Existing Conditions Report

Alaskan Way Seawall Replacement Project Feasibility Study ■ U.S. Army Corps of Engineers
October 2008

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Alaskan Way Seawall Replacement Project Feasibility Study Environmental Impact Statement—Existing Conditions

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Acronyms and Abbreviations

ºF	degrees Fahrenheit
µg/m3	micrograms per cubic meter
B&O	business and occupation
BG	Block Group
BNSF	Burlington Northern Santa Fe Railway
CFR	Code of Federal Regulations
CIP	Capital Improvement Program
City	City of Seattle
CO	Carbon monoxide
Corps	U.S. Army Corps of Engineers
CSO	Combined sewer outflow
CT	Census Tract
CZM	Coastal Zone Management
dB	Decibel
dBA	A-weighted decibels
DCLU	Department of Construction and Land Use
DEIS	Draft environmental impact statement
DNR	Department of Natural Resources
DoIT	Department of Information Technology
DPM	Diesel particulate mater
DPSs	Distinct Population Segments
ECAs	Environmentally critical areas
Ecology	Washington State Department of Ecology
EFH	Essential Fish Habitat
EIS	Environmental impact statement
EPA	Environmental Protection Agency
ESA	Endangered Species Act

ESUs	Evolutionarily Significant Units
FHWA	Federal Highway Association
FTA	Federal Transit Administration
GMA	Washington State Growth Management Act
HCM	Highway Capacity Manual
HHS	Department of Health and Human Services
I-5	Interstate 5
kV	Kilovolt
Leq	Level equivalent
Lmax	Maximum sound level
LOS	level of service
MCI	multiple casualty incident unit
MMST	metropolitan medical strike team
mph	Miles per hour
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NO_2	Nitrogen dioxide
NOX	Nitrogen oxides
NRC	Natural Resources Consultants, Inc.
O_3	Ozone
OEHHA	California Office of Environmental Health Hazard Assessment
OFM	Office of Financial Management
PCBs	Polychlorinated biphenyls
PFMC	Pacific Fishery Management Council
PHS	Priority Habitats and Species
PM10	Particulate matter with a diameter less than or equal to 10 microns
PM2.5	Particulate matter with a diameter less than or equal to 2.5 microns
PSAMP	Puget Sound Ambient Monitoring Program
PSBRT	Puget Sound Biological Review Team

PSCAA	Puget Sound Clean Air Agency
PSE	Puget Sound Energy
PSRC	Puget Sound Regional Council
RCW	Revised Code of Washington
SDEIS	Supplemental Draft Environmental Impact Statement
SEM	Seattle Emergency Management
SFD	Seattle Fire Department
SMC	Seattle Municipal Code
SMSA	Standard Metropolitan Statistical Area
SO_2	Sulfur dioxide
SPD	Seattle Police Department
SPU	Seattle Public Utilities
SR	State Route
USAR	Urban search and rescue
USC	United States Code
UGAs	Urban growth areas
USFWS	U.S. Fish and Wildlife Service
V/C	Volume to capacity
VdB	Vibration decibel levels
VOC	Volatile organic compounds
WDFW	Washington Department of Fish and Wildlife
WSDOT	Washington State Department of Transportation
WSF	Washington State Ferries
YEP	Youth Education Program

Chapter 1. Introduction

The Seattle District U.S. Army Corps of Engineers (Corps) is in the process of determining whether there is federal interest in replacing the Alaskan Way Seawall along the City of Seattle waterfront. The Corps has signed a feasibility study cost-sharing agreement with the City of Seattle under the Corps' hurricane and storm damage reduction authority. The feasibility study will result in a feasibility report integrated with an environmental impact statement (EIS) that will assess various alternatives and potential environmental impacts associated with a seawall replacement project.

This report contains sections on 15 disciplines (see table of contents), with topics covered in each discipline section corresponding to those presented in the draft and supplemental draft Alaskan Way Viaduct and Seawall Replacement Project EIS prepared by the Federal Highway Administration (FHWA), the Washington State Department of Transportation (WSDOT), and the City of Seattle (FHWA 2004, 2006). Where appropriate, information provided in the Draft EIS (DEIS) and Supplemental DEIS (SDEIS) are incorporated by reference.

Chapter 2. Existing Conditions

2.1. Transportation

2.1.1. Introduction and Overview

This section provides information on the existing condition of transportation facilities within the study area. The project is located on the Seattle central waterfront along Alaskan Way, which serves as a transportation hub for surface and waterborne transportation through the region.

Surface transportation facilities include State Route (SR) 99 (Alaskan Way Viaduct), the arterial and local streets in the study area, the waterfront streetcar (replaced by King County Metro Transit Route 99) and buses, the Burlington Northern Santa Fe railroad (BNSF), and the bicycle and pedestrian routes. Waterborne transportation facilities include the Washington State Ferry Terminals at Piers 50 & 52, Elliott Bay Water Taxi dock at Pier 55, Victoria Clipper dock at Pier 69, and Bell Street Cruise Ship terminal at Pier 66.

2.1.2. Study Area

The project limits of the Alaskan Way Seawall Study extend along Alaskan Way from S. Washington Street in the south to north of Broad Street. Alaskan Way is a principal arterial that serves as a major truck route for freight and oversized vehicles; however, it plays a unique role as the waterfront street, serving multiple purposes as an access route to the ferries, a tourist connection to the waterfront and cruise ships, and occasionally as a local street for limited through-movement and as a way of bypassing the congestion further upland in downtown Seattle (City of Seattle 2003).

Figure 2.1-1 shows the transportation study area, which encompasses the project limits on Alaskan Way and nearby transportation facilities that are closely related to or affected by the study section of Alaskan Way (between Broad and S. Washington streets). The study area is roughly bordered by Second Avenue to the east, Puget Sound to the west, Denny Way and Elliott/Western Couplet in the north, and S. Atlantic Street in the south. It includes a range of multimodal transportation facilities and service types, including limited access highways, arterial streets, transit services and facilities, rail services and facilities, ferry services and facilities, non-motorized facilities and routes, and important freight corridors.

2.1.3. Methodology

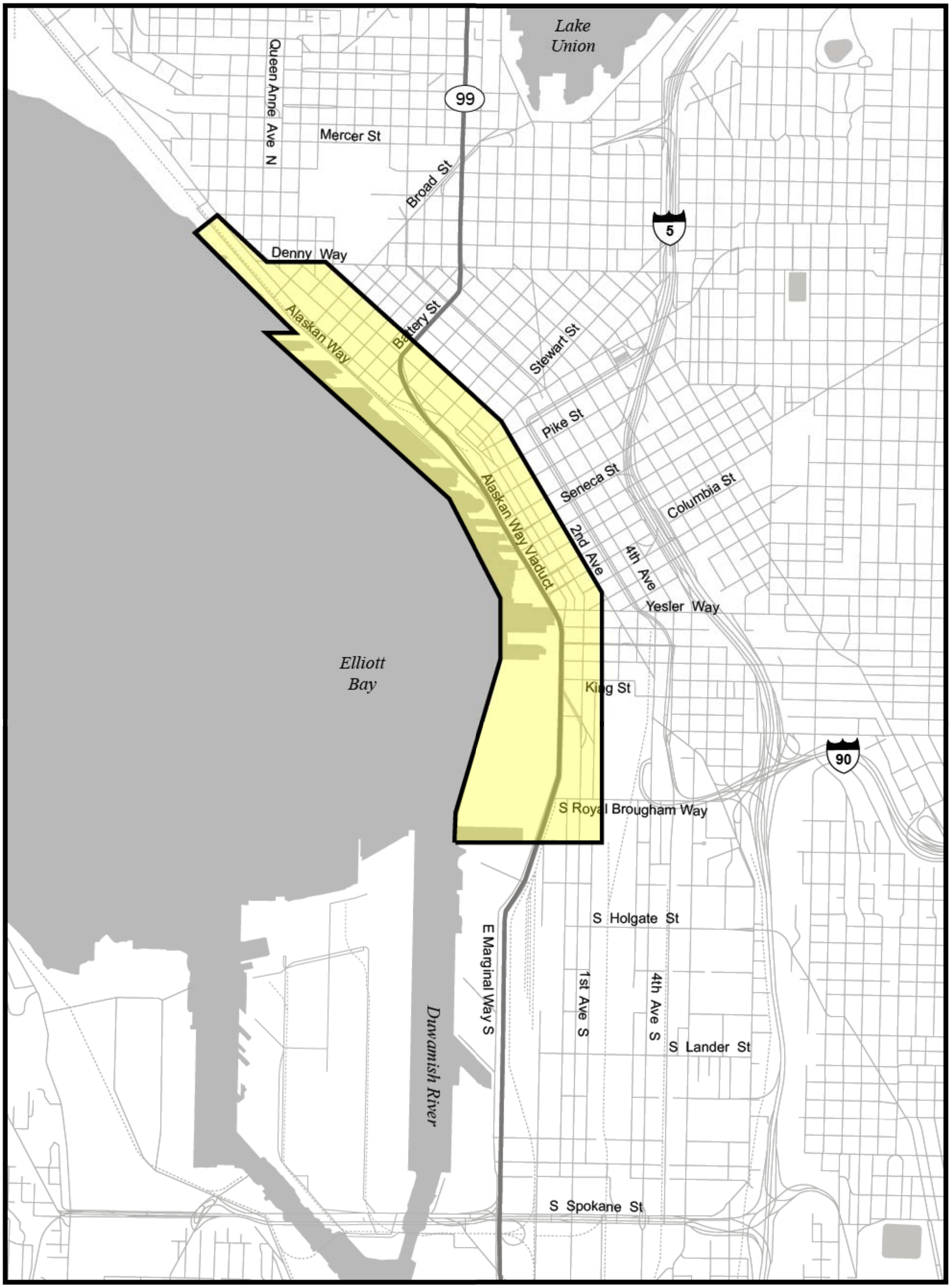
The existing conditions of transportation facilities within the study area were determined through the use of existing written resources; no field surveys or analyses were performed. A significant portion of the information provided in this chapter was based on the information and analysis presented in the Transportation Discipline reports (FHWA 2004, 2006) for the *SR 99 Alaskan Way Viaduct and Seawall Replacement Project Draft Environmental Impact Statement* (DEIS) and *Supplemental DEIS* (SDEIS) along with information provided in the Transportation Background Report for Seattle's Central Waterfront Concept Plan (City of Seattle 2003).

This section summarizes the methodology for evaluating intersection traffic conditions based on the methodology established in the Transportation Discipline reports (FHWA 2004, 2006) for the SR 99 Alaskan Way Viaduct and Seawall Replacement Project DEIS and SDEIS.

Arterial and Local Street Intersection Operations

PM peak-hour traffic operations on primary and selected secondary intersections in the study area were assessed using Trafficware Corporation's Synchro (Vision 5) traffic analysis software. Synchro is a computer program designed for analysis of intersection traffic operations. Intersection level of service [LOS], average vehicle delay, and intersection capacity utilization [ICU] (analogous to volume to capacity ratio) are reported for selected intersections including ramp termini and heavily congested intersections within the study area.

For intersections providing egress from the ferry terminal at Colman Dock (Marion Street/Alaskan Way and Yesler Way/Alaskan Way), LOS and ICU were calculated separately for periods during which ferry traffic is actively exiting the dock and periods during which no ferry traffic is exiting the dock. Results are presented for each period, as well as overall for the PM peak hour using a weighted average of the amount of time each condition is expected during the PM peak hour.



Sources: SR99 AWVSRP DEIS (2004, 2006); Jones & Stokes (2006)

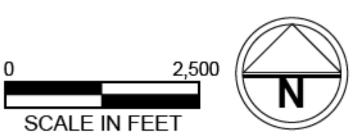


Figure 2.1-1
Transportation Impact Study Area

Intersection analysis results were used to identify locations on surface streets in the study area where traffic operations are expected to be poor during the PM peak. These intersections are identified as “congested,” and further subdivided into two categories, “moderately congested” and “highly congested.” Intersections are identified as highly congested if the PM peak hour average vehicle delay exceeds 110 seconds and the ICU is greater than 110%. Moderately congested intersections are those that fall below the threshold for highly congested but have an average vehicle delay of greater than 80 seconds (i.e., LOS F) or an ICU greater than 100%.

2.1.4. Highways and Streets

Regional and Local Access

Regional highway access to the study area is provided by I-90, I-5, and SR 99. A key access route to the study area, and the designated ferry access route, is SR 519, which includes portions of Alaskan Way S. and S. Royal Brougham Way. Alaskan Way S. is classified as a primary arterial and a designated oversized vehicle and truck route. It is designated as SR 519 from S. Royal Brougham Way to Marion Street. Parking is allowed where the roadway is widened specifically for on-street parking (City of Seattle 2003).

S. Royal Brougham Way is classified as a primary arterial and is also designated as a truck route. S. Royal Brougham Way provides a primary link between the marine terminals at the Port of Seattle and Colman Dock, Safeco Field and Qwest Field, and the I-5 and I-90 Interstate system. S. Royal Brougham Way is designated SR 519 between Fourth Avenue S. and Alaskan Way S. (City of Seattle 2003).

Access to Alaskan Way is restricted by limited east-west connections. Elliott and Western Avenues comprise an important north/south couplet that, together with Alaskan Way, provides an important Interbay/Ballard connection, which accounts for about one-third of the traffic on the Alaskan Way Viaduct. Western Avenue tends to be underutilized since it traverses the “choke” point at the Pike Place Market, and Elliott Avenue terminates at the southbound on-ramps to the Alaskan Way Viaduct at Lenora Street (City of Seattle 2003).

Alaskan Way within the project limit is a 4-lane arterial with sidewalks on both sides of the road. The BNSF railroad and a bike route are located on the east side of the road. On-street parking is provided north of Pine Street on both sides of Alaskan Way within the project limit. The posted speed limit on Alaskan Way is 30 miles per hour (mph).

In the latest study performed on the traffic volumes on the Alaskan Way Viaduct (Parsons, Brinckerhoff, Quade, and Douglas 2004), it was found that daily traffic on Alaskan Way at King Street totals 4,800 vehicles. This number is expected to increase to 10,000 vehicles by 2030. Additional results including average daily traffic volumes and PM Peak hour volumes on regional access highways and arterials in the study area are presented in Table 2.1-1.

