be similar to those for the south portal construction. In addition, the tunnel boring operation would generate substantial volumes of spoils that would need to be transported from the site, and substantial quantities of construction material would be required to construct the walls of the TBM launch pit.

The control of groundwater would also be enhanced by the confines of the bored tunnel, as all the groundwater infiltrating into the tunnel area would be contained within the tunnel. This would require active collection and removal processes (i.e., pumping). Depending on the quality of this groundwater, it would either be injected back into the ground to minimize ground settling processes, discharged to the combined sewer system for treatment at the West Point Wastewater Treatment Plant, or collected and transported to an approved treatment facility.

6.1.3 North Portal

The north portal would extend from the northern end of the bored tunnel at approximately Sixth Avenue N. and Thomas Street. The stacked roadway configuration of the bored tunnel would ramp upward to match the existing surface street grades at a merge point near the existing Broad Street overcrossing.

The activities associated with constructing the north portal are expected to be similar to those described for the south portal, with about 400 feet of covered roadway. Similar equipment would be used, and similar volumes of excavation spoils would likely be generated. These activities are expected to have similar effects on natural resources, although the types of species occurring in the north portal area are expected to be somewhat dissimilar.

While also a highly developed urban area, the north portal area is somewhat less industrial than the Seattle waterfront near the south portal. In addition, more naturally vegetated areas occur near the north portal. These vegetated habitats (primarily street trees) are expected to provide better nesting, foraging, and rearing habitat for a wider range of species, which could be disturbed or displaced by the construction activities. The species occurring in the north portal area likely have a greater reliance on upland habitats than the species occurring near the south portal, where the dominant natural resource habitat is associated with the nearshore marine environment. Therefore, construction activities that disturb upland habitats could have a greater effect on wildlife species in the north portal area.

The construction activities in the north portal area could potentially affect the freshwater habitats and aquatic species in Lake Union if construction BMPs fail to control potential spills and stormwater runoff from the construction site. If they reach Lake Union, construction-related pollutants would result in temporary effects on water quality and aquatic resources. The lake environment has a lower capacity to handle these inadvertent discharges because of the limited currents, wave action, and overall water volumes in the lake compared to Elliott Bay. Because of the project's distance from Lake Union, the primary mechanism for affecting Lake Union water quality would be any exceedance of the capacity of the combined sewer system. However, the stormwater detention facilities constructed for the north portal would minimize or eliminate such combined sewer overflow events.

Construction staff will monitor turbidity, pH, and other water quality parameters in receiving water bodies, in compliance with applicable permit requirements, and state protocols. Any exceedances of state water quality standards would result in halting the associated work activities until adequate BMPs are implemented to meet the standards (see Appendix O, Surface Water Discipline Report).

6.1.4 Viaduct Removal

Demolition of the existing viaduct would result in a substantial change in the noise levels along the central waterfront. The existing traffic noise, which is relatively constant in terms of volume and frequency, would be replaced with intermittent and sharper impact-generated noises from the demolition equipment during the approximately 9 months required for demolition. The characteristics of these impact-generated noises have a greater potential to affect wildlife species occurring in the area than the relatively continuous traffic noise. However, the demolition noises would cease during nonworking hours and after the viaduct has been removed and the debris has been hauled away.

The demolition process is also expected to generate measurable quantities of fugitive dust during concrete cutting, crushing or sawing, lifting cut sections out of the viaduct structure, loading debris onto trucks, and any recycling efforts (such as grinding concrete into a smaller pieces for reuse). This could temporarily affect habitat conditions in the area, including producing slight changes in water quality along the nearshore area, directly resulting from the dust settling on the water surface or indirectly resulting from stormwater runoff reaching the bay. However, appropriate BMPs (e.g., spraying water on the demolition area) would be used to minimize and contain the amount of dust generated and dispersed. Construction site dewatering and wash water collection and treatment BMPs would also reduce the potential for demolition dust discharging directly to the bay. Regular street sweeping during construction would also reduce the dispersal of demolition dust from the project area.

Some of the demolition debris could be recycled as fill for the decommissioned Battery Street Tunnel, which would minimize debris transport activities. This reduction in debris transport would reduce the potential for indirect effects on natural resources by minimizing air, noise, and stormwater pollution levels from transport vehicles. On-site debris disposal would also minimize the spread of fugitive dust during the transport process. However, using the debris to fill the Battery Street Tunnel would likely require additional on-site handling of demolition debris to generate material small enough to be efficiently placed in this tunnel. Demolition debris not used to fill the Battery Street Tunnel would be transported off-site by ground transportation to an approved recycling or disposal facility. It is assumed that debris sorting for recycling purposes would occur at a permitted off-site location, except for the potential use of some of the debris to fill the Battery Street Tunnel. BMPs for on-site debris sorting and recycling would be similar to those used during the viaduct demolition process, and include wetting down or applying a water mist to demolition areas.

While a number of structural and procedural BMPs would be used to prevent the release of cement dust, some dust is likely to be released to the environment. When wetted, cement dust can raise the pH and leach metals. Additionally, cement dust contributes to the amount of suspended solids in solution, potentially acting as an abrasive to aquatic organisms. Therefore, the viaduct removal process could have some minor effects on fish and wildlife species in the area. Such effects could include incidental fugitive concrete dust reaching Elliott Bay, demolition noise, and surface water runoff from area roadways affected by construction activities. These potential effects could result in the disturbance or displacement of species. However, these effects are expected to be temporary and minor, and they would not affect the long-term conditions of the species or their habitat.

6.1.5 Battery Street Tunnel Decommissioning

Decommissioning the Battery Street Tunnel is not expected to measurably affect fish, wildlife, or vegetation resources in the study area. Decommissioning would likely consist of recycling some of the concrete rubble from viaduct demolition as fill in the tunnel, capping both ends, and filling the voids with concrete pumped in from the street level above.

6.2 Construction Mitigation

The primary activity that could affect fish and other aquatic species is the potential operation of a barge landing facility at Pier 46. This operation would use existing facilities, and no in-water construction would be required.

Construction effects on fish and wildlife habitat would be avoided, minimized, and mitigated through the development and implementation of the following plans:

- Stormwater pollution prevention plan (SWPPP)
- TESC plan
- SPCC plan
- Concrete collection, containment, and disposal plan
- Fugitive dust control plan

Each of these plans would include performance standards based on state regulations, such as turbidity and TSS levels in stormwater discharged from construction staging and work areas. In addition to implementing these plans, stormwater runoff from active construction sites should be treated prior to discharge as necessary to comply with the requirements of the Washington Administrative Code and applicable permits, such as King County Wastewater Discharge Authorization or Permit.

Construction-related runoff and dewatering water would likely be discharged to the combined sewer system for treatment at the West Point Wastewater

Treatment Plant. Before discharge to the combined sewer, stormwater runoff from active construction areas would need to be treated as necessary to comply with applicable permit requirements and project specifications or disposed of off-site at an approved hazardous waste facility. Monitoring should also be performed in accordance with applicable standards. Specific measures to protect water quality will be specified in the plans discussed above.

Depending on the volumes and timing, some dewatering discharges to the combined sewer system would not be feasible and off-site disposal would be required. Also, risk for potential ground settlement caused by dewatering would be mitigated by reinjecting water back into the ground with water from the dewatering operation. Excess water that is not used for injection would need to be treated and disposed of in the sanitary sewer or off-site.

To the extent feasible, the construction dewatering systems would be designed to minimize any reduction in the water table. This would reduce the volume of groundwater that requires treatment and disposal. It would also reduce the potential for mobilization and spreading of groundwater contaminants in the project area. In addition, ground treatment techniques such as freezing may also reduce the need for dewatering. However, adequate site investigation would be necessary to select and design the best ground treatment approaches.

Chapter 7 CUMULATIVE EFFECTS

Cumulative effects are effects on the environmental that result from the incremental impacts of the proposed action when added to the other past, present, and reasonable foreseeable future actions.

Although most of the study area is currently highly developed and devoted to intensive human use, potential cumulative effects would likely be associated with projects that would change stormwater runoff and associated pollutants that enter Elliott Bay or Lake Union. These would include projects that reduce traffic or shift traffic away from the waterfront areas, or areas where stormwater is currently untreated. Such projects include improvements to I-5 and the Sound Transit projects and are discussed in more detail in the cumulative effects analysis in Attachment A.

Previous NEPA reviews for the Program included replacing the Elliott Bay Seawall along the Seattle waterfront, as some of the alternatives would have directly or indirectly affected the integrity of the already failing seawall structures. While the Bored Tunnel Alternative does not have this same potential, replacing the seawall remains a priority of the City of Seattle. While the Elliott Bay Seawall Project will undergo independent environmental review, it is evaluated as a non-roadway element of the Program and included in the cumulative effects assessment.