Table 2.1-1. Average Daily Traffic Volumes and PM Peak Hour Volumes

Thoroughfare	1995 Average Weekday Volume[1]	2002 Average Daily Volume[2]	2002 PM Peak Hour Volume[2]	2006 Average Weekday Volume[4]
Alaskan Way Viaduct (SR 99)				
S. Atlantic Street to Railroad Way S.	77,700	82,000	7,400	8,400
Railroad Way S. to Columbia Street	102,300	103,000	9,300	109,300
Columbia Street ramp to Seneca Street ramp	93,900	95,000	8,000	95,000
Seneca Street ramp to Western Avenue exit	85,400	86,000	7,350	80,000
Western Avenue to Battery Street Tunnel	67,700	60,000	5,650	20,000
Alaskan Way				
Yesler Way to Lenora Street	12,900	-	1,150	12,000
Lenora Street to Broad Street	10,900			12,000
Elliott Avenue (southbound)				
Western Avenue to Denny Way	17,600	-	-	16,700
Western Avenue (northbound)				
Stewart Street to Viaduct entrance	12,300	-	-	-
Viaduct entrance to Denny Way	17,700			16,800
First Avenue				
S. Royal Brougham Way to Railroad Way S.	24,200	-	3,500	24,000
Railroad Way S. to S. Jackson Street	15,000		1,550	12,300
S. Jackson Street to Stewart Street	22,100			-
Stewart Street to Denny Way	16,300			-
Second Avenue				
Yesler Way to Stewart Street	15,400	-	-	-
Stewart Street to Denny Way	12,400			-
S. Jackson Street				
S. Alaskan Way to First Avenue S.	Less than 5,000			5,000
First Avenue S. to Fourth Avenue S.	15,000	-	-	20,000
S. Royal Brougham Way				
Alaskan Way to Fourth Avenue S.	15,000–20,000	-	525–1,000	20,000

Thoroughfare	1995 Average Weekday Volume[1]	2002 Average Daily Volume[2]	2002 PM Peak Hour Volume[2]	2006 Average Weekday Volume[4]
Broad Street				
Alaskan Way to Denny Way	10,000	-	-	

[1] Source: Seattle Department of Transportation (City of Seattle 2003)

[2] Source: Parsons Brinckerhoff Quade and Douglas 2004

[4] Source: Seattle Department of Transportation (City of Seattle 2006 Traffic Flow Map)

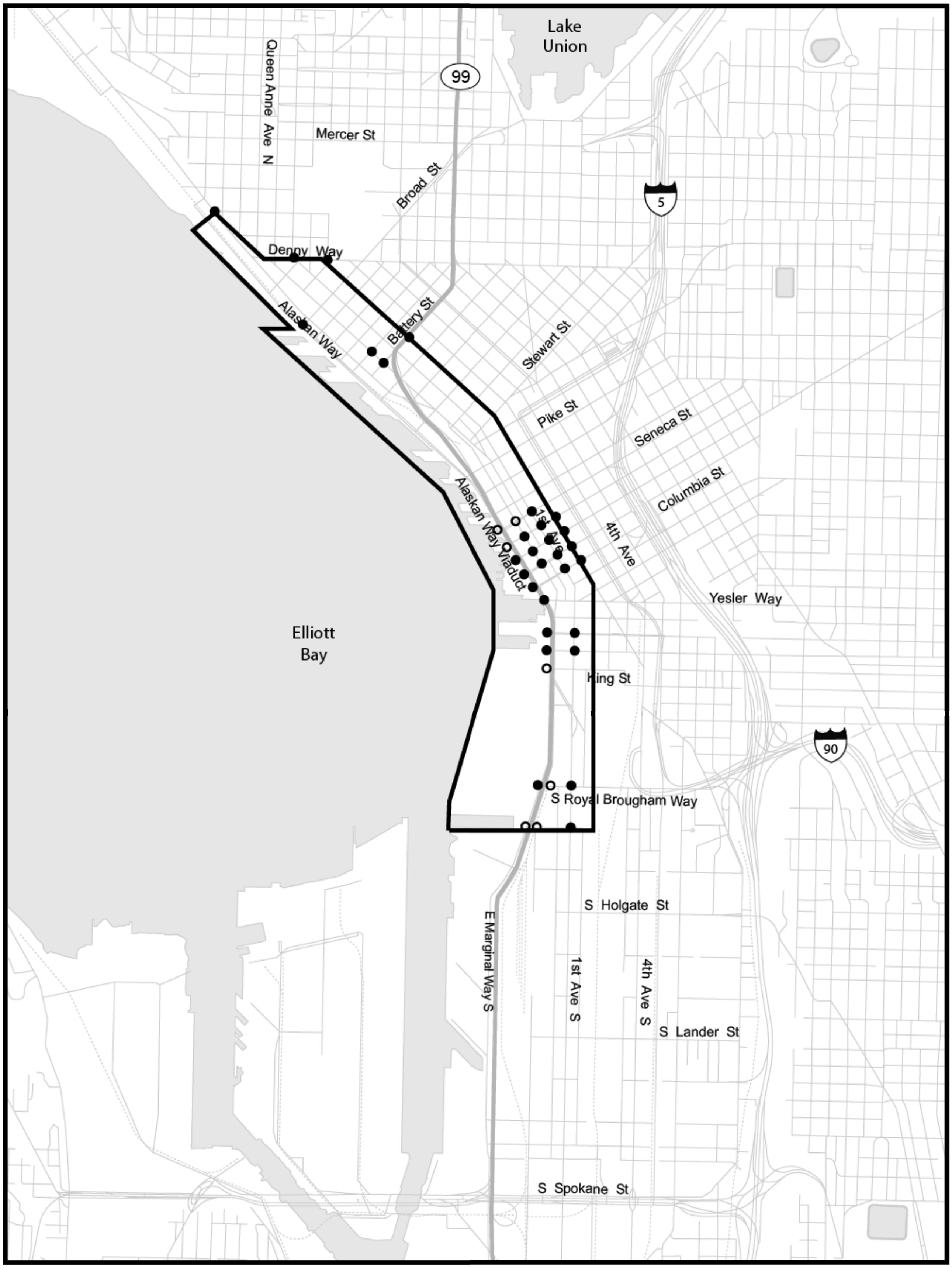
Arterial Intersection LOS

Traffic operations at selected signalized intersections (Figure 2.1-2) in the study area were assessed to determine intersection LOS[1], average vehicle delay, and ICU[2]. The intersections of First Avenue S./S. Royal Brougham Way and First Avenue S./S. Atlantic Street are analyzed under their current configuration with SR 519 Phase I improvements in place. These improvements included connecting S. Atlantic Street to Fourth Avenue S. and a new I-90 on-ramp.

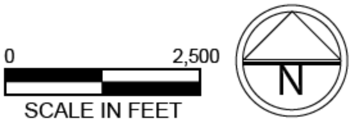
Table 2.1-2 below shows PM peak hour signalized intersection LOS and ICU for selected signalized intersections. Eight intersections were found to operate at congested conditions during the PM peak hour, though none were identified as being highly congested.

[1] LOS is a measure that characterizes the operating conditions, as perceived by a driver or facility user, of a highway, street, or other transportation facility. Although LOS is a qualitative measure, it is based on quantitative measures, such as vehicle density, average speed, or average vehicle delay. A range of six LOS designations, ranging from “A” to “F,” are defined in the Transportation Research Board (TRB)’s 2000 Highway Capacity Manual (HCM). LOS A represents ideal, uncongested operating conditions, while LOS F designates extremely congested, breakdown conditions. LOS B through LOS D designate intermediate operating conditions, while LOS E denotes congested conditions at the point of maximum service rate.

[2] ICU may be a better indicator of intersection performance for signalized intersections, as it is independent of signal timing assumptions, which are uncertain for analysis under future conditions. Instead, it is a measure of basic capacity compared with the traffic forecasted to use the intersection. Additionally, both delay- and capacity-based measures of performance are evaluated, since each measure can identify operational problems that the other cannot.



Sources: SR99 AWVSRP DEIS (2004, 2006); Jones & Stokes (2006)



● Signalized Intersection
○ Unsignalized Intersection

Figure 2.1-2
Study Intersections for Transportation Impact Analysis

Table 2.1-2. Existing (2002) PM Peak Hour Intersection LOS

Street	Cross Street	Identified as Congested	LOS	Avg Veh Delay	ICU
Alaskan Way	Madison Street	-	B	15	59%
Alaskan Way	Marion Street	-	C	29	86%
Alaskan Way	Columbia Street	-	A	6	47%
Alaskan Way	Yesler Way	-	C	26	67%
Alaskan Way	S. Main Street	-	B	11	50%
Alaskan Way	S. Jackson Street	-	A	2	61%
Alaskan Way	S. Royal Brougham Way	-	C	21	55%
Elliott Avenue	Denny Way (Western Avenue)	MC	F	100	105%
Elliott Avenue	Broad Street	-	C	28	68%
Western Avenue	Wall Street	-	C	31	92%
Western Avenue	Battery Street	-	B	12	62%
Western Avenue	Spring Street	-	B	11	71%
Western Avenue	Madison Street	-	B	12	55%
Western Avenue	Marion Street	-	B	14	59%
First Avenue	Denny Way	-	B	17	95%
First Avenue	Seneca Street	-	B	19	77%
First Avenue	Spring Street	-	D	37	85%
First Avenue	Madison Street	MC	F	82	67%
First Avenue	Marion Street	-	C	21	85%
First Avenue	Columbia Street	MC	F	89	119%
First Avenue	S. Main Street	-	C	21	57%
First Avenue	S. Jackson Street	-	C	26	75%
First Avenue	S. Royal Brougham Way	-	D	50	80%
First Avenue	S. Atlantic Street	MC	E	77	118%
Second Avenue	Denny Way	MC	C	34	111%
Second Avenue	Spring Street	MC	F	192	92%
Second Avenue	Madison Street	MC	F	141	100%
Second Avenue	Marion Street	MC	F	145	88%
Second Avenue	Columbia Street	-	D	44	84%
Moderately Congested Intersections		8			
Highly Congested Intersections		0			
Total Congested Intersections		8			

MC Moderately Congested Intersections (LOS F or ICU > 100%)

HC Highly Congested Intersections (Delay > 110 seconds per vehicle and ICU > 110%)

Source: FHWA 2004

The following intersections were found to meet the criteria for congested operations:

- Elliott Avenue and Denny Way (Western Avenue),
- First Avenue and Madison Street,
- First Avenue and Columbia Street,
- First Avenue and S. Atlantic Street,
- Second Avenue and Denny Way,
- Second Avenue and Spring Street,
- Second Avenue and Madison Street, and
- Second Avenue and Marion Street.

None of these intersections was identified as highly congested, although several met either the delay or the capacity threshold required for such designation.

The Second Avenue intersections (except the intersection of Second Avenue and Denny Way) showed very high levels of delay with ICUs in the range of 88 to 100%. These intersections carry very high vehicle volumes during the PM peak hour and also experience high conflicting pedestrian volumes, bus traffic in the right lane, and heavy conflicting movements on cross streets. Review of current signal timing indicates that reduction in intersection delay could be realized if predominant movements (north–south) were allotted a larger share of green-light time, although issues associated with the short storage lengths on east–west streets could limit the ability to implement such changes. Even with signal timings optimized to minimize delay, the improvement would not be sufficient to result in LOS of better than F.

Elliott Avenue at Western Avenue (north of Denny Way) is a heavily traveled intersection. Analysis indicates an LOS F and overcapacity (ICU 105%) operations during the PM peak hour. The intersection of Denny Way and Second Avenue was also found to operate with overcapacity, with an ICU of 111%, though an LOS C result indicates acceptable operations. This intersection accommodates left turning vehicles from the mainline, though it does not have left turn pockets or a protected signal phasing. Under current traffic levels, enough gaps exist on Denny Way to allow the left turn movements, hence the acceptable LOS.

2.1.5. Parking

Parking on the waterfront within the project limits is provided on Alaskan Way and under the Alaskan Way Viaduct. The parking study area included Alaskan Way and the Alaskan Way Viaduct from King Street north to Broad Street. As shown in Figure 2.1-3, the data collected for the area was sorted according to the three following geographic sub-areas:

- Pioneer Square Sub-areas (from S King Street north to Yesler Way),
- Waterfront Sub-areas (from Yesler Way north to Pine Street), and
- North Waterfront Sub-area (from Pine Street north to Broad Street).

The following definitions were used to define parking spaces and are summarized accordingly:

Metered: metered parking spaces.

Time restricted: any public parking spaces that are time-restricted but not metered includes 30-minute, 1-hour, 2-hour, passenger, and other loading zones.

Bus/Taxi: parking spaces posted for taxis and buses; includes bus stops.

Non-restricted: unmetered, unrestricted, on-street public parking.

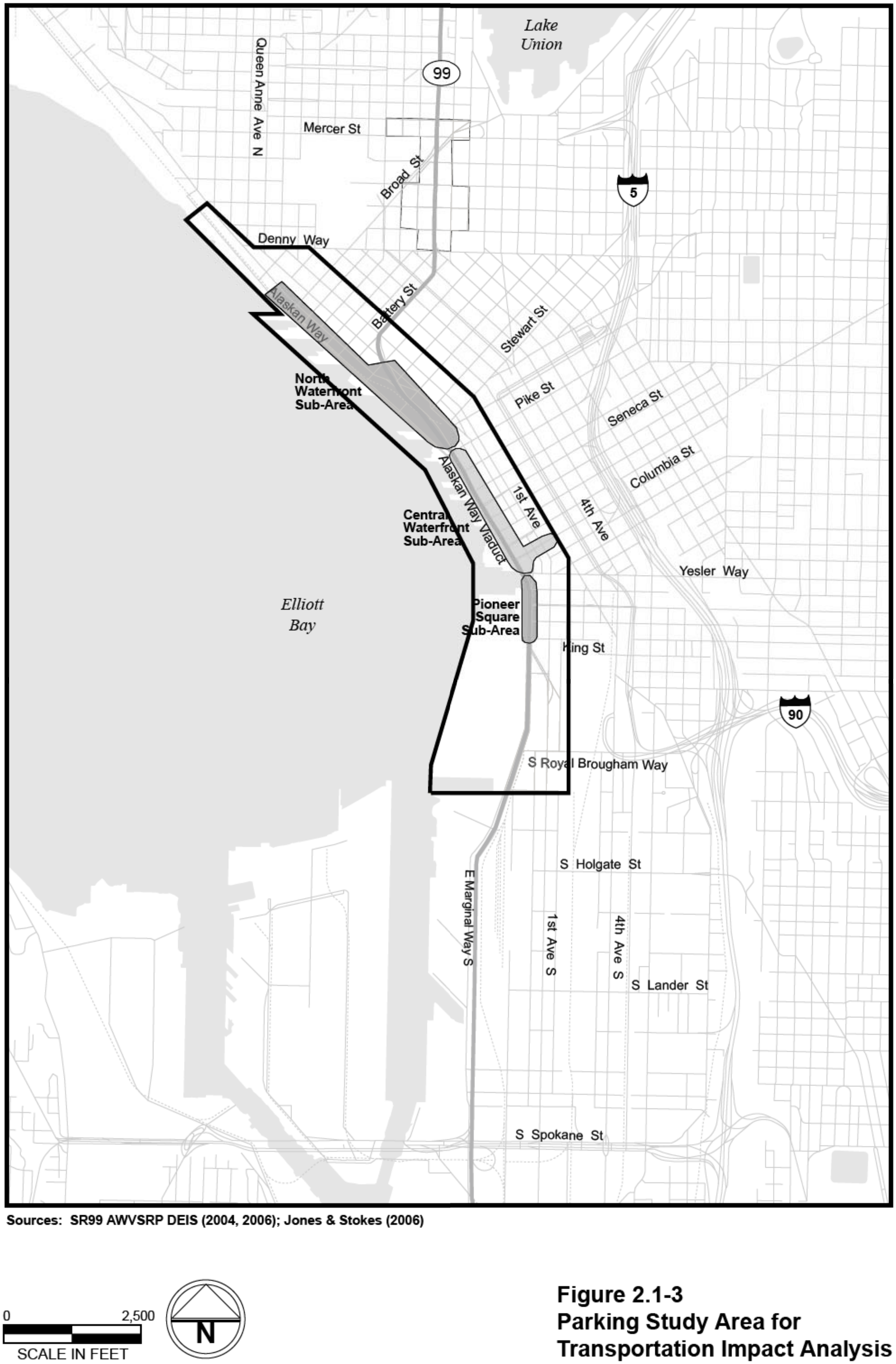
Government: posted police spaces, consular spaces, and other spaces designated for government operations.

Paid/Permit Parking: parking spaces that require a permit, or are let to the general public for a fee.

Tenant Only: off-street parking that is designated as restricted, or private, and is not let to the general public for a fee.

Parking was grouped into four main categories, defined as the following:

- Short-Term On-Street Parking is the sum of (Metered) + (Time Restricted) spaces;
- Long-Term On-Street Parking is (Non-restricted) spaces;
- Off-Street Parking is the sum of (Paid/Permit Parking) + (Tenant Only) spaces; and
- “Other” Parking is the sum of (Bus/Taxi) + (Government) spaces.



Sources: SR99 AWVSRP DEIS (2004, 2006); Jones & Stokes (2006)

Figure 2.1-3
Parking Study Area for Transportation Impact Analysis

When the parking data were classified and categorized, there were some assumptions made in the analysis (below):

- Fire lanes (red curbed areas) are not included as a part of this study;
- Holding areas for the Washington State Ferries are not included in the existing or proposed parking space data; and
- The SR 519 surface improvements were included as part of the baseline when determining existing parking availability and potential impacts.

Table 2.1-3 summarizes the existing parking in the study area. On-street parking on Alaskan Way is mostly provided on both side of the road north of Pine Street.

Table 2.1-3. Summary of Existing Parking within Study Area*

Sub-Area	On-Street Parking			Off-Street Parking	Other Parking	Total
	Short-Term	Long-Term	Subtotal			
Pioneer Square	155	15	170	18	0	188
Waterfront	388	0	388	229	34	651
North Waterfront	178	0	178	176	14	368
Total	721	15	736	423	48	1,207

Source: FHWA 2004 * Referenced Data was collected in 2004, before Seattle's conversion to pay stations took place. Subsequently, small changes to space counts have taken place.

A total of 762 parking spaces are provided under the existing Viaduct structure. Table 2.1-4 shows the number of on- and off-street parking spaces counted under the Viaduct structure during spring of 2003. The data presented is a subset of parking values shown in Table 2.1-3.