This chapter evaluates the contributions of the various Program elements (roadway elements, non-roadway elements, projects under construction, and completed projects) in terms of their effects on wildlife, fish, and vegetation. It then evaluates the cumulative effects of the Bored Tunnel Alternative when combined with the effects of the other Program elements. The chapter ends with a description of the cumulative effects of the Bored Tunnel Alternative and the Program elements in combination with the effects of past, present, and reasonably foreseeable future projects.

7.1 Current Wildlife, Fish, and Vegetation Trends

There have been dramatic changes in fish, marine organisms, and marine mammals in the Puget Sound since 1850 as species composition, individual species population size, and physical habitat were altered by human activity. For example, some species that were once common are now rare or absent from the region. "The current status of species and food webs in Puget Sound lead to three major conclusions: 1) a relatively large proportion (or number) of species in the Puget Sound ecosystem are imperiled, due in large part to human activities over the last 150 years, 2) changes in species abundance can affect food webs, perhaps in dramatic and permanent ways, and 3) our limited knowledge of species and food webs response to current threats limits our ability to predict ecosystem outcomes with great certainty." (Puget Sound Partnership 2010)

Actions such as logging, road construction, mining, shipping, urban development, commercial and recreational fishing, and agriculture have resulted in loss and fragmentation of in-stream habitat, changes in flow regimes, predation by invasive fish species, overharvesting of fisheries, loss of intertidal and subtidal habitats (and loss of marine vegetation such as eelgrass) and increases in impervious surfaces, which continue to adversely affect fish and marine organisms. Other stressors such as global climate change continue to affect several salmonid stocks. While some fish populations are fairly stable, the future trend for a number of fish species is a general decline.

The Puget Sound Partnership regularly publishes a State of the Sound report, which follows the trends of various indicators (water quality, water quantity, habitat, species, and food webs) that help to indicate the overall health of Puget Sound (Puget Sound Partnership 2010). Indicators that show a worsening trend include the decline in orca populations and herring spawning biomass and loss of eelgrass area.

Indicators showing improving trends include increasing numbers of Chinook and Hood Canal summer chum salmon and a slower rate of development and conversion to impervious surfaces. Indicators of no change include species of conservation concern and shoreline habitat.

7.2 Effects From Other Roadway Elements of the Program

7.2.1 Alaskan Way Surface Street Improvements – S. King to Pike Streets

A new Alaskan Way surface street would be located on the east side of the right-of-way where the viaduct is located today. Improvements to the Alaskan Way surface street would require construction activities along the Seattle central waterfront, which would result in potential effects on natural resources, similar to those described for the south portal construction in Section 6.1.1. These activities would include demolition of some existing paved surfaces, grading, and repaving. However, given the general level of industrial, commercial, and construction activity that regularly occurs in this highly developed urban setting, these activities would likely have an immeasurable effect on the natural resources in the area. This conclusion assumes that appropriate construction BMPs are implemented and maintained throughout the construction process to minimize or eliminate potential direct and indirect effects on the existing habitat and species in the area.

7.2.2 Elliott/Western Connector – Pike Street to Battery Street

A new roadway would be constructed connecting Alaskan Way to Elliott and Western Avenues in the area between Pike and Battery Streets. Potential effects of constructing the Elliott/Western Connector are expected to be similar to those described in Section 6.1.1 for the south portal and in Section 7.1.1 for the Alaskan Way surface street improvements. Construction activities and BMPs would be similar to these projects.

7.2.3 Mercer West Project – Fifth Avenue N. to Elliott Avenue

Mercer Street would be restriped and resignalized between Fifth Avenue N. and Second Avenue W. to create a two-way street with turn pockets. These improvements also include the restriping and resignalization necessary to convert Roy Street to two-way operations from Fifth Avenue N. to Queen Anne Avenue N. Potential effects would be minor. This highly developed area contains limited natural resources that could be affected by construction activities, and appropriate BMPs are expected to minimize potential effects on species and habitats. This project area is farther separated from Elliott Bay than other project and Program elements, resulting in minimal opportunities to affect species associated with the marine environment.

7.3 Effects From Non-Roadway Elements of the Program

7.3.1 Elliott Bay Seawall Project

The Elliott Bay Seawall needs to be replaced to protect the shoreline along Elliott Bay, including Alaskan Way. It is at risk of failure due to seismic and storm events. The seawall currently extends from S. Washington Street in the south to Bay Street in the north, a distance of about 8,000 feet. The Elliott Bay Seawall Project limits extend from S. Washington Street in the south to Pine Street in the north (also known as the central seawall).