Table 2.1-4. Parking Spaces Located Under the Alaskan Way Viaduct*

Location	On-Street Parking			Off-Street Parking	Other Parking	Total
	Short-Term	Long-Term	Subtotal			
Under the Viaduct on Alaskan Way	474	70	544	209	9	762

Source: FHWA 2004 * Referenced Data was collected in 2004, before Seattle's conversion to pay stations took place. Subsequently, small changes to space counts have taken place.

The majority of metered spaces cost $1.50 per hour and are limited to a 2-hour duration. On average, 68% of metered stalls were occupied on the weekday afternoon when the survey was conducted.

The Puget Sound Regional Council (PSRC) 2004 Parking Inventory Report provides a breakdown of average parking cost and utilization rates by zone for the Seattle Central Business District area that will generally be referred to as the Commercial Core in this document. Although the parking study sub-areas differ slightly from the

PSRC zones as described in the 2004 Inventory Study, the PSRC zonal data does provide a close approximation to the parking utilization rate and costs associated with each sub-area in the parking study area.

The north waterfront sub-area has an approximate utilization rate of 63.9% with an average daily parking cost of $9.95. The waterfront sub-area has an approximate parking utilization rate of 73.6% and a public parking daily rate of $15.11. The Pioneer Square sub-area has an estimated 79.5% parking utilization rate with a public daily parking cost of averaging $11.73.

2.1.6. Movement of Goods

Alaskan Way is a designated truck route and can be used by oversize and overlegal loads with permits. It plays an important role in the movement of goods for the region, providing access to the industrial district to the south and activities on the waterfront. At the southern end of the waterfront, truck access is primarily from the south by S. Royal Brougham Way and Alaskan Way, with trucks turning left from Alaskan Way into the Port of Seattle's container ship terminal (Terminal 46) near King Street.

At the northern end of the waterfront, the Elliott/Western couplet is of paramount importance to truck movement from the Ballard/Interbay/Northend Manufacturing and Industrial Center to the SR 99 corridor (City of Seattle 2003).

2.1.7. Transit

Transit service to the waterfront area is provided by the King County MetroTransit and Grayline Waterfront Trolley.

King County Metro Transit

King County Metro Transit provides bus service in the study area and operates the waterfront streetcar (currently replaced by Bus Route 99) on Alaskan Way. The majority of the buses are routed north-south along First Avenue. Trolley buses on First Avenue use S. Jackson Street as a turnaround.

Bus Route 16, connecting Seattle downtown with the Northgate Transit Center, provides the only east–west bus access to the waterfront. Within the Seattle downtown, the route is southbound on Fifth Avenue, west on Madison Street to Alaskan Way, south on Alaskan Way to Yesler Way, east on Yesler Way to Third Avenue, then northbound on Third Avenue. There is only one stop at the Washington State Ferry Terminal (Colman Dock) on the southbound leg along Alaskan Way between Madison Street and Yesler Way. Route 16 provides 15- to 20-minute service all day during the week and 30-minute service at night (City of Seattle 2003).

The former waterfront streetcar route is currently operated as Bus Route 99. The original waterfront streetcar trolley service was temporary suspended and replaced by Bus Route 99, because the streetcar's maintenance facility near Pier 70 was demolished for construction of the Olympic Sculpture Park. The streetcar trolley service is expected to resume service when a new site is found and the maintenance facility is rebuilt (King County 2007a).

Bus Route 99 operates on Alaskan Way between Pier 70 at Broad and Jackson streets, where the route extends eastward to a final stop on Eighth Avenue between Jackson and King Streets. It makes six waterfront stops on Alaskan Way at Clay, Wall, Bell, Pike, Spring, and Jackson Streets, as well as stops at Occidental Park in Pioneer Square and Jackson Street in the International District. The route operates on weekdays between 6:00 a.m. and 7:00 p.m. and weekends between 10:00 a.m. and 7:00 p.m., with 2-minute headways. While Bus Route 99 provides connections to activities along the waterfront, as well as links to Pioneer Square and the edge of the International District, it does not improve connections to the central core and primarily serves recreational uses and visitors.

Regional transit service is within walking distance of the waterfront, primarily along Second and Fourth avenues and in the Metro transit tunnel underneath Third Avenue. Access points to the transit tunnel closest to the waterfront are at the University Street stop and the Pioneer Square Station stop. Light rail service will begin operations in the transit tunnel in 2009, sharing the tunnel with bus service.

Gray Line Trolley

Gray Line operates a local circulator route with stops along the waterfront, Pioneer Square, the Seattle downtown retail core, Seattle Center, and the Pike Place Market. The route operated on a daily basis from May to October between the hours of 9:00 a.m. and 6:00 p.m. The primary users of the trolley were tourists staying in downtown hotels (City of Seattle 2003).

Transit Accessibility

Accessibility to the transit system is determined by the route network structure and the frequency of service. Regional and local transit service to the waterfront area is hindered by limited connections and limited frequency. The least accessible areas are located at the southern (south of S. Washington Street) and northern (north of Pike Street) ends of the waterfront, where transit access is constrained by the topography that limits pedestrian travel between the downtown core and Alaskan Way. Riders must transfer in the CBD or they must traverse steep east-west grades. Since the majority of downtown transit trips are commuter/work related, the relatively low employment density of the waterfront area also results in low transit demand (City of Seattle 2003).

2.1.8. Waterborne Transportation

Washington State Ferries

Ferry Services

Washington State Ferries provides ferry service between downtown Seattle and both Bainbridge Island and Bremerton. These communities would not otherwise have direct access to Seattle, as the only alternate routes are by highway through Tacoma, or by ferry to Edmonds.

Colman Dock, located on Piers 50 and 52 on Seattle's downtown waterfront, is the Seattle terminus for this service. Access to Colman Dock is provided from Alaskan Way at Yesler Way, and exits are provided to Alaskan Way at Yesler Way and Marion Street.

Vehicle and passenger ferries service routes between Seattle and both Bainbridge and Bremerton. Two Jumbo Mark II boats, each with a capacity of 202 vehicles, 60 commercial vehicles, and 2,500 passengers, operate on the Bainbridge Island service between 4:45 a.m. and 1:35 a.m. daily, with departures and arrivals averaging approximately every 50 minutes. Service to Bremerton is provided via a Super Class ferry, which has a capacity of 144 vehicles, 30 commercial vehicles, and 2,500 passengers, or a 140-vehicle Issaquah Class ferry, which has a capacity of 124 vehicles, 30 commercial vehicles, and 1,076 passengers. It operates on approximately 80-minute headway daily between 4:50 a.m. and 12:50 a.m. (Washington State 2007)

Passenger-only ferries at Pier 50 provide service between Seattle and Vashon Island. Service is provided by Skagit/Kalama passenger-only vessels, which have a capacity of 250 people. Only three ferry runs are provided on weekdays from Seattle at 7:35 a.m., 4:45 p.m., and 6:10 p.m. (Washington State 2007)

Vehicle Traffic and Terminal Operations

Vehicles enter Colman Dock from Alaskan Way northbound at Yesler Way, using a signalized left turn. Right turns into the terminal from southbound Alaskan Way are prohibited during peak periods except for registered carpools. Vehicles pass through a toll area that has four booths and capacity for 35 queued vehicles. They then proceed to holding lanes that can accommodate roughly 650 passenger vehicles. Queued vehicles are directed from there onto the ferries.

When vehicle arrivals exceed dock capacity, queuing occurs at the northbound Alaskan Way left-turn lane to the ferry dock, causing congestion for the remaining single lane of northbound through traffic. Current data shows that this does not occur often.

There are two vehicle exits from Colman Dock. The first is to Alaskan Way at Yesler Way. This exit is two lanes and forces all traffic to turn right to southbound Alaskan Way. Traffic destined for downtown or other locations to the north must turn around on Alaskan Way, or more commonly, circle back into town on S. Royal Brougham Way to Fourth Avenue. The second exit is located at the signalized intersection of Alaskan Way and Marion Street, which allows vehicles to travel north or south on Alaskan Way, as well as east on Marion Street.

During PM peak hour on a typical traffic day, 360 vehicles exit Colman Dock (145 at Yesler Way and 215 at Marion Street) and 540 vehicles arrive at Colman Dock. The analysis assumes that there is one Bremerton and two Bainbridge route arrivals/departures, with the eastbound ferries at approximately 60% capacity and the westbound ferries at about 90% capacity. This estimate is based on existing PM peak hour demand at Colman Dock for the 30th busiest day of the year, which corresponds to a 92nd percentile weekday and is of a magnitude that is consistent with traffic counts taken in the vicinity of Colman Dock. Because the volumes represent a typical traffic day, there are days throughout the year during which even higher volumes occur.

Currently, unloading (eastbound) traffic cues a signal preempt that allocates up to 180 seconds for traffic exiting Colman Dock at either Marion Street or Yesler Way. Once the preempt phase is completed, the north-south movements are allocated their normal split timings. The combined splits result in very long and uncoordinated signal cycle lengths. The preempt will continue to trigger subsequent allocations of up to 180 seconds for exiting ferry traffic until the vessel is empty (typically three preempt cycles). While vessels are unloading, approximately 70 to 75% of the green time is allocated to traffic exiting Colman Dock.

Following an unloading event, the signals will attempt to reactivate coordination with neighboring signals and eventually return to normal operation. The patterns of regular unloading with such a long preempt often leads to essentially uncoordinated traffic operations on Alaskan Way during peak hours. The adverse effect on Alaskan Way traffic flow from cycling in and out of signal preemption cannot be fully accounted for in the traffic operations modeling, so LOS and delay at these locations may be understated.

Access to and from Colman Dock

Passenger Connections to the Seattle CBD

The majority of foot passengers arriving at or departing from Colman Dock use the larger vehicle ferries. Loading and unloading is at the upper level of Colman Dock, from which a direct walkway is provided that crosses above Alaskan Way and below the Viaduct, connecting to the sidewalk on the south side of Marion Street at First Avenue. Passengers can also enter and exit at Alaskan Way, where they can catch a bus, or cross Alaskan Way to take a taxi or ride the Waterfront Streetcar, which has a station at Madison Street. Signalized crosswalks crossing Alaskan Way are located at Marion Street, Columbia Street, and Yesler Way. Conflicting traffic volumes are heavy on Alaskan Way while ferries are unloading, as traffic exits at Marion Street (to northbound and southbound Alaskan Way, as well as eastbound on Marion) and Yesler Way (to southbound Marion Street only). Additionally, pedestrians using the Marion Street pedestrian overpass can face conflicts from turning vehicles as they rejoin the street-level sidewalk system at the intersection of First Avenue and Marion Street. While the intersection is signalized, exiting ferry traffic that wishes to turn right onto southbound First Avenue will face conflicting pedestrians in the crosswalk.

Automobile Access and Egress

Intersection analysis on Alaskan Way surface street at Yesler Way and Marion Street indicates that Yesler Way, where all westbound (departing) traffic arrives at Colman Dock, operates at an average PM peak hour LOS C today. With regard to specific movements, traffic entering Colman Dock (left turn at Yesler Way) is estimated to operate at LOS D conditions (Table 2.1-5). Traffic exiting Colman Dock, which is limited to turning right onto Alaskan Way, operates at LOS B. While northbound traffic on Alaskan Way operates at LOS B, southbound traffic is more congested, operating at LOS D.

The majority of eastbound traffic exits Colman Dock at Marion Street, which overall operates at an average LOS C today. However, the eastbound movement exiting Colman Dock (in other words, ferry traffic leaving Colman Dock) operates at an estimated LOS D (Table 2.1-5). Southbound and northbound traffic on Alaskan Way operate under good LOS (A and B) during the PM peak hour. Note, however, that both the Marion Street and Yesler Way intersections experience increased congestion while ferry vessels unload, with decreased congestion at other times. The data presented here are the average for the entire PM peak hour.

Table 2.1-5. Existing (2002) PM Peak Hour Average Vehicle Delay (seconds) and LOS by Movement at Colman Dock

	While Ferries Unload		Between Ferry Unloading		Average PM Peak Hour Conditions	
Traffic Movement	**Delay (sec)**	**LOS**	**Delay (sec)**	**LOS**	**Delay (sec)**	**LOS**
Marion Street	48	D	18	B	29	C
Eastbound(exiting Colman Dock)	42	D	N/A		42	D
Northbound Alaskan Way	13	B	1	A	6	A
Southbound Alaskan Way	21	C	7	A	12	B

Traffic Movement	While Ferries Unload		Between Ferry Unloading		Average PM Peak Hour Conditions	
	Delay (sec)	LOS	Delay (sec)	LOS	Delay (sec)	LOS
Yesler Way	22	C	27	C	26	C
Eastbound (exiting Colman Dock)	15	B	N/A		15	B
Northbound left (entering Colman Dock)	39	D	19	A	22	D
Northbound through Alaskan Way	13	B	7	A	8	B
Southbound Alaskan Way	45	D	29	C	31	D

sec = seconds; N/A = not applicable

Source: Parsons Brinckerhoff 2006

Other Waterborne Transportation Services

Water Taxi

The King County Ferry District operates the Elliott Bay water taxi from spring to fall. During this time, daily service is provided from Pier 55 at the foot of Spring Street to Seacrest Dock in West Seattle via boats contracted through Argosy Cruises. King County plans to purchase its own energy efficient boats and provide year-round service by 2010 (King County Metro Transit, 2008).

Victoria Clipper

The Victoria Clipper, docking at Pier 69, provides daily hydrofoil service between Seattle and Victoria, B.C. In addition, the Clipper provides transport from Pier 69 to the San Juan Islands.

Cruise Ship Operations

The Port of Seattle operates a cruise ship terminal at Pier 66/Bell Harbor. Between May and October of 2001, there were 56 cruise ship arrivals and departures. Eleven of these arrivals and departures were ports-of-call where the vessel typically arrives in the morning and passengers disembark for the day and return for an evening departure. Seattle docked 190 cruise ship vessels with about 781,000 passengers over the 2007 ship season (Port of Seattle 2008).

On the north edge of Pier 55, Argosy Cruises operates a local cruise service offering tours of the harbor and other destination points on Puget Sound.

2.1.9. Non-motorized Transportation

The Seattle waterfront is both a destination and a travel corridor for pedestrians and bicyclists. The Alaskan Way Viaduct (SR 99) crosses over pedestrian and bicycle access routes to the City and waterfront area as well as affecting the pedestrian environment in general. The study area includes several noteworthy pedestrian generators, including the following:

- Major employment centers,
- Major tourist attractions,
- Green space/recreational areas, and
- Colman Dock ferry terminal.

Additionally, the City of Seattle has identified several bicycle pathways within the study area of the project. These routes include both local and regional pathways. The following provides a summary of existing pedestrian and bicycle conditions for the study area.

Pedestrians

The proximity of the Seattle waterfront to the downtown commercial core, Belltown, Pioneer Square, and numerous other destinations makes walking the mode of choice for many. Major points of access for pedestrians include the Colman Dock ferry terminal for commuters and tourists, east-west streets linking the waterfront to the working population of the commercial core, and the Pike Street Hillclimb connecting the Pike Place Market with the waterfront at the Seattle Aquarium, which is heavily used by tourists (City of Seattle 2003).

The grid pattern of downtown Seattle makes for very walkable urban streets and is partitioned into blocks well scaled for pedestrians. However, steep topography interrupts the continuity of east-west streets to the waterfront. Extensions of the street grid to the waterfront are limited, with only four vehicular/pedestrian streets connecting in Belltown (Broad, Clay, Vine, and Wall streets); three in the commercial core (Spring, Madison, and Marion streets); five in the Pioneer Square area (Yesler Way, S. Washington, Main, Jackson, and King streets); and two in the southern area (Royal Brougham Way and Atlantic Street) (City of Seattle 2003).

Pedestrian stairways and overpasses have been very important in facilitating pedestrian access the waterfront, with existing connections at Bell and Lenora streets, the Pike Street Hillclimb, Union Street, University Street (Harbor Steps), and Seneca Street. The Bell Street pedestrian bridge provides a waterfront connection over Alaskan Way and the BNSF railroad tracks. Nearby, the Lenora Street pedestrian bridge provides a connection from Elliott Avenue to Alaskan Way over the BNSF tracks. The commuter bridge on Marion Street also provides a pedestrian overpass above Western Avenue and Alaskan Way to link First Avenue with the Colman Dock ferry terminal (City of Seattle 2003).

Table 2.1-6 presents PM peak hour pedestrian volumes at select intersections along the waterfront. Note that the data collected in Table 2.1-6 consists of data collected in winter 2002 during weekday PM peak hour as well as data collected in August 2006 during the weekday PM peak hour. Pedestrian activity on the waterfront promenade may be substantially higher on weekends and during the summer.

Table 2.1-6. Existing (2002) PM Peak Hour Pedestrian Counts

Street	Cross-Street	North Leg	South Leg	East Leg	West Leg	Control
Alaskan Way	Pike Street	**657	40	**206	**857	Signalized
Alaskan Way	Pine Street	110	55	5	*	Unsignalized
Alaskan Way	Spring Street	59	72	46	300	Unsignalized
Alaskan Way	Madison Street	**135	**86	**169	**848	Signalized
Alaskan Way	Marion Street	5	120	95	180	Signalized
Alaskan Way	Marion Street Pedestrian Bridge		**870 (entire bridge)			Grade-separated
Alaskan Way	Columbia Street	25	50	135	45	Signalized
Alaskan Way	S. Jackson Street	45	100	20	10	Signalized
Alaskan Way	S. Main Street	40	15	65	90	Signalized
Second Avenue	Marion Street	**208	570	**258	**415	Signalized
Alaskan Way	Clay Street	10	10	10	100	Signalized
Alaskan Way	Wall Street	40	40	40	115	Signalized
Alaskan Way	Bell Street	25	--	35	**305	Unsignalized
Alaskan Way	Bell Street Pedestrian Bridge		**199(entire bridge)			Grade-separated
Elliott Avenue	Vine Street	30	25	15	325	Unsignalized
Elliott Avenue	Battery Street	25	15	35	360	Unsignalized
Elliott Avenue	Blanchard Street	10	5	50	125	Unsignalized
Western Avenue	Bell Street	5	80	100	55	Unsignalized
Western Avenue	Lenora Street	60	65	195	130	Signalized

* Leg not counted **City of Seattle 2006 summer Data

Source: FHWA 2004, City of Seattle 2006 (Memo from Alex Atchison and Steve Rolle to Kathryn Stenberg (12/8/06), "Draft Alaskan Way Pedestrian Volumes")

As seen in Table 2.1-6, the entrance to the Colman Dock ferry terminal located at the intersection of Alaskan Way and Marion Street generates a relatively high volume of pedestrians. Significant volumes at the intersection of Marion Street and Second Avenue can be attributed in large part to the connection to the Marion Street over-crossing to the Colman Dock ferry terminal located at that intersection.

In the north waterfront area (Clay, Vine, Wall, Bell, Battery, Blanchard, and Lenora streets), the large number of visitors to the waterfront is augmented by activity related to the cruise ship industry. Overall, the Port of Seattle saw 781,000 cruise ship passengers arrive at the waterfront in 2007 (Port of Seattle 2008). Bell Street Pier (Pier 66) includes a cruise ship terminal as well as the Bell Harbor International Conference Center, which hosts various conferences and other activities. Also, a significant number of residential units have been developed in recent years on the east side of Alaskan Way, generating additional pedestrian traffic on the waterfront.

The north waterfront area includes two major pedestrian facilities providing connections to the waterfront, the Bell Street and the Lenora Street footbridges. Table 2.1-6 provides existing pedestrian counts for various intersections within the north waterfront area during the PM peak hour. Note that the volume shown for the north leg of the intersection of Alaskan Way and Bell Street are those on the pedestrian bridge that crosses over Alaskan Way.

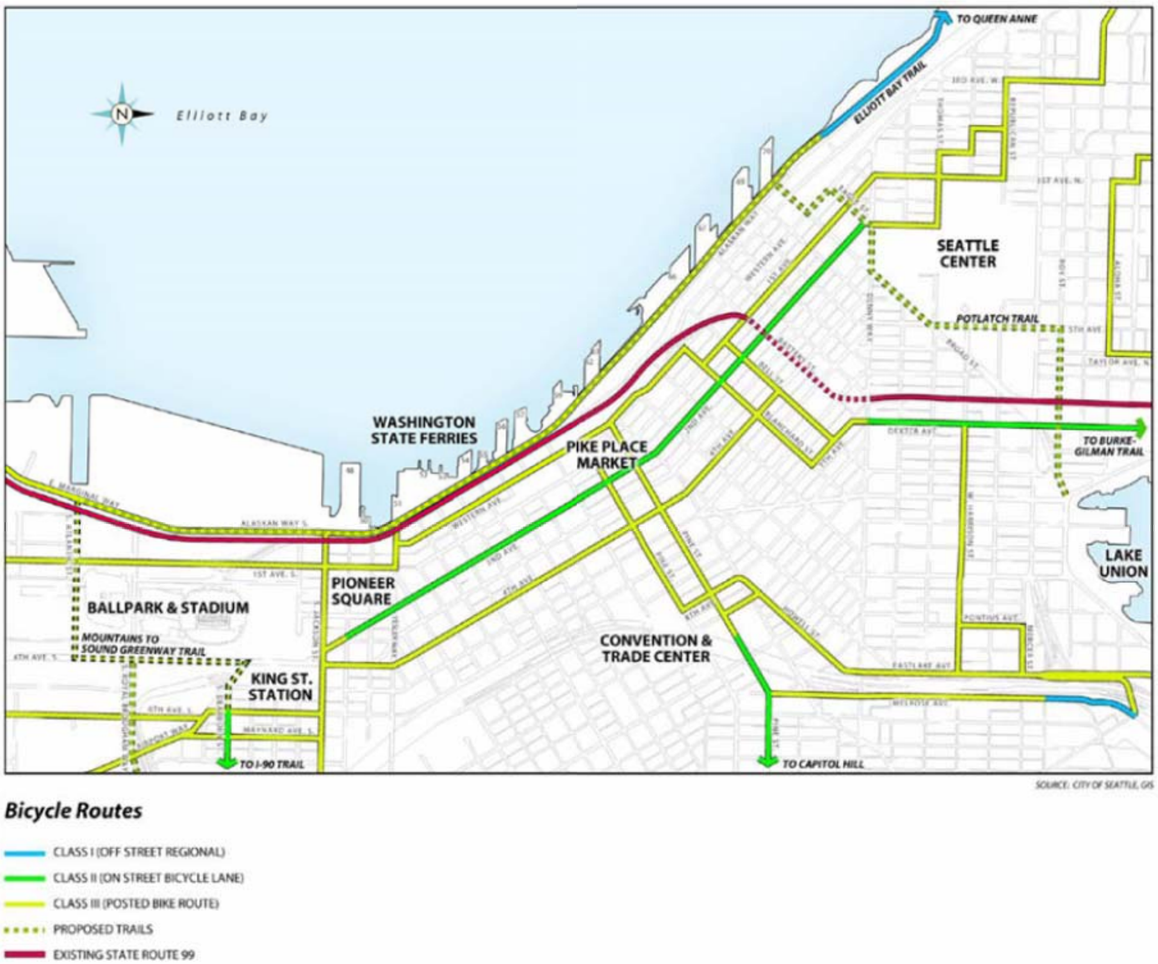
Bicycles

Cycling is a growing mode of travel for commuting as well as recreational trips, both within the study area and throughout the region. Figure 2.1-4 identifies the existing hierarchy of bicycle routes within the study area.

Alaskan Way is part of the bicycle circulation network for the region and is commonly used by bicyclists. Alaskan Way is an important arterial for cyclists because it provides a flat connection between the Elliott Bay Trail to the north and streets connecting to Pioneer Square, the International District, and points beyond to the south or West Seattle. Currently, Alaskan Way is a Class III Bicycle Route and incorporates a 10-foot exclusive bicycle/pedestrian route adjacent to the Viaduct. It is a posted bicycle route, but like the bicycle routes in most of the downtown Seattle, no space has been reserved for this purpose exclusively. Rather, bicyclists share space with joggers and pedestrians, which can pose conflicts. In addition, access to the waterfront on the northern end of the harbor and across the rail tracks can be difficult especially in the busy summer tourist months and the bicycle commuting season (City of Seattle 2003).

To the north, at Myrtle Edwards Park, the Elliott Bay Trail begins—a Class I (off-street) route for bicyclists that extends 1.5 miles along the shoreline with an 8- to 10-foot-wide asphalt path. The Elliott Bay Trail provides a connection across Interbay to Magnolia (City of Seattle 2003).

Existing bicycle counts were collected during the PM peak hour for several corridors. In the waterfront area, the Alaskan Way Viaduct Corridor (including waterfront route users) at Bell Street observed approximately 50 bicyclists per hour. Additionally, in the stadium region, the First Avenue corridor at S. Main Street counted approximately 15 bicyclists per hour. Finally, in the Belltown area, along Elliott Avenue at approximately Vine Street, five bicyclists per hour were observed.



Sources: City of Seattle (2003); Jones & Stokes (2006)

Figure 2.1-4
Bicycle Routes for Transportation Impact Analysis

Bicycling along the waterfront is complicated by narrow traffic lanes, railroad tracks at intersections to the CBD, irregular pavement under the Viaduct, rail spurs in the Alaskan Way roadway, steep grades up to the Downtown core, vehicular congestion—especially related to queuing at the Ferry Terminal, substantial pedestrian traffic, and limited connections to other parts of downtown (City of Seattle 2003).

2.1.10. Railroad Operation

The railroad running on the east side of Alaskan Way is the BNSF mainline that serves both the West coast and traffic to Chicago and points east. The tracks also serve the grain terminal near Interbay. Both Sound Transit and Amtrak use the tracks for passenger service. Trains regularly block traffic along surface streets south of the project area such as Spokane Street, which can result in vehicles detouring to Alaskan Way. In addition, east-west traffic near Pier 67 is blocked multiple times per day by rail traffic.

Commuter Rail

Sound Transit's commuter rail line, Sounder, travels between Tacoma, Everett, and the King Street Station in downtown Seattle and serves the communities of Puyallup, Sumner, Auburn, Kent, Tukwila, and Edmonds. The King Street Station interfaces with several other forms of transportation, including the waterfront streetcar (currently served by Bus Route 99) and Metro transit tunnel (currently closed for construction of light rail). The Weller Street pedestrian bridge provides a direct connection between Sounder service and the Metro transit tunnel.

Amtrak

Amtrak uses the BNSF tracks for passenger service north to Canada, south to California, and east via Stevens Pass. This route is part of a federally designated high-speed corridor.

2.2. Land Use and Shorelines

2.2.1. Overview

This section contains information on the land uses, development activities and trends, zoning designations, development regulations, plans and policies, and planned developments in the vicinity of the Alaskan Way Seawall structure. The land use and shoreline study area is situated within or immediately adjacent to the Alaskan Way right-of-way between S. Washington Street on the south and Broad Street on the north.

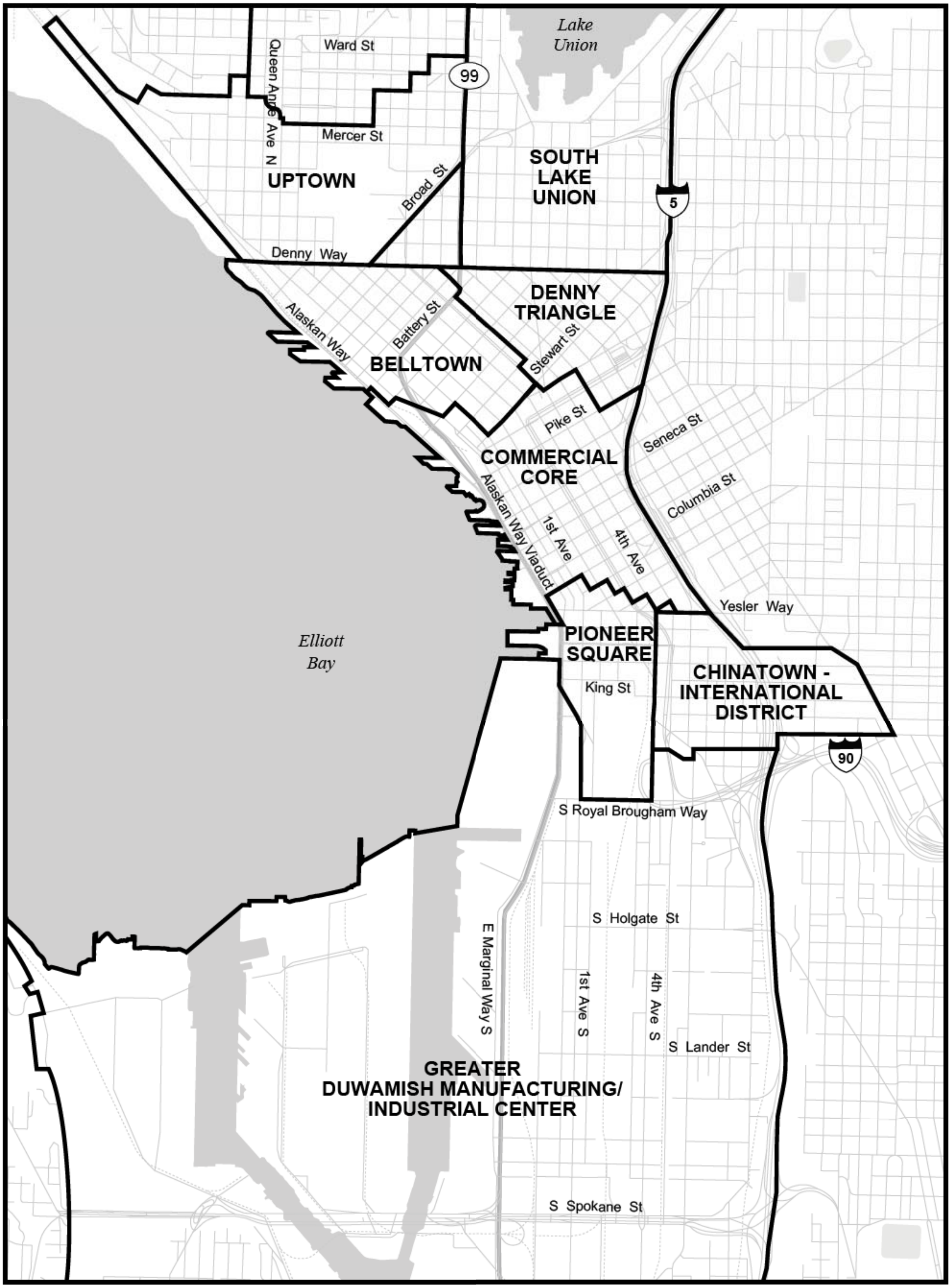
2.2.2. Methodology

Existing conditions were identified through use of existing written resources; no field surveys or assessments were undertaken. Data for this report was obtained primarily from discipline reports and technical memoranda completed for the Alaskan Way Viaduct and Seawall Replacement Project (AWVSRP) Draft Environmental Impact Statement (DEIS) (FHWA 2004), and Supplemental DEIS (SDEIS) (FHWA 2006). Additional data on residential and nonresidential land use in the study area was obtained through searches of King County GIS Based Parcel Data Property Reports in March 2008.

2.2.3. Land Uses

The Alaskan Way Seawall study area includes the entire width of the Alaskan Way right-of-way, typically extending landward 100 to 180 feet from the face of the Seawall, and any uses abutting the right-of-way, including the piers that extend waterward from the Seawall. The study area contains a variety of land use zones and types between S. Washington Street on the south and Broad Street on the north. Land use types include commercial, retail, governmental, and residential uses. Figure 2.2-1 provides a map of the Seattle neighborhood planning areas. Figures 2.2-2 and 2.2-3 show generalized maps of existing land uses in and around the study area.

Following is a discussion of the specific land uses immediately adjacent to either side of the Alaskan Way right-of-way.