Detailed evaluations of the potential effects of replacing the Elliott Bay Seawall were addressed in the previous NEPA documents for the Alaskan Way Viaduct and Seawall Replacement Program; additional project-level documentation will be prepared by the City.

This replacement project would provide an opportunity to enhance habitat for intertidal invertebrates and fishes occurring in the area. Although the physical characteristics of the existing shoreline and deep water habitat at the seawall face limit opportunities to restore the nearshore habitat to natural shoreline conditions, the Elliott Bay Seawall Project is expected to enhance the seawall face to improve productivity of the nearshore environment. Depending on the actual construction process, some additional nearshore habitat could also be provided.

However, the effectiveness (productivity) of the habitat enhancement approach has not been fully evaluated.

It is assumed that the majority of the construction activities would occur from land, and that the new seawall would be constructed landward of the existing seawall where feasible. Constructing the new seawall landward of the existing seawall is expected to substantially minimize the potential effects of the project.

As a Program element, the Elliott Bay Seawall Project would eliminate the risk of catastrophic failure of the existing seawall and resulting environmental damage to the shallow water habitat. Replacing the seawall would also reduce the maintenance activities required for the existing seawall, and applying habitat enhancement face panels is expected to improve the nearshore habitat along the central waterfront.

7.3.2 Alaskan Way Promenade/Public Space

Construction of the new, expanded Alaskan Way promenade and public space is expected to require construction activities similar to those described in Section 7.1.1 for the improvements to the Alaskan Way surface street. The two projects would occur in the same area, use similar equipment, and apply similar BMPs to minimize effects on natural resources along the Seattle central waterfront. This project is also expected to improve habitat conditions for birds and other terrestrial species by replacing substantial sections of existing impervious surface area with trees and other vegetated areas.

7.3.3 First Avenue Streetcar Evaluation

The First Avenue streetcar is currently planned to run between Yesler Way and Republican Street along First Avenue. Due to the highly developed urban area along First Avenue, construction associated with the First Avenue streetcar is not expected to affect natural resources in the downtown area.

7.3.4 Transit Enhancements

A variety of transit enhancements would be provided to support planned transportation improvements associated with the Program and accommodate future demand. These transit enhancements include (1) the Delridge RapidRide line, (2) additional service hours on the West Seattle and Ballard RapidRide lines, (3) peak-hour express routes added to the South Lake Union and Uptown neighborhoods, (4) local bus changes (such as realignments and a few additions) to several West Seattle and northwest Seattle routes, (5) implementation of transit signal priority on S. Main and/or S. Washington Streets between Alaskan Way and Third Avenue, and (6) simplification of the electric trolley system. RapidRide transit along the Aurora Avenue corridor would also be provided. However, enhanced transit service is not expected to measurably affect natural resources in the Seattle downtown area, due to the limited resources occurring in this urban environment.

7.4 Cumulative Effects of the Project and Other Program Elements

The Program is largely transportation-oriented and would replace but not increase traffic capacity in the area; no secondary (indirect) effects are expected. Therefore, the cumulative effects on wildlife, fish, and vegetation resulting from the incremental effects of this proposed Program would be minor. However, some of the Program elements have the potential to improve the habitat conditions along the waterfront, particularly the Elliott Bay Seawall Project. Such improvements could include minor enhancements to the nearshore habitat to the extent practical. However, there is likely no opportunity to restore substantial portions of the waterfront to replicate natural shoreline conditions that occurred prior to the initial construction of the existing seawall.

An ongoing research project along the Seattle waterfront is evaluating the efficacy and effectiveness of options for enhancing the face of the replacement seawall with textured areas to increase the overall productivity of the area. Preliminary data indicate mixed results from the various wall treatments applied, with some species occurring more frequently on the test wall treatment panels, while others were more abundant on reference or control areas (Toft 2009). The results also suggest that colonization of the test panels or recolonization of control panels is generally slow. The waterfront will also continue to function as a commercial and industrial area.

7.5 Cumulative Effects of the Project, Other Program Elements, and Other Actions

The complement of cumulative effects of other past, present, and foreseeable actions combined with the Bored Tunnel Alternative and Program elements may add to the effects on fish and wildlife discussed in this discipline report. These would be in addition to all the past activities in the project area that have resulted in the existing conditions (see Chapter 4). The following projects have taken place or are anticipated in or near the study area:

- Alaskan Way Viaduct and Seawall Replacement Moving Forward projects
- Sound Transit projects
- S. Spokane Street Viaduct Widening
- SR 519 Intermodal Access Project, Phase 2
- SR 520 Bridge Replacement and HOV Program
- I-5 Improvements

- South Lake Union Redevelopment
- SR 99/East Marginal Way Grade Separation
- Washington State Ferries Seattle Terminal Improvements

The project team considered 39 projects (shown in the cumulative effects matrix in Attachment A) for potential activities that could have a cumulative effect on the fish, wildlife, and vegetation resources within the study area. Of these, only one project, the SR 520 Bridge Replacement and HOV Program, would have a slightly adverse effect, while the other projects would have no effect or slightly beneficial effects.