Sources: SR99 AWVSRP DEIS (2004, 2006); Jones & Stokes (2006)

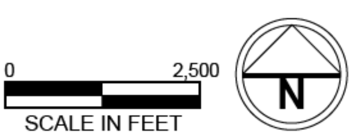
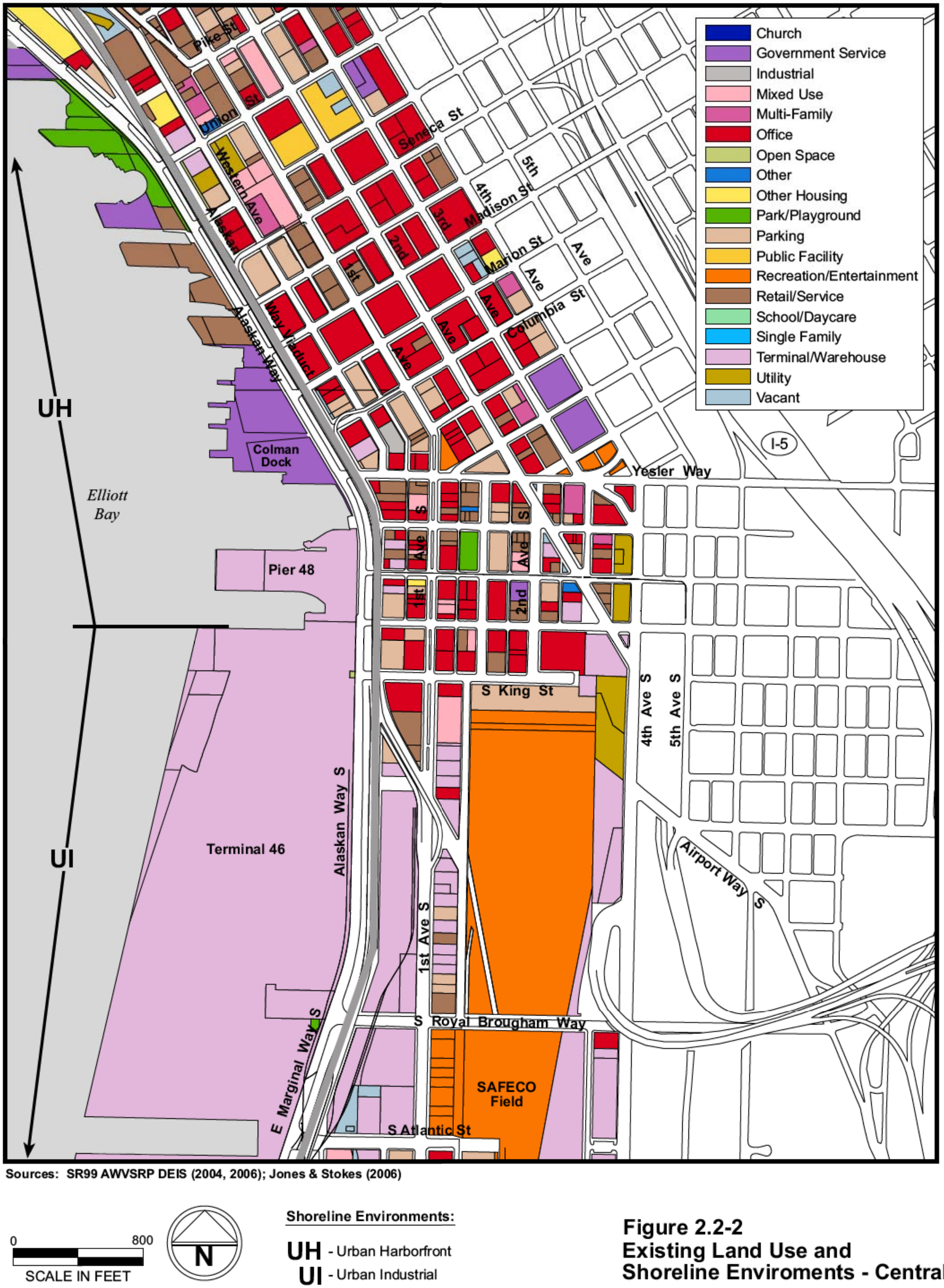
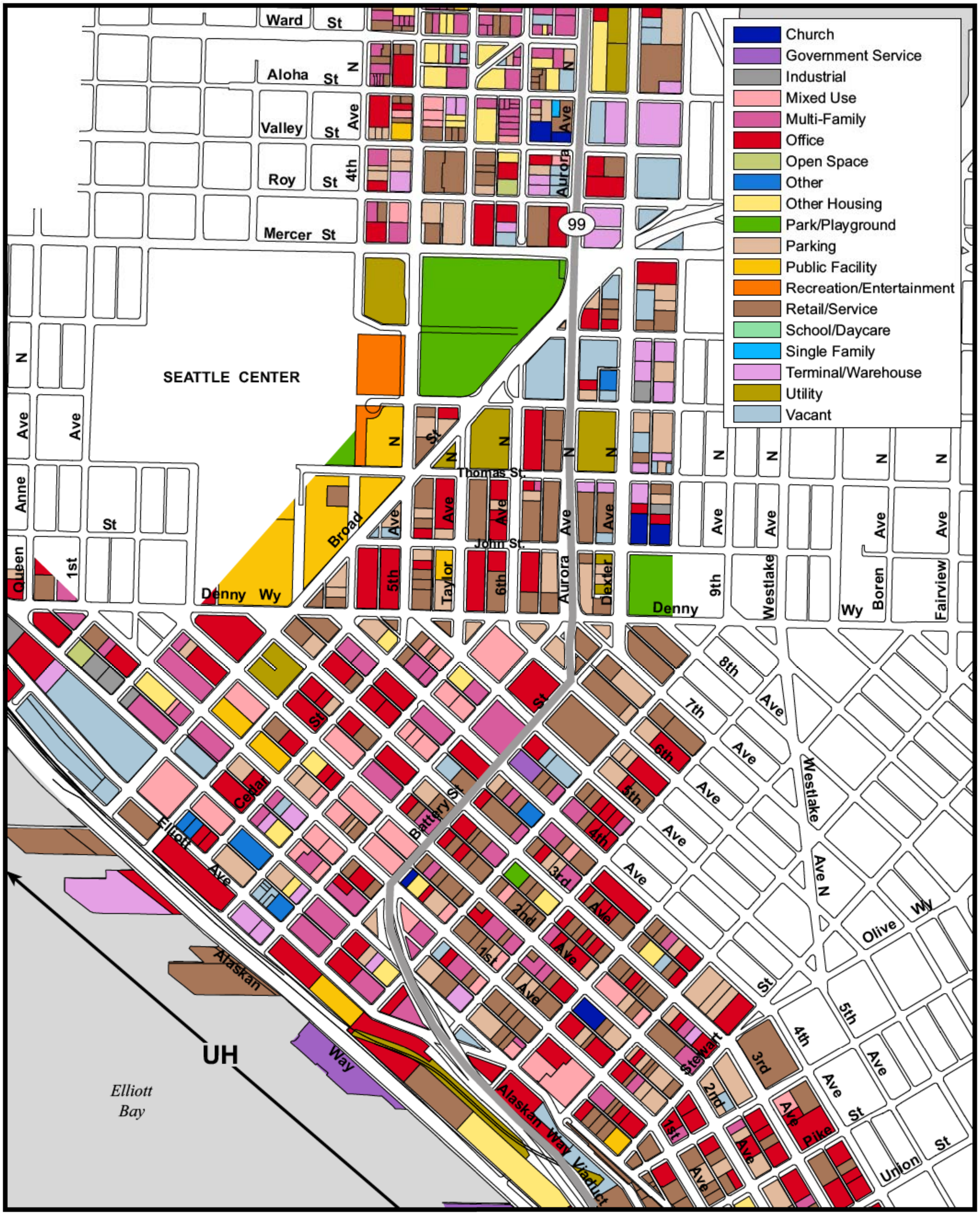


Figure 2.2-1
Land Use Study Area
Neighborhood Planning Areas



Sources: SR99 AWVSRP DEIS (2004, 2006); Jones & Stokes (2006)

Figure 2.2-2
Existing Land Use and Shoreline Enviroments - Central



Sources: SR99 AWVSRP DEIS (2004, 2006); Jones & Stokes (2006)

0 800 SCALE IN FEET

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Shoreline Environments:

UH - Urban Harborfront

Figure 2.2-3
Existing Land Use and Shoreline Enviroments - North

South Washington Street to Pike Street

Port of Seattle Terminal 46 and Pier 48 abut the southern end of the study area on the west and the Alaskan Way Viaduct structure to the east. The tracks for the Waterfront Streetcar, which is currently not in service, are located along the east side of the Alaskan Way. The Alaskan Way Viaduct runs along the east side of the Alaskan Way surface street between S. Washington and Pike Streets. Parking is the primary land use under the Viaduct. Businesses between S. Washington and Pike streets west of the Seawall include the Washington State Ferries Colman Dock at Piers 50 and 52, Fire Station No. 5 at Pier 53, Ivar's Seafood restaurant and the Ye Olde Curiosity Shop at Pier 54, the Red Robin restaurant at Pier 55, Argosy Cruises and Elliott's Restaurant at Pier 56, the Bay Pavilion shops at Pier 57, and the Seattle Aquarium at Pier 59. The range of businesses located on the waterfront piers includes restaurants, gift shops, sightseeing companies and professional offices.

Pike Street to Broad Street

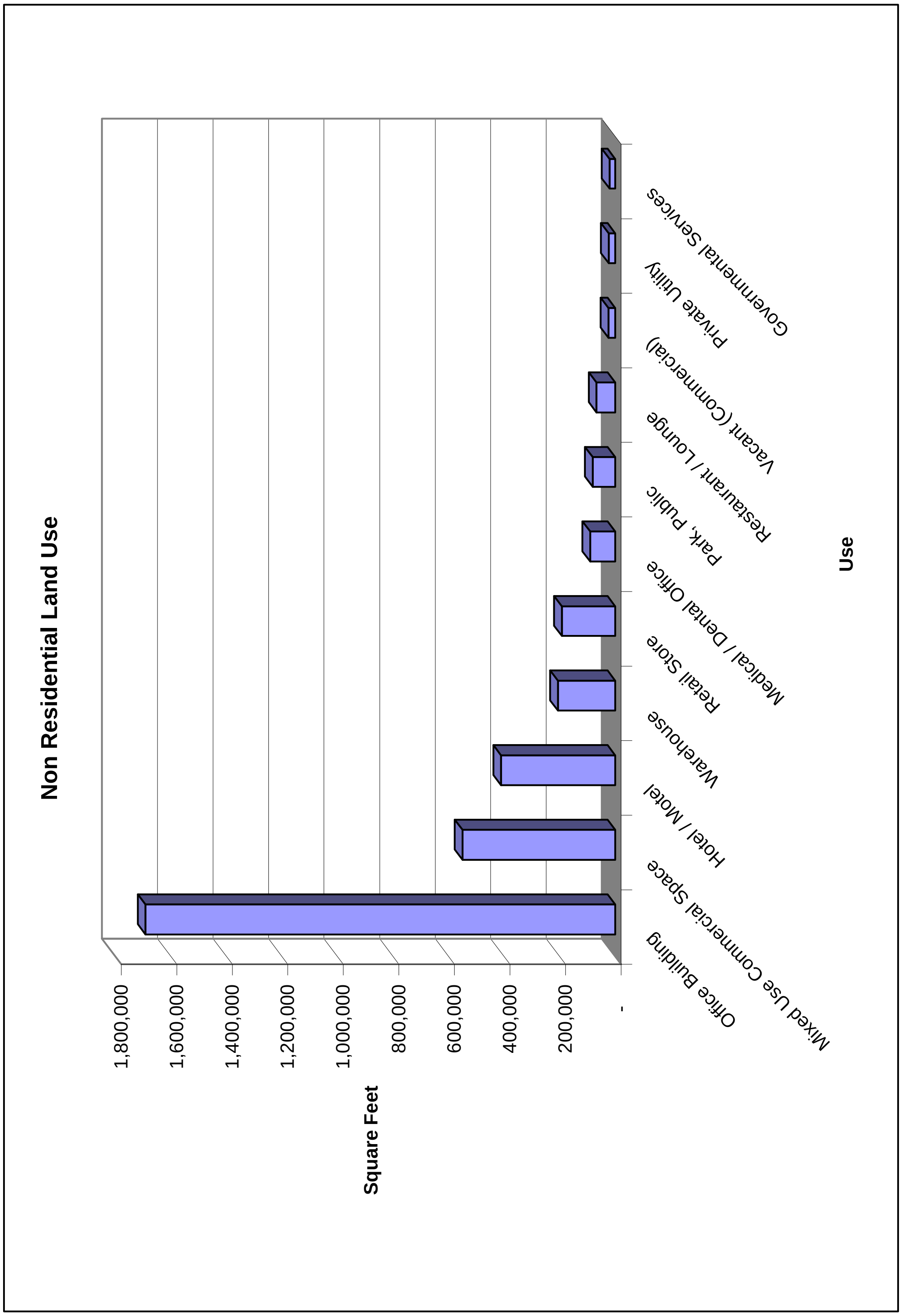
Land uses along the north waterfront area between Pike and Broad Streets consist of a mix of retail, residential, and office uses. Along the east side of the Alaskan Way right-of-way, adjacent buildings include the Waterfront Landings Condominiums, Marriot Hotel, Microsoft, World Trade Center, a storage facility, Art Institute of Seattle, Real Networks, and the Spaghetti Factory.

Buildings housing a range of uses are located on piers along the west side of Alaskan Way, including Anthony's Pier 66 restaurant, Bell Street Cruise Ship Terminal and Conference Center, and Odyssey Maritime Discovery Center at Pier 66; Edgewater Inn at Pier 67; and Port of Seattle Headquarters and Victoria Clipper Terminal at Pier 69. Pier 70 is a privately owned pier, housing a variety of office uses and a restaurant.

Residential/Nonresidential Mix

A search of King County GIS Based Parcel Data Property Reports in March 2008 for all parcels in the area bounded by Elliott Bay to the West, Elliot Avenue/Western Avenue to the East, Broad Street to the North, and South Washington Street to the South identified a total of 3.8 million usable square feet in buildings. This space is made up of 3.361 million square feet of non residential space (89%) and 429,000 square feet of residential space (11%).

All residential development in this zone was in the form of condominiums, distributed across five buildings and totaling 372 units with an average size of 1,154 square feet per unit. Non residential use by subcategory as reported in the King County property reports is presented in Figure 2.2-4.



Source: King County GIS Parcel Reports (2008)

Figure 2.2-4. Non-Residential Land Use Categories

2.2.4. Development Activity and Trends

Development along the Seattle waterfront has changed significantly during the past decade. The focus has broadened from primarily employment-related uses to becoming a major center for tourism and recreation, retail shopping, meeting and convention activities, and entertainment. Increasingly, the area is providing space for new businesses, in particular to those developed to high technology uses.

New development in the vicinity of the Alaskan Way Seawall is likely to occur concurrently with Seawall replacement construction activities. Under consideration are potential changes to Terminal 46 at the southern edge of the Seawall, along with the various proposals to replace the SR-99 Viaduct, and reconstruction and expansion of the Colman Dock Ferry Terminal. In addition, plans to expand the Seattle Aquarium are underway. The staff-preferred plans in the Final EIS for the Central Waterfront Master Parks Plan call for rebuilding Piers 62/63 and demolition of Waterfront Park and Pier 60 to make room for the larger Aquarium. However, finalization of the Master Parks Plan will likely be postponed until decisions are reached with regard to the viaduct and seawall. Figure 2.2-5 shows permitted development by the City of Seattle in and adjacent to the study area (bounded by Elliott Bay to the West, Elliott Avenue/Western Avenue to the East, Broad Street to the North, and South Washington Street to the South).

Planned Development Within Study Area

Map Key	Address	Type	Status	New Area	Description
118	2501 Elliot Avenue	Commercial	Permit Issued	32400 sq ft	Permitted to change use from 32,400 mini-warehouse/warehouse to Institution (Mars Hill College)
91	1528 Alaskan Way	Residential	Permit Issued	2 Units	3,984 sq. ft. 3rd and 4th floor residential addition to an existing 2 story adminstrative office building for two dwelling units. Include surface parking for 10 vehicles.

Planned Development Adjacent to Study Area

Map Key	Address	Type	Status	New Area	Description
115	2334 Elliot Avenue	Residential	Reviews Completed	120 Units	Construction of 9-Story Mixed Occupancy Structure with Underground Parking (120 Units)
173	55 Bell Street	Residential	Information Converted	19 Units	Construction of a 9 story building (retail/apartment/administrative office)
185	1426 Western Avenue	Residential	Information Converted	64 Units	Construction of a six-story building containing retail space, low income dwelling units, and community center.
61	810 Western Avenue	Commercial	Application Accepted	145,393 sq ft	12 Story, 131,832 sq ft. administrative office structure with 13,561 sq. ft. of retail on ground and 2nd floors. Includes below grade parking.

Source: City of Seattle (2007)

Figure 2.2-5. Planned Development (2007)

2.2.5. Seattle Municipal Code

The Seattle Land Use Code (Seattle Municipal Code [SMC] Title 23) provides zoning and development regulations for the City. These regulations set forth procedures for the use of land within the City. In addition to general use requirements, these provisions include specified height and size restrictions, as well as setback, parking, landscaping, and view requirements. The Land Use Code also includes special overlay and review districts that identify other development requirements in addition to those noted for individual zones.

Following are some specific sections of the SMC that pertain to the replacement of the Seawall or development along Alaskan Way:

- Shoreline Master Program (SMC Chapter 23.60) provides for the protection of shoreline ecosystems; encourages water-dependent uses; allows maximum public enjoyment of City shorelines; and preserves, enhances and increases views of the water and access to the water.
- State Environmental Policy Act (SMC Chapter 25.09) ensures compliance with state environmental regulations and procedures.
- Stormwater, Grading and Drainage Control Code (SMC Chapter 22.80) manages the quality and quantity of stormwater to protect property, the environment, public interests and surface and receiving waters.
- Design Review (SMC Chapter 23.41) ensures that new development enhances the character of the City and fits well into existing neighborhoods, as well as to provide flexibility in meeting development standards while promoting communication between the City and developers throughout the construction process.

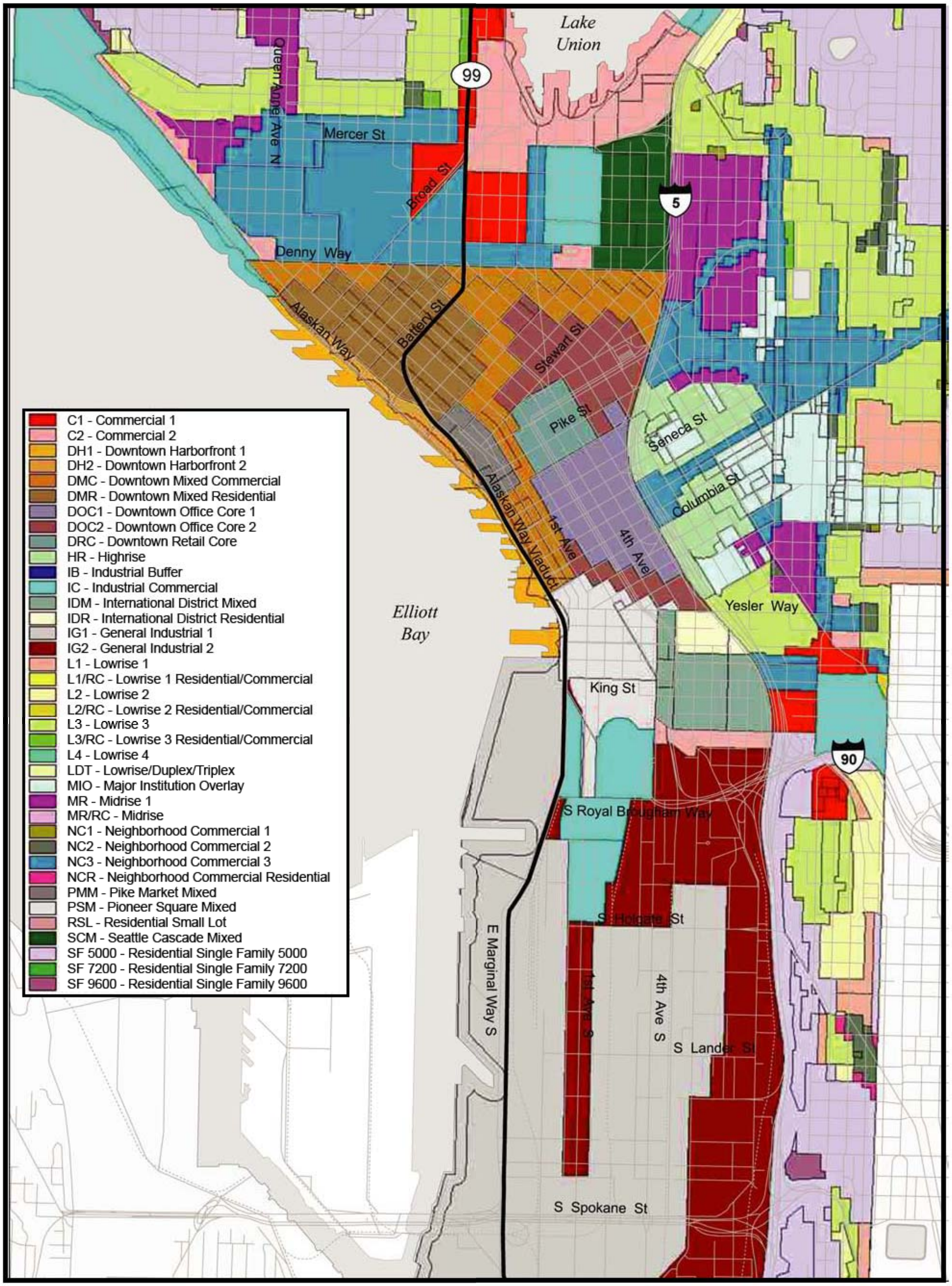
Zoning

Zoning along Alaskan Way consists of a number of urban zones, including industrial, commercial and mixed use. A zoning map is provided in Figure 2.2-6. Generally, these zones allow a variety of potential uses at different intensities along the project corridor. The zoning code specifies allowable uses, standards for parking and building size, shape and location within each zone. Existing development along Alaskan Way is generally consistent with height and density regulations in these zoning classifications.

The following zones, as described in the Seattle Land Use Code (SMC Title 23) are located along the Alaskan Way right-of-way starting from the south and moving north:

- Pioneer Square Mixed: Provides for less intensive uses than surrounding zoning in keeping with the historic designation of the Pioneer Square District.
- Downtown Harborfront 1: Applies to Urban Harborfront Shoreline Environment designation to waterfront lots and adjacent harborfront area within the boundaries of downtown.
- Downtown Mixed Commercial: Provides for commercial development characterized by lower-scale, retail, and commercial uses related to activity in the office and retail cores, mixed with housing and associated residential services.
- Pike Market Mixed: Provides for less intensive uses than surrounding zoning in keeping with the Pike Market Historic District designation.
- Downtown Harborfront 2: Provides for commercial activities in support of shoreline goals and related office, commercial, and residential uses, where the intended scale of development is moderate and an orientation toward the water exists, to provide a transition in scale and character between the waterfront and downtown.
- Downtown Mixed Residential/Residential: Provides a mixed community where housing and associated services and amenities predominate, with the intent that office, retail, and other commercial uses are compatibly integrated with the predominant residential characters at low to moderate densities.

In addition to land use zones, the City also has special districts, environmentally critical areas, and shoreline designations that apply to land along Alaskan Way. These are described in more detail in the following sections.



Sources: SR99 AWVSRP DEIS (2004, 2006); Jones & Stokes (2006)

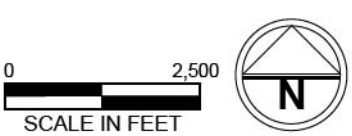


Figure 2.2-6
Project Area Zoning Map

Environmentally Critical Areas

The City of Seattle environmentally critical areas (ECAs) ordinance (SMC Chapter 25.09) regulates development affecting landslide-prone areas, steep slopes, potential seismic liquefaction zones, abandoned landfills, flood-prone areas, wetlands, riparian corridors, shoreline habitat and other fish and wildlife habitat conservation areas, and ECA buffers.

The shoreline area along Alaskan Way has been mapped as a potential seismic liquefaction zone (much of the shoreline is underlain by old fill material that is potentially unstable during earthquakes). Critical area maps also identify several steep slopes scattered near the waterfront. Steep slopes may be subject to slide conditions if overburdened by extensive development. See Section 2.14.5 Geological Hazards for additional information.

SMC Section 25.09.060 provides general development standards that apply to all development containing environmentally critical areas or their buffers. These standards include requirements for minimizing clearing and grading, implementing Best Management Practices for development within these critical areas, and requiring additional engineering studies, third party review of geotechnical reports, bonding, and insurance. Additional development standards specific to landslide-prone critical areas are provided in SMC 25.09.080, development standards specific to liquefaction-prone areas are provided in SMC 25.09.100, and standards specific to steep slope areas are provided in SMC 25.09.180.

Development in an ECA requires preparation of a surveyed site plan and submittal of additional information relating to critical areas and their buffers as part of the application and review process.

Much of the Seawall is located within a liquefaction zone. The general development standards for ECA set out in SMC 25.09.060 do not apply to liquefaction-prone areas. Instead specific standards for liquefaction-prone areas are contained in SMC 25.09.10 that allow the city to require soils engineering studies to determine the physical properties of the surficial soils, especially the thickness of unconsolidated deposits and their liquefaction potential, as set out in the 2003 International Building Code. The City may also impose mitigation measures (for building within these zones) pursuant to the Building Code.

In some cases the director of the Seattle Department of Planning and Development may allow exemptions or modifications to the ECA regulations. If an ECA exemption is granted the development is relieved of all the provisions of the ECA chapter, except for those standards specified in the exemption section of the code. As mentioned above, these standards include limits on development, conditions on development and the use of best management practices. Examples of types of development that may be exempted include the following:

- Work directly related to ending a condition that 1) is an immediate threat to the public health, safety, and welfare or creates an immediate risk of damage to public or private property and 2) requires remedial or preventive action in a timeframe to allow compliance with the applicable provisions of the critical areas regulations.
- Maintenance, repair, renovation, or structural alteration of an existing structure that does not increase the impact to or encroach further within, or further alter an environmentally critical area or buffer.
- Rebuilding or replacing structures that are destroyed by an act of nature

Early consultation with the City is encouraged to determine if the proposal to replace the Seawall is likely to be exempt from the ECA regulations. In all likelihood because the project is not a repair but a total replacement it will be determined not to be exempt. Consultation with City staff on the proposed design of the replacement project and type of construction techniques will determine which development standards apply and which may be modified.

Overlay Districts

Shoreline District

The Seattle Shoreline Master Program (SMC Chapter 23.60) defines shoreline environments. In these areas, special development standards must be met in addition to standard zoning requirements in the Seattle Land Use Code (SMC Title 23). The additional requirements establish the types of land uses permitted within the shoreline areas. The shoreline along the entire length of the Seawall is designated as Urban Harborfront.

The purpose of the Urban Harborfront shoreline environment is to encourage economically viable, water-dependent uses to meet the needs of waterborne commerce, facilitate the revitalization of downtown Seattle’s waterfront, provide opportunities for public access and recreational enjoyment of the shoreline, preserve and enhance elements of historic and cultural significance, and preserve views of Elliott Bay and the land forms beyond.

Special Review Districts

Pioneer Square Preservation District

Alaskan Way runs through the Pioneer Square Preservation District from S. Washington Street to Columbia Street, where specific development policies apply. The Pioneer Square Preservation District was established as both a national and local preservation district in 1970. Pioneer Square is protected by Ordinance 112134; design guidelines focus on preserving its unique historic and architectural character; assuring the sensitive rehabilitation of buildings; promoting development of residential uses for all income levels; and enhancing the district's economic climate for residents, employers, workers, and visitors.

2.2.6. Plans and Policies

Several State laws and local plans and policies may apply to the project at a general level. These plans and policies are identified below.

State Regulations

Growth Management Act

The Washington State Growth Management Act (GMA) of 1990 (Revised Code of Washington [RCW] 36.70A) requires State and local governments to manage statewide growth by identifying urban growth areas and preparing comprehensive plans, capital improvement programs, and development regulations. The GMA requires that the infrastructure, such as transportation projects be identified and constructed to keep pace with development.

While local governments have broad discretion in developing their comprehensive plans and development regulations, that discretion is guided by the goals and requirements of the GMA. The GMA, adopted in 1990, requires and guides the preparation and amendment of comprehensive plans in the state’s fastest-growing counties and the cities within them. The City is planning in accordance with the GMA and the city’s adopted Comprehensive Plan complies with the GMA requirements.

Projects designed and implemented consistent with local development regulations will be consistent with GMA.

Aquatic Lands Act

The Washington State Aquatic Lands Act of 1984 (RCW 79.105) provides for the protection and management of state-owned aquatic lands. These aquatic lands include tidelands, shorelines of navigable rivers and lakes, beds of marine and fresh waters, lands in harbor areas and waterways, and some filled aquatic lands. This law indicates that these harbor areas are to be reserved for “landings, wharves, streets, and other conveniences of navigation and commerce.” The Washington State Department of Natural Resources (DNR) acts as a land manager who has the authority to lease or grant easements on aquatic land to tenants on behalf of the owners: the current and future citizens of the state. Public benefits to be considered in determining the use of aquatic lands include economic development, environmental protection, public use and renewable resources.

However, the Seawall is not on DNR-managed land. Therefore, if the Seawall is replaced in its current location or farther landward, it will not directly impact DNR-managed land, and no DNR authorization will be required. The Seawall is in closest proximity to DNR-managed land at its north end, near Pier 70. Farther south along the Seawall, the DNR-managed lands are located farther waterward. The DNR has expressed interest in collaborating to work toward alternatives that satisfy DNR and Corps interests (D. Kiehle, DNR, Personal Communication).

Coastal Zone Management Program

Under the requirements of the federal Coastal Zone Management Act of 1972 (Public Law 92-583, 16 United States Code [USC] 1451-1456), activities of federal agencies that affect coastal zone land uses, water uses, or natural resources must be consistent with the state's Coastal Zone Management Program. The Washington State Coastal Zone Management (CZM) Program includes the Shoreline Management Act, State Environmental Policy Act, Water Pollution Control Act, Clean Air Act, Ocean Resources Management Act, and Energy Facility Site Evaluation Council Act. The Washington State Department of Ecology reviews projects under this act and ensures that a project complies with state environmental requirements and permits through the laws in the CZM Program. King County is one of 15 counties in the state's coastal zone.

Local Plans and Polices

Puget Sound Regional Council VISION 2040 and Destination 2030

VISION 2040 presents the central Puget Sound region's growth management, economic, and transportation strategy. Within this overall plan, Destination 2030, currently in the update process, represents the Metropolitan Transportation Plan for the region. The 2008 update to VISION 2040 contains policies and guidelines for implementation of local comprehensive plans and development regulations within central Puget Sound, including King, Kitsap, Pierce, and Snohomish counties. The plan identifies long-range growth and transportation strategies to fulfill the vision of economically diverse and environmentally healthy communities. By integrating land use and transportation planning, the plan provides a framework for allowing regional growth while maintaining open space, resource lands, and an efficient transportation system with travel mode options.

Destination 2030 policies are intended to improve regional mobility and access and address the region's long-range transportation needs arising from regional growth. It defines five major objectives:

- Support maintenance and preservation of existing transportation infrastructure and services as a high priority;
- Provide stronger links between the transportation system and land use development to encourage growth within defined urban growth areas (UGAs) with balanced investments in multimodal transportation improvements;

- Identify and prioritize projects, programs, and policies to improve all modes of transportation and keep up with growth;
- Improve the region's financial capacity to fund needed improvements; and
- Tailor recommendations at the sub-regional and corridor levels, in recognition of the region's social, physical, and cultural diversity.

Destination 2030 identifies regionally important components of the area's Metropolitan Transportation System and includes a complete list of projects and transportation system improvements.

King County Comprehensive Plan and Countywide Planning Policies

The King County Comprehensive Plan (created in 1995) establishes a growth management strategy for King County over a 20-year period, in compliance with the planning goals of GMA. The policies address broad areas such as urban and rural land use, economic development, housing, transportation, the natural environment, and open space. The King County Comprehensive Plan establishes boundaries for the UGA that direct growth and development away from rural areas and areas where services are not available, thereby containing urban sprawl and protecting open space while making the most efficient use of transportation and utilities.

County-wide planning policies provide guidance for coordination between cities and the County in comprehensive planning efforts. These policies are intended to assist local jurisdictions in ensuring that each jurisdiction's own comprehensive plan is consistent with the King County Comprehensive Plan, as required by GMA. Goals and objectives of the Seattle Comprehensive Plan have been coordinated with King County's Plan to ensure consistency under GMA (Seattle 2007).