Overall, the proposed Bored Tunnel Alternative and Program are expected to slightly improve natural resource conditions along the Seattle waterfront. As discussed above, however, the downtown Seattle area and the central waterfront have undergone considerable changes since the mid-1850s (see Section 4.2). These changes have eliminated or substantially reduced much of the natural resources in the area. Although habitat restoration is a key consideration for many projects that are currently occurring in the area, or that would likely occur in the future, it is uncertain whether substantial improvements in habitat quality and quantity would be achieved. The area is a highly urbanized environment, and this condition is expected to continue into the future.

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ATTACHMENT A

Cumulative Effects Analysis

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CUMULATIVE EFFECTS ANALYSIS

This cumulative effects analysis follows *Guidance on Preparing Cumulative Impact Analyses*, published by Washington State Department of Transportation (WSDOT) in February 2008. The guidance document was developed jointly by WSDOT, Federal Highway Administration (FHWA) – Washington Division, and U.S. Environmental Protection Agency – Region 10. The guidance can be used for FHWA's National Environmental Policy Act (NEPA) compliance (Code of Federal Regulations, Title 23, Part 771) and fulfillment of Washington State Environmental Policy Act (SEPA) requirements for evaluation of cumulative effects (Washington Administrative Code, Section 197-11-792).

The approach provided in the WSDOT guidance calls for early consideration of cumulative impacts while direct and indirect effects are being identified, preferably as part of the scoping process. For analysis, the guidance recommends the use of environmental documents such as discipline reports, as well as other relevant information such as local comprehensive plans, zoning, recent building permits, and interviews with local government. The guidance also advocates a partnership approach among agencies that includes early collaboration and integrated planning activities.

The guidance established eight steps to serve as guidelines for identifying and assessing cumulative impacts. These eight steps have been used in the following cumulative effects evaluation for the Bored Tunnel Alternative of the Alaskan Way Viaduct Replacement Project (the project). A matrix that identifies projects with the potential for cumulative effects with this project and an assessment of likely contributions to cumulative effects is also included.

Step 1. Identify the resource that may have cumulative impacts to consider in the analysis

Wildlife, fish, and vegetation

Step 2. Define the study area and timeframe for the affected resource

For wildlife and vegetation, the study area includes the areas that would be directly or indirectly affected by construction activities, including the immediate construction areas, and associated staging areas. For fish, the study area also includes areas that would be directly or indirectly affected by the operation of the constructed facilities, including some nearshore areas of Elliott Bay and Lake Union near stormwater discharge outfalls (refer to Appendix O, Surface Water Discipline Report). The study area includes heavily urbanized upland habitat in the vicinity of the proposed project footprint and nearby shoreline and open water habitats of Elliott Bay and Lake Union.

Fisheries and aquatic habitat within the study area have been substantially affected by past, present, and reasonably foreseeable actions. To analyze cumulative effects on fisheries, several assumptions were made. Because the Bored Tunnel Alternative has the potential to affect anadromous salmonid species within the study area, and because the Pacific Coast anadromous salmonids use a large portion of the North Pacific Ocean for feeding, the assumed study area includes this area as well as Water Resource Inventory Area (WRIA) 8 and 9 watersheds, Elliott

Bay, Puget Sound, the Georgia Strait, and the Strait of Juan De Fuca. The study area reflects the area within which anadromous fish could be affected by the Bored Tunnel Alternative in combination with effects of other past, present, and reasonably foreseeable actions. However, the Bored Tunnel Alternative's contribution to cumulative effects would be limited to a much smaller area, consisting of the portion of Puget Sound within Elliott Bay.

The analysis timeframe for fisheries and aquatic resources has an assumed start date of 1850, as defined by the presence of significant European settlement within the Pacific Northwest and Alaska (including the operation of large-scale commercial fisheries) and an endpoint of 2030, which represents the design year for the project.

Step 3. Describe the current health and historical context for each affected resource

The fish, wildlife, and vegetation resources potentially affected by the Bored Tunnel Alternative occur in an urban environment resulting from the extensive historical development and redevelopment of the shoreline and upland areas of Seattle. For example, numerous past events such as the Denny Regrade, the Great Seattle Fire of 1899, and construction of the original Elliott Bay Seawall played a role in removing vegetation and adversely affecting fish and wildlife habitat. Because of the past and present urban development in the study area, the current baseline conditions for fish, wildlife, and vegetation are substantially degraded. The natural resources that are present are concentrated along the Seattle shoreline and Elliott Bay, and in Lake Union, which support numerous fish and wildlife species. However, even the Seattle shoreline has undergone substantial development, including construction of the Elliott Bay Seawall, which filled intertidal and shallow subtidal areas, and construction of piers over substantial portions of the remaining shallow water habitat. Similarly, much of the Lake Union shoreline is hardened with vertical bulkheads or riprap armoring, as well as being extensively modified with overwater and in-water docks and piers.

The extensive urban development in the study area has eliminated nearly all the natural wildlife habitat in the area, which historically was abundant. The urbanized setting of the study area has little or no remaining natural vegetated habitat, resulting in only a few wildlife species occurring in the upland portion of the study area. The upland and shoreline areas are entirely manmade, consisting of concrete sidewalks, paved roadways, and buildings. No natural vegetation remains along the shoreline of Elliott Bay, although various street trees (trees planted along roadways) and ornamental vegetation in planters are present at scattered locations within the study area. These habitat areas support typical urban wildlife species.

The baseline (present-day) condition of fish resources within the study area is degraded, with substantial degradation in both the quality and quantity of freshwater and marine habitat within WRIAs 8 and 9 and Elliott Bay and those natural physical, biological, and chemical processes that are important to the maintenance of healthy fish populations.

The overall status of many fish stocks within the study area is depressed because of the changes in the natural environment throughout the region. For example, the stocks of Chinook, coho, and sockeye salmon and steelhead show a substantial decline from historical numbers, when comparing spawning escapement. A number of fish species found in Elliott Bay are also listed or proposed for listing under the Endangered Species Act (ESA). The primary factor in determining year-to-year population trends in anadromous fish stocks is ocean survival, which depends heavily on temporal ocean conditions. These factors are directly influenced by ocean temperatures and circulation patterns, which are influenced by climate processes and may be negatively affected by global climate change associated with emission of greenhouse gasses.

Past actions have altered the resource and set trends that have led to its present condition. These include the extensive urban and industrialized development along the Seattle waterfront and substantial modification of the shoreline around Lake Union and Elliott Bay. In addition, reduced water quality and increased fish passage barriers have occurred throughout WRIAs 8 and 9 in lakes and streams, and intense development has occurred along the area shorelines. Coupled with the introduction of invasive predator fish species, these occurrences have negatively affected juvenile salmon outmigration and rearing. These and other activities have resulted in a substantial decline in runs of Pacific salmonids in WRIAs 8 and 9, as well as multiple fish stocks that are considered in declining condition or at risk according to resource management agencies (Good et al. 2005; WDF et al. 1993; WDFW 1998, 2002, 2004). Furthermore, three fish species within WRIA 8 have been included for listing under the ESA as threatened species: Chinook salmon, steelhead, and bull trout. Recovery actions have been identified for multiple salmonid species within WRIAs 8 and 9, generally focusing on improvements of water quality and freshwater and marine habitat (Shared Strategy for Puget Sound 2007).

Although some salmonid stocks that use the marine and freshwater habitat in the study area appear to have stabilized, continued recent and current trends and stressors (such as global climate change) indicate that the likely future condition of the resource may continue along a downward trend into the reasonably foreseeable future. These stressors are also expected to affect the aquatic habitat of other fish and wildlife species that occur in the study area.

Step 4. Identify the direct and indirect impacts that may contribute to a cumulative impact

Only minor direct or indirect construction effects on fish or wildlife are expected to occur, primarily from wildlife (urban bird) disturbance and potential sedimentation during construction (although best management practices [BMPs] will minimize or eliminate these effects). There would be no impacts on vegetation. The primary operational effects of the Bored Tunnel Alternative on fish and wildlife are associated with enhancements to stormwater treatment within the project area. These enhancements would likely result in some improvement in long-term water quality within Elliott Bay (see Appendix O, Surface Water Discipline Report for further details), resulting in a slight beneficial effect on fish and wildlife within Elliott Bay, although this beneficial effect is likely unquantifiable, especially from a stockwide or WRIA-wide perspective.