Seattle 2007–2012 Capital Improvement Program

The Capital Improvement Program (CIP) is used to fund rehabilitation, restoration, improvements, and additions to the City's capital facilities, such as libraries, street repairs, parks and recreation facilities, neighborhood projects, community centers, and utilities. The CIP is part of the annual City budget adoption and is prepared by the Seattle Department of Finance to cover a 6-year planning period. The Seawall replacement is included in the CIP as a component of the Seattle Department of Transportation's capital programs Alaskan Way Viaduct & Seawall Replacement Project.

Seattle Parks and Recreation 2006 Development Plan

The Seattle Parks and Recreation Development Plan (Seattle City Council Resolution 30181) is specific to acquisition and development efforts that will be pursued over the next 5 to 6 years. This Plan provides a recap of goals and policies relative to park acquisition and development, an update of the Gap Analysis that indicates areas of the city where the City's distribution guidelines for parks and open space remain to be met, and Seattle's adopted 2006–2011 CIP for parks and recreation. Seattle's adopted 2006–2011 CIP for the Department of Parks and Recreation is part of the citywide CIP (Ordinance 121991).

Seattle Comprehensive Plan: *Toward a Sustainable Seattle* (2007)

The Seattle Comprehensive Plan (2007) includes goals and policies to guide growth and development over a 20-year period. In 2004, the City adopted a series of amendments to meet the GMA requirement for a 10-year review of the Plan. This update included extending the horizon year of the Plan from 2014 to 2024 and adopted new growth targets based on revised population forecasts provided by the State. The current Comprehensive Plan contains all amendments adopted by the Seattle City Council through December 2007 (Ordinance 122610), including selected goals and policies of 38 neighborhood plans. Consistent with GMA requirements, the City's Comprehensive Plan contains the following elements (Seattle 2007):

- Urban Village Element,
- Land Use Element,
- Transportation Element,
- Housing Element,
- Capital Facilities Element,
- Utilities Element,
- Economic Development Element,
- Neighborhood Planning Element,
- Human Development Element,
- Cultural Resource Element, and
- Environment Element.

The City's Comprehensive Plan includes an urban village strategy. This strategy includes land use, transportation, and housing goals that, in combination, are intended to provide for affordable housing and facility improvements for higher-density neighborhoods.

The Comprehensive Plan includes specific policies related to individual neighborhoods. The neighborhood plans described below are located within the study area.

Seattle Neighborhood Plans

Plans have been prepared for 38 Seattle neighborhoods. Key policies from each plan are incorporated into the overall Seattle Comprehensive Plan to provide specific direction and strategies that guide development activities within individual neighborhoods. Figure 2.2-1 shows the location of each neighborhood in relation to the Seattle waterfront area and the Alaskan Way right-of-way. The following sections describe the neighborhood plans for three specific neighborhoods in the study area.

Pioneer Square Neighborhood Plan (1998)

The Pioneer Square neighborhood lies within the study area between S. Washington and Columbia Streets. The current Pioneer Square Neighborhood Plan was adopted in 1998.

Key objectives associated with the waterfront in the current Pioneer Square Neighborhood Plan include the following:

- Connect Pioneer Square with the waterfront by creating destinations that attract people to Waterfront south.
- Weave the east–west Pioneer Square streets to the waterfront by strengthening the pedestrian connections under the SR 99 Viaduct. Use connections at street level to minimize the barrier effect.
- Revive the S. Washington Street Boat Landing and restore it to its position as the centerpiece of the South Waterfront. This historic pier is the key relic that connects Pioneer Square and Seattle to its waterfront history.
- Redesign waterfront parks to allow better access to the water, provide facilities for recreation, and provide places to experience the unique port activity. This is a productive urban waterfront that public space design should celebrate.

Commercial Core Neighborhood Plan (1999)

The Alaskan Way right-of-way runs through Seattle’s Commercial Core from Columbia Street north to Bell Street. The Commercial Core Neighborhood Plan, adopted in 1999, contains goals and policies for the Commercial Core, the City’s largest and most developed downtown neighborhood. The Commercial Core encompasses Seattle’s downtown retail core, financial center/office core, City, County and federal government offices, the central waterfront area, and the Pike Place Market Historic District. The Commercial Core Plan presents the area’s goals and policies for implementing the overall Seattle Comprehensive Plan goal to concentrate future growth in urban centers throughout the city. The two goals of the Commercial Core are listed below:

1. Create a major center for employment, tourism and conventions, shopping, and residential neighborhoods resulting in a regional hub of cultural and entertainment activities; and
2. Promote a unique neighborhood identify for the Commercial Core.

Examples of policies included in the plan are as follows:

- Strive to maintain the neighborhood's historic, cultural and visual resources;
- Guide development and capital projects throughout the entire downtown area through development of a unified urban design strategy that provides a vision for new public facilities, waterfront connections, pedestrian environments, transit linkages, and open spaces;
- Strive to take advantage of opportunities to develop new public open space and encourage development of a system of connected green spaces and open areas;
- Use Green Streets and open space as a means to improve urban design character and provide amenities that support growth; and
- Seek to improve the pedestrian qualities of streets and public spaces.

Belltown Neighborhood Plan

The northernmost portion of the project area runs through the Belltown (Denny Regrade) neighborhood. Belltown is the northern neighborhood of downtown Seattle bounded by Denny Way to the north, Elliott Bay to the west, Sixth Avenue to the east, and Virginia Street to the south (historically, the southern border was Stewart Street). Belltown is an eclectic and diverse neighborhood. It is Seattle's densest residential community and is an arts center, shopping and dining destination, and home to a wide variety of businesses. This diversity shapes the neighborhood's unique social and cultural fabric. It is also reflected in the built environment through its architecture, public art, and other street amenities.

A key objective in the current Belltown Neighborhood Plan is described below:

- Green Street & Open Space Connection Strategy: combines a series of actions that will provide parks and open space opportunities for Belltown residents without a significant expenditure of public funds for land acquisition. The strategy seeks to improve Green Streets within the community and to improve and enhance connections to Open Spaces both inside and outside the neighborhood, most notably the Waterfront and the Seattle Center.

Harborfront Public Improvement Plan (1987)

The 1987 Harborfront Public Improvement Plan was intended as a guide to achieving the City's 1985 Downtown Land Use and Transportation Plan's vision and framework policy to reunite the waterfront with the rest of downtown, strengthen its maritime character, and enhance public access. The plan proposed strategies for the revitalization of the downtown waterfront area along Alaskan Way between Pier 48 and Myrtle Edwards Park north of Pier 70, along the narrow corridor between Elliott Bay and properties east of Alaskan Way.

Seattle's Central Waterfront Concept Plan

In June 2006, *Mayor's Recommendations: Seattle's Central Waterfront Concept Plan* was issued. The Concept Plan was initiated in 2003 to recognize the opportunity created by the removal of the Alaskan Way Viaduct. This Concept Plan provides an overview of the history of planning along the waterfront, existing conditions, and conceptual plans and policies for the waterfront area roughly encompassing the corridor between the Elliott Bay shoreline and First Avenue, extending from Myrtle Edwards Park on the north to S. Atlantic Street on the south. The Concept Plan includes preliminary recommendations for new parks and open spaces, shoreline and habitat improvements, improved linkages to the downtown, transit connections, land use changes, and regulatory changes (City of Seattle 2006). The Mayor has submitted the Concept Plan to the City Council for review and approval.

2.3. Public Services and Utilities

2.3.1 Overview

This section provides information on public services and utilities in the study area. In general, public services and utilities are considered to be within the study area and construction impact area if they are along or adjacent to the Alaskan Way right-of-way between S. Washington Street to the south and Broad Street to the north. Public services and facilities include police, fire suppression, emergency medical response, public schools, disaster preparedness, and solid waste collection. The primary public service providers in the study area include the Seattle Police Department (SPD), Seattle Fire Department (SFD), Seattle Public Utilities (SPU) Solid Waste Division, Seattle Emergency Management, Washington State Department of Transportation (WSDOT), Washington State Ferries, and the Port of Seattle.

A number of utilities within the study area (including municipal agencies and private companies) provide electricity, water, wastewater and stormwater collection, natural gas, steam, oil/petroleum, and telecommunications services. The primary public utility providers in the study area include Seattle Public Utilities for the water, sanitary sewer, and stormwater systems and Seattle City Light for electrical power. Private utilities include Puget Sound Energy (PSE), Seattle Steam, Qwest, Comcast, British Petroleum (doing business as Olympic Pipeline), Waste Management, and other private communications companies.

2.3.2 Methodology

Existing public services and utilities were identified by examining existing written resources; no field surveys or assessments were completed for this chapter. Data focusing on the Alaskan Way right-of-way and Seawall was obtained primarily from discipline reports and technical memoranda completed for the Alaskan Way Viaduct and Seawall Replacement Project (AWVSRP) Draft Environmental Impact Statement (DEIS) (FHWA 2004), Supplemental DEIS (SDEIS) (FHWA 2006), and information provided in the Corps of Engineers Feasibility Alaskan Way Seawall Without Project Conditions Report.

2.3.3 Public Services

Public services and facilities include fire suppression and emergency medical services, law enforcement services, disaster preparedness, and solid waste and recycling. Section 2.8 of this report discusses other community services.

Fire Suppression and Emergency Medical Services

Fire Suppression

The SFD provides fire suppression and emergency medical services to a metropolitan urban population of over 560,000 people within a land area of approximately 83.9 square miles and approximately 193 miles of waterfront (U.S. Census Bureau 2000 in FHWA 2004). The SFD employs more than 1,100 uniformed and non-uniformed personal at 34 fire stations and other facilities located throughout the City. Its equipment includes 33 fire engines, 11 ladder trucks, four aid units (basic life support), seven medic units (advanced life support), two air trucks, two fireboats, two hose wagons, and one foam trailer. Miscellaneous special equipment is also used by the following specializations: command and control unit, marine unit, hazardous materials unit, multiple casualty incident unit (MCI Van), urban search and rescue (USAR Tractor/Trailer), metropolitan medical strike team (MMST Tractor/Trailer), weapons of mass destruction Decon Trailer, and technical rescue unit (high angle, confined space, trench and dive rescue) (SFD 2006).

At least six SFD stations are available for first response to fire and medical emergencies within the Alaskan Way Seawall study area. The City of Seattle (City) fire alarm center is located at Fire Station No. 2 at the corner of Fourth Avenue and Battery Street in Belltown. Emergency fire and medical units are generally dispatched from the station nearest the call site, although units can be dispatched from other stations as well. The SFD’s average response times in 2005 (from the time units were dispatched following a 911 call to their arrival at the site) are as follows: 4.23 minutes for fire and hazardous materials responses, 3.65 minutes for basic life support responses (fire and aid cars), and 3.72 minutes for advanced life support (Medic One) (SFD 2005).

The only SFD Fire Station located within the Seawall study area is Station No. 5. Fire Station No. 5 is located along the Seawall at 925 Alaskan Way, and currently houses one marine company that operates the fireboat (Engine No. 4) and one land-based company that operates Engine No. 5 and acts as marine backup. Current response constraints for Engine No. 5 are primarily linked to ferry and/or other normal special event traffic delays on Alaskan Way (FHWA 2004).

Emergency Medical Services

In addition to the emergency medical units provided by the SFD, several hospitals provide emergency medical services to the study area. These hospitals include Harborview Medical Center (325 Ninth Avenue), Swedish Medical Center (747 Broadway), Group Health Cooperative (201 16th Avenue E.), Virginia Mason Medical Center (925 Seneca Street), and Swedish Medical Center at Providence (500 17th Avenue).

Law Enforcement Services

Seattle Police Department

SPD provides law enforcement and responds to 911 emergency calls in and throughout Seattle. SPD has officers and civilian personnel in five main bureaus: Patrol Operations I and II, Criminal Investigations, Emergency Preparedness, and Field Support (SPD 2005). The SPD protects public safety in many ways, ranging from officers patrolling beats to the deployment of special teams and task forces. Task forces focus on a variety of issues, including auto theft, drug dealing and violence, and crimes against children.

SPD is divided into five precincts, which include South Precinct (3001 S. Myrtle Street), Southwest Precinct (2300 SW Webster Street), East Precinct (1519 12th Avenue), West Precinct (810 Virginia Avenue), and North Precinct (10049 College Way N.). Additionally, the Seattle Police Headquarters shares the Seattle Justice Center at 610 Fifth Avenue with the Seattle Municipal Court. The Alaskan Way Seawall is located entirely within the West Precinct.

In 2005, SPD dispatched patrol units in response to nearly 251,000 calls. The closest Neighborhood Service Center is located at 202 Yesler Way; the center is operated by the City's Department of Neighborhoods and provides information on City services, including crime prevention and block watch.

Crime Data

The City maintains statistics related to crime in its jurisdiction. Crimes are typically divided into Part I and Part II. In general, Part I crimes (also known as index crimes) include felony crimes such as homicide, rape, robbery, aggravated assault, burglary, theft, auto theft and arson. Part II crimes are considered less serious and include all other crimes, such as simple assault, vandalism, forgery, prostitution, weapons offenses, drug and liquor violations, disorderly conduct, loitering, and other offenses.

In 2005, SPD reported 47,602 index crimes citywide, representing a 2.1% increase from 2004. Overall, Seattle crime rates had been declining since the early 1990s. Property crime saw a slight increase of 1.5%; however, both residential and commercial burglaries saw significant reductions of 12.7 and 12.6%, respectively. In 2005, the West Precinct reported 11,683 index crimes (SPD 2005).

Port of Seattle Police

The Port of Seattle Police patrol major portions of the Seattle waterfront and Elliott Bay. The Port Police provide law enforcement response and patrol services for several commercial properties located at Port-owned piers and terminals in the study area. Port Police address law enforcement issues associated with the expanding cruise ship industry (on Port property such as Pier 66) including drug smuggling, theft aboard ship during transit, and travelers with outstanding arrest warrants. Special teams include Bike Team, Boat and Dive teams, Bomb Disposal Unit, Crisis Negotiations Team, Criminal Investigations Unit, K-9 Team, and Special Response Team (FHWA 2004).

Burlington Northern Santa Fe Railway Police Solutions Team

The Burlington Northern Santa Fe Railway (BNSF) Police Solutions Team coordinates with other law enforcement agencies to investigate crimes committed on railroad property. Typical crimes involve cargo from containers being offloaded from ships, loaded onto rail cars or trucks, or in transit. Vandalism typically includes shooting at railroad signals or throwing rocks at railcars. Tagging (writing graffiti on railcars) is prevalent. Trespassing is another serious problem and one that often results in injury from people crossing BNSF tracks (Stairs 2003 cited in FHWA 2004).

Disaster Preparedness

Because of the detailed nature of some of the emergency response plans, they are no longer publicly available due to homeland security issues (Serrill 2003 cited in FHWA 2004) and are discussed only generally in this section. In the event of an emergency or a major disaster, these plans are the primary controlling documents. The focus of the emergency response and maintenance plan includes establishing designated meeting areas, managing disaster equipment and materials, conducting initial property damage assessments, coordinating electric utility shutoffs, implementing an emergency response organization plan, and managing recovery and resumption of business (Port of Seattle 2003 cited in FHWA 2004).

Seattle Emergency Management

Seattle Emergency Management (SEM) is an emergency preparedness bureau of the SPD devoted to citywide disaster preparedness, response, recovery, and mitigation. The unit is generally staffed by nine people whose principal responsibilities involve encouraging individual and community preparedness and providing a key liaison function between the City and its state and federal emergency management counterparts. The primary functions of SEM include 1) maintaining the City's command center, 2) developing disaster plans, 3) educating the public, 4) protecting and repairing City infrastructure, 5) coordinating mitigation projects and managing recovery processes, 6) managing outside assistance, and 7) planning and running emergency exercises and training (FHWA 2004).

Washington State Ferries

Washington State Ferries has an Operations Center located at Colman Dock, adjacent to the Alaskan Way Seawall. The Operations Center originated during the 1995 to 1997 biennium and consists of approximately 50 employees, including a watch supervisor, dispatchers, and customer information agents. The center operates 24 hours per day, 365 days per year with its primary role that of response in times of crisis, such as bomb threats, severe regional weather, emergency vehicle transport coordination, and vessel/terminal accidents. The center also serves an administrative function by coordinating, monitoring, and gathering performance data for Washington State Ferries in 26 different areas including cancelled trips, nonscheduled trips, nonrevenue trips, employee injuries, customer injuries, and sick leave (Washington State Ferries 1999 Annual Report cited in FHWA 2004).