<u>Step 5</u>. Identify other historic, current, or reasonably foreseeable actions that may affect resources

As discussed above, past urban development and activities such as mining, agriculture, commercial and recreational fishing, road construction, logging, and shipping have substantially degraded the baseline conditions for fish, wildlife, and vegetation in the study area. Fisheries and aquatic habitat within the study area have been and will be substantially affected by past, present, and reasonably foreseeable actions, including climate change, alteration of ecosystem processes, loss of forests and riparian habitat, in-stream habitat loss and fragmentation, competition and predation by invasive species, overharvesting of fisheries, increases in impervious surfaces and water pollution, and changes in flow regimes (PSRC 2009; Kerwin 2001; Williams et al. 1975).

The project team considered 39 projects (shown below in the cumulative effects matrix) for potential activities that could have a cumulative effect on the fish, wildlife, and vegetation resources within the study area. Of these, only one project, the SR 520 Bridge Replacement and HOV Program, would have a slightly adverse effect, while the other projects would have no effect or slightly beneficial effects.

<u>Step 6</u>. Assess potential cumulative impacts to the resource; determine the magnitude and significance

Although the net effects of the Bored Tunnel Alternative on fish resources would be beneficial, the Bored Tunnel Alternative's contribution to existing habitat trends or stressors would be small and unquantifiable, for the same reasons discussed in Step 3. Based on the estimated fish populations within the study area, project actions have the potential to affect only a negligible percentage of species within the greater Puget Sound area. The existing conditions for fish and wildlife within the study area are severely degraded. Furthermore, the project area represents a small fraction of the total habitat utilized by these species during their life cycle. In short, the Bored Tunnel Alternative's contribution to the health of fish and wildlife habitat resources within the overall study area could help to alleviate or offset the overall cumulative effect on these resources, although the beneficial effects that would occur are likely to be small and immeasurable.

<u>Step 7</u>. Report the results

The net cumulative effects are expected to be localized and slightly beneficial, and these effects would be focused on the project area and other areas of immediate impact (stormwater discharge locations). However, the Bored Tunnel Alternative would not have a measurable cumulative effect on Elliott Bay, WRIA 8, Puget Sound, or the fish, wildlife, and vegetation resources within these areas.

<u>Step 8</u>. Assess and discuss potential mitigation issues for all adverse impacts

Only slightly beneficial or slightly negative cumulative effects on fish, wildlife, and vegetation would occur. Because of the nature and magnitude of the expected effects, no mitigation is currently proposed.

The following matrix identifies project-specific potential cumulative effects.

PROJECT-SPECIFIC CUMULATIVE EFFECTS MATRIX

PROJECT	POTENTIAL CUMULATIVE EFFECTS
A. Roadway Elements	
A1. Alaskan Way Surface Street Improvements – S. King Street to Pike Street	The project would potentially improve water quality over the long term if stormwater retrofit thresholds were triggered. Cumulative long-term effects on natural resources are expected to be between no effect and slightly beneficial, although beneficial effects on fish and aquatic wildlife would be small and likely immeasurable.
A2. Elliott/Western Connector – Pike Street to Battery Street	Effects expected to be similar to those described for project A1.
A3. Mercer Street Improvements – Mercer Street becomes two-way from Fifth Avenue N. to Elliott Avenue, and Roy Street becomes two-way from Aurora Avenue to Queen Anne Avenue N.	Effects expected to be similar to those described for project A1.
B. Non-Roadway Elements	
B1. Elliott Bay Seawall Project	The long-term effects from construction of the project (including project mitigation) are at least partially beneficial. The project would enhance habitat conditions along the Seattle waterfront, improving natural resource conditions in the area. Overall cumulative effects on natural resources are expected to be slightly beneficial, although beneficial effects on fish and aquatic wildlife would be small and likely immeasurable.
B2. Alaskan Way Promenade/Public Space	Effects expected to be similar to those described for project A1.
B3. Transit Enhancements – 1) Delridge RapidRide 2) Additional service hours on West Seattle and Ballard RapidRide lines 3) Peak hour express routes added to South Lake Union and Uptown 4) Local bus changes to several West Seattle and northwest Seattle routes 5) Transit priority on S. Main and/or S. Washington Streets between Alaskan Way and Third Avenue 6) Simplification of the electric trolley system	No effect, as no natural resources occur in the project area and no water quality effects would occur.
B4. First Avenue Streetcar Evaluation	Effects expected to be similar to those described for project A1.

PROJECT-SPECIFIC CUMULATIVE EFFECTS MATRIX (CONTINUED)

PROJECT	POTENTIAL CUMULATIVE EFFECTS
C. Projects Under Construction	
C1. S. Holgate Street to S. King Street Viaduct Replacement Project	Effects expected to be similar to those described for project A1.
C2. Transportation Improvements to Minimize Traffic Effects During Construction	Effects expected to be similar to those described for project B3.
D. Completed Projects	
D1. SR 99 Yesler Way Vicinity Foundation Stabilization (Column Safety Repairs)	No long-term cumulative effects on fish, wildlife, or vegetation are expected. The project was not of a level to disturb natural resource habitat along the commercial and industrial Seattle waterfront or to affect water quality in the project area.
D2. S. Massachusetts Street to Railroad Way S. Electrical Line Relocation Project (Electrical Line Relocation Along the Viaduct's South End)	Effects expected to be similar to those described for project B3.
E. Seattle Planned Urban Development	
E1. Gull Industries on First Avenue S.	Effects expected to be similar to those described for project B3.
E2. North Parking Lot Development at Qwest Field	The project would have some minor negative effects on the quality of water discharged to Elliott Bay due to increased demand on the combined sewer system and, therefore, increased risk of combined sewer overflows. However, these effects on fish and wildlife would be minor and likely immeasurable.
E3. Seattle Center Master Plan (EIS) (Century 21 Master Plan)	Effects expected to be similar to those described for project B3.
E4. Bill and Melinda Gates Foundation Campus Master Plan	Effects expected to be similar to those described for project B3.
E5. South Lake Union Redevelopment	Effects expected to be similar to those described for project B3.
E6. U.S. Coast Guard Integrated Support Command	Effects expected to be similar to those described for project B3.
E7. Seattle Aquarium and Waterfront Park	Effects expected to be similar to those described for project B3.
E8. Seattle Combined Sewer System Upgrades	Effects expected to be similar to those described for project B3.
F. Local Roadway Improvements	
F1. Bridging the Gap Projects	Effects expected to be similar to those described for project A1.
F2. S. Spokane Street Viaduct Widening	Effects expected to be similar to those described for project A1.
F3. SR 99/East Marginal Way Grade Separation	Effects expected to be similar to those described for project A1.
F4. Mercer Corridor Improvements from Dexter Avenue to I-5	Effects expected to be similar to those described for project A1.

Project-Specific Cumulative Effects Matrix (continued)

PROJECT	POTENTIAL CUMULATIVE EFFECTS
G. Regional Roadway Improvements	
G1. I-5 Improvements	Effects expected to be similar to those described for project A1.
G2. SR 520 Bridge Replacement and HOV Program	Short-term effects on fish and wildlife resources would likely occur due to direct disturbance from vegetation clearing, pile driving, and in-water construction activities. Long-term effects from construction could include negative effects on fish and wildlife resources due to habitat alteration caused by increased amounts of in-water and overwater structures. However, beneficial effects on water quality would also result from the retrofit of impervious surfaces for stormwater treatment. Overall, the cumulative effects would be slightly negative but offset by habitat creation and improvement that would be constructed as part of the SR 520 mitigation package.
G3. I-405 Corridor Program	Effects expected to be similar to those described for project A1.
G4. I-90 Two-Way Transit and HOV Operations Stages 1 and 2	Effects expected to be similar to those described for project A1.
H. Transit Improvements	
H1. First Hill Streetcar	Effects expected to be similar to those described for project A1.
H2. Sound Transit University Link Light Rail Project	Effects expected to be similar to those described for project A1.
H3. RapidRide	Effects expected to be similar to those described for project B3.
H4. Sound Transit North Link Light Rail	Effects expected to be similar to those described for project A1.
H5. Sound Transit East Link Light Rail	Effects expected to be similar to those described for project A1.
H6. Washington State Ferries Seattle Terminal Improvements	Effects expected to be similar to those described for project A1.
I. Transportation Network Assumptions	
I1. HOV Definition Changes to 3+ Throughout the Puget Sound Region	Effects expected to be similar to those described for project B3.
I2. Sound Transit Phases 1 and 2	Effects expected to be similar to those described for project A1.
I3. Other Transit Improvements	Effects expected to be similar to those described for project B3.
J. Completed but Relevant Projects	
J1. Sound Transit Central Link Light Rail (including the Sea-Tac Airport extension)	Effects expected to be similar to those described for project A1.
J2. South Lake Union Streetcar	Effects expected to be similar to those described for project A1.
J3. SR 519 Intermodal Access Project, Phase 2	Effects expected to be similar to those described for project A1.

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