Port of Seattle

The Port of Seattle maintains an emergency response plan for all of its facilities, including marine and seaport facilities within the study area. In the Central Harbor area, these facilities include Pier 69, which accommodates the Port of Seattle headquarters and the terminal for the Victoria Clipper; and piers 64, 65, and 66, home to a cruise ship terminal, conference center, and marina, respectively.

Solid Waste Collection, Disposal, and Recycling

The Seattle Solid Waste Utility, a division of SPU, currently contracts with two private firms, Waste Management of Seattle and Northwest Waste Industries, to collect commercial and residential solid waste generated in Seattle. Residential waste is delivered to one of two City-owned facilities operated by the Solid Waste Division. These facilities consist of the North Transfer Station immediately north of Lake Union, and the South Transfer Station, located near the South Park area (City of Seattle Comprehensive Plan 2001 in FHWA 2004). Commercial garbage generated in the city, as well as construction, demolition, and land clearing waste are delivered to two private transfer stations in the city: Waste Management's Eastmont Station (located in the South Park area near the City's South Recycling and Disposal Station) and the Rabanco-owned station (at Third Avenue S. and S. Lander Street). Contaminated soils are handled by Rabanco and Waste Management. Waste Management sends its soils to a separate facility, the Alaska Street Recycling Station. Municipal solid waste and construction-demolition waste are transferred by truck and rail from the transfer stations to the Argo Intermodal Facility in south Seattle, where they are transported by rail to landfills. Eastmont sends its municipal waste to the Columbia Ridge Landfill in Arlington, Oregon, while Rabanco sends its municipal waste to the Columbia Ridge and Roosevelt landfills on the Columbia River in Washington (Jiries 2003; Zimmerman 2003 cited in FHWA 2004).

Capacity of Waste Processing Facilities

The Eastmont and Rabanco transfer stations have a current capacity to process 300,000 to 400,000 tons of waste per year, including waste from Seattle's businesses. In 1999, the two stations processed 225,000 tons of garbage from the City (Seattle Comprehensive Plan 2001 in FHWA 2004). This capacity has significantly increased in the past 4 years. Eastmont alone handled approximately 650,000 tons, or 2,500 tons a day in 2002 to 2003, with 30% of the waste coming from construction sites (Bridges 2003 cited in FHWA 2004). Waste Management's Alaska Street facility handled 220,000 tons of waste in 2002 (Borghese 2003 cited in FHWA 2004).

The AWVSRP DEIS stated that the local transfer and recycling stations and the regional landfills indicated that their facilities have sufficient capacity to handle increases in the amount of solid waste expected from growth in Seattle, potential demolition of the Alaskan Way Viaduct, and replacement of the Seawall (FHWA 2004). In addition, the rail transfer capacity between the transfer stations and the landfills has been doubled in recent years and is also expected to have sufficient capacity to manage both area growth and project waste (Borghese 2003 cited in FHWA 2004).

Recycling

Two private material recovery facilities serve as the processing and transfer facilities for most of the recyclable materials collected from City residents. Recycle Seattle is located south of downtown on South Lander Street, and Recycle America is located in the South Park area (Seattle Comprehensive Plan 2001 in FHWA 2004). In 2000, two contracts for garbage and recycling were awarded to two companies; U.S. Disposal is responsible for the south half of the city, while Waste Management Inc. is responsible for the north half of the city. According to the City of Seattle, the two-contractor system fosters competition and reduced the number of contracts out for waste collection. Residents separate glass, paper, and all other recyclables and receive pickup service every other week. In 2007, these facilities processed around 87,000 tons of recyclable materials from curbside and apartment pickups (Seattle 2007).

2.3.4 Utilities

A number of public and private utilities in the study area provide electricity, water, wastewater, stormwater collection, natural gas, petroleum, steam, and communications and telecommunications services. Major providers in the study area are described below.

Typically, water lines and high-pressure gas mains are located 3 to 6 feet underground. Main line sewer pipes are typically located at least 6 feet below ground level, but depth of cover may vary depending on site constraints. Sewer lateral pipes are typically installed with less cover than main line sewers. Smaller pipes such as fiber-optic cables, telephone lines, and other utilities are often less than 3 feet below ground level. Water, sewer, and storm drain pipelines typically run parallel beneath streets, placed in locations ranging from the center of the roadway to the periphery. Fiber-optic cables, telephone lines, underground electrical conduits, and smaller pipes are often located beneath sidewalks (FHWA 2004).

Electrical Power

Information on electrical power in the study area was obtained from Seattle's 2004 Draft EIS for replacement of the Viaduct and Seawall (FHWA 2004). Seattle City Light (City Light), which supplies electric power to customers in Seattle and some portions of King County north and south of the city limits, provides electrical power to the study area. City Light owns and maintains 3,100 circuit miles of distribution lines within Seattle that deliver power from the principal distribution stations to over 350,000 customers.

Electrical power is disbursed from substations via primary voltage feeder lines to numerous smaller distribution substations and overhead and underground transformers, which reduce voltage to required levels for customers. The utility currently has capacity to generate an annual average output of approximately 1,900 megawatts (MW) of hydroelectric generation. In the study area, the City Light system uses a combination of overhead and underground electrical transmission and distribution lines. City Light has a combination of transmission and distribution lines running along and under the viaduct structure.

Substations near the study area include the Massachusetts Substation at Colorado Avenue and Massachusetts Street, and the Broad Substation at Sixth Avenue and Broad Street. The only substation within the study area is the Union Substation at Western Avenue and Union Street.

Overhead and underground distribution lines are also located along many streets in the study area. Although the system is designed and operated to minimize the likelihood of a problem in one area cascading into other areas, the system must still be approached as an integrated whole; impacts on one area could lead to impacts on other areas. City Light has increased its system security and provision for continued reliability to minimize potential impacts of both criminal acts and natural disaster. For more information on security measures taken by City Light, refer to the Draft Seattle All-Hazard Mitigation Plan, October 2003 (City of Seattle 2004).

Water Supply

SPU provides potable water to more than 1.3 million King County customers through two surface water sources. The Cedar River provides approximately 70% of SPU service area's annual average consumption, and the South Fork Tolt River provides approximately 30% (SPU 2002 cited in FHWA 2004). SPU inspects, repairs, operates, and maintains the water system. This provider also installs water services, hydrants, or other appurtenances on any charged water system (FHWA 2004 and Seattle 2006).

Within the study area, a 21-inch water main in Alaskan Way supplies water service from Bay Street to Yesler Way, which then becomes a 12-inch line extending to S. Washington Street. The water main provides flow to fire hydrants and service connections at pier facilities, condominiums, and businesses adjacent to the east and west sides of Alaskan Way. The water main connects to downtown Seattle's looped water supply system at Madison Street, Union Street, Yesler Way, and S. Washington Street. The Seawall is located in Pressure Zone 326.

Sanitary Sewer and Storm Drainage

The storm, sanitary, and combined sewer system within the study area varies by function and jurisdiction (i.e., King County and the City). Seattle has a combined sewer area with a variety of standard and nonstandard-sized pipes, regulator structures, low-flow diversions, weirs, outfalls, and combined sewer overflow points. While it does not own facilities within the project study limits, the King County Department of Natural Resources Wastewater Treatment Division (formerly Metro) provides sewage treatment services for the study area. King County bills SPU for services provided (King County Wastewater Treatment Division 2002 cited in FHWA 2004).

SPU inspects, repairs, operates, and maintains wastewater (sewer) pipes in the study area to protect public health and avoid property and environmental damage from sanitary sewer backups and combined sewer system overflows and backups. Wastewater in the study area is conveyed to the West Point Treatment Plant, which processes an average of 133 million gallons per day (King County 2006) and a maximum of 440 million gallons per day during peak storms. The pipelines and other conveyance facilities within the study area are owned, operated, and maintained by SPU. The King County Wastewater Treatment Division maintains the regional wastewater conveyance system (e.g., the Elliott Bay Interceptor). Individual side sewer lines are owned privately according to the property they serve (FHWA 2004).

Sanitary and Combined Sewer Flows

The King County Wastewater Treatment Division provides wholesale wastewater conveyance and treatment for flows from the City and 33 other cities and sewer districts. The City's wastewater collection system contains combined sewers that collect both waste- and stormwater. The City's collection system conveys flows to King County trunks and interceptors, which then convey flows to the West Point Treatment Plant located in Discovery Park. When medium to large storms occur, flows may exceed the capacity of the collection system pipes, resulting in combined sewer overflows (CSOs) in to waterbodies such as Elliott Bay (King County 2006). The combined sewer overflows (CSOs) discharged from this area result in approximately 1.6 billion gallons of untreated water flowing into the Bay on average per year (King County DNR 2006; Parametrix 2007). No work to identify impact zones below the outfalls has been performed in the project area though they are expected to exist.

CSOs are a recognized source of water pollution that can result in temporary increases in bacterial counts, odors, aesthetic degradation of shorelines, long-term adverse effects on sediment quality at discharge points, and raised public health concerns in areas where there is potential for public contact. Since the 1970s, King County and SPU have been implementing CSO control projects to improve water quality in the Seattle-King County area (King County 2006). For further discussion of impacted sediments and water quality from CSOs, see section 2.5.5.

Within the study area, sanitary and combined sewer flows are collected from businesses and services in parallel systems from both sides of Alaskan Way. Flows are directed to the Elliott Bay Interceptor (EBI), which is part of King County's regional wastewater system, at the connection points described below.

Lenora to Broad Street

Wastewater collected from the area between Lenora Street and Bay Street (which encompasses the north boundary of the study area at Broad Street) flows to the Vine Street Diversion Structure, which is owned and maintained by the City of Seattle. This diversion structure provides control of combined sewer overflows for areas of Belltown and along Alaskan Way between Virginia and Bay Streets. Normal flows through the Vine Street Diversion Structure are directed north via a 24-inch SPU sewer line and the EBI to the Denny Way combined sewer overflow facility for eventual treatment at the West Point Treatment Facility. Emergency overflows from the Vine Street Diversion Structure are released through a 48-inch CSO outfall to Elliott Bay.

University to Lenora Street

Wastewater collected in the area from approximately University to Lenora Street flows to an interceptor pipe at Alaskan Way. The Alaskan Way interceptor (owned and operated by the City of Seattle) connects to the EBI at Pike Street via the University Diversion Structure and the Pike Street Adit. The University Diversion Structure is owned and operated by the City of Seattle; the Pike Street Adit is part of the regional wastewater system owned and operated by King County.

Madison to University Street

Wastewater collected from areas between approximately Madison Street and University Street drains to an interceptor pipe at Alaskan Way, where it joins flows from the larger contributing basin uphill from the waterfront. The wastewater is routed to the University Diversion Structure before connecting to the EBI at Pike Street via the Pike Street Adit. Overflows from the University Street Diversion Structure are released through a 48-inch CSO outfall to Elliott Bay.

Madison to Columbia Street

Wastewater collected between approximately Madison Street and Columbia Street drains to an interceptor pipe at Alaskan Way, which flows toward the Madison Diversion Structure at the intersection of Madison Street and Alaskan Way. The Madison Diversion Structure is owned and operated by the City of Seattle. The intersection of Madison Street and Alaskan Way has many large-diameter sewers and dedicated storm drains (RWE 2002c cited in FHWA 2004). Wastewater eventually flows to the EBI at Pike Street, connecting to a 36-inch pipe just downstream of the University Diversion Structure and then to the Pike Street Adit. Overflows from the Madison Street Diversion Structure are released to Elliott Bay through a 60-inch outfall.

Columbia to South Washington Street

Wastewater collected between Columbia Street and S. Washington Street are routed to an interceptor pipe at Alaskan Way, which flows into either the diversion structure at S. Washington Street (owned and operated by the City of Seattle) or the King Street regulator (owned and operated by King County). These structures provide control of combined sewer overflows, with a 24-inch CSO outfall at S. Washington Street and a 48-inch CSO outfall at King Street. Flows from the Alaskan Way interceptor sewer are routed to the EBI at King Street.

Outfalls and Drainage System

Almost all stormwater along the Alaskan Way right-of-way ultimately drains into Elliott Bay. In the study area, stormwater discharges via CSO outfalls or from separated storm drain outfalls.

Outfalls

The City and King County have five CSO outfalls that discharge during CSO events to marine waters in or near the project area (FHWA 2006). These CSO outfalls are located at the ends of Vine Street, University Street, Madison Street, S. Washington Street, and King Street. Nearby County CSO outfalls include Lander, Connecticut (S. Royal Brougham Way) and north of the project area and sculpture park at Denny Way, shown in Figure 2.3-1 (FHWA 2006).

The City of Seattle owns and operates three separated storm drain system outfalls in the project study area. These storm drain outfalls are located at the end of Pine Street, Seneca Street, and Washington Street. There is an additional stormwater outfall at Bell Harbor near Pier 66. The ownership and source of flows at this outfall are uncertain and currently under investigation (HDR, *et al*. 2007).

Drainage System – West of Alaskan Way

Within the study area, areas west of Alaskan Way (adjacent to the waterfront) are generally served by a separated storm drainage system, with individual catch basins that drain street runoff from the western section of Alaskan Way directly through existing penetrations in the Seawall and discharge directly into Elliott Bay. These individual outfalls are typically 4-inch or 6-inch diameter pipes that terminate at the Seawall. Approximately 50 of these individual outfalls are located within the project study area (HDR, *et al*. 2007).

Drainage System – East of Alaskan Way

A system of catch basins and pipes collects runoff from the eastern side of Alaskan Way and directs runoff to one of the many drainage systems (either the separated storm drain or combined sewer systems) located in the study area (FHWA 2006, Appendix G; HDR, *et al*., 2007):

Between Broad Street and Lenora Street, drainage from the east side of Alaskan Way primarily flows to individual Elliott Bay outfalls via separated storm drain systems. In the areas between approximately Vine and Wall Streets and Bell and Blanchard Streets, a combined sewer system collects surface runoff and directs it to the Vine Street Diversion Structure, which passively diverts low flows to the EBI and directs high flows to the Vine CSO Outfall via an overflow weir.

Between Lenora Street and Pine Street, a separated storm drain system collects storm runoff from west of the southbound Alaskan Way Viaduct and directs it to an existing outfall through the Seawall at Pine Street.

Storm runoff from the area underneath the Alaskan Way viaduct at Pike Street flows directly to the EBI via the Pike Street Adit.

From south of the Pike Place Market to south of Union Street, a combined sewer system storm runoff conveys surface runoff from the vicinity of the Alaskan Way Viaduct to the existing combined sewer diversion structure at University Street, which diverts low flows to the EBI (via the Pike Street Adit) and overflows to the University CSO Outfall..

In the vicinity of Seneca Street (just north of Seneca Street to just north of Spring Street), storm runoff is directed to a separate storm drain system, which has outfalls at Seneca Street and other individual locations along the Seawall.

Between approximately Spring Street and Columbia Street, separated and low-flow diversion storm drain systems collect runoff from the vicinity of the Alaskan Way Viaduct and direct it to the combined sewer diversion structure at Madison Street. The Madison Diversion Structure diverts low flows to the EBI (flowing to a 36-inch pipe just downstream of the University Diversion Structure and then to the Pike Street Adit), and overflows to the Madison CSO Outfall.

Between approximately Columbia and S. Washington streets, storm runoff from the vicinity of the Alaskan Way Viaduct is directed to the separate storm drain system outfall at S. Washington Street.

0 500 1,000 Feet

Figure 2.3-1
Existing Major Outfalls Along Seattle Central Waterfront

Natural Gas

PSE provides natural gas service along Alaskan Way. PSE’s network consists of transmission and distribution pipes, pressure controls, meters and service lines (FHWA 2004). Natural gas mains, along with distribution and service lines, are located within the study area.

A 12-inch, high-pressure gas line is located between Blanchard and S. Washington streets within the Alaskan Way right-of-way. This 12-inch, high-pressure gas line is part of PSE’s gas transmission system that provides natural gas to the Seattle Steam Plant and other businesses along Alaskan Way.

The majority of local service connections between Blanchard and Union streets are supplied by a 2-inch gas line. This 2-inch gas line runs from a connection to the 12-inch main at Pike Street to a dead end north of Virginia Street. A 2-inch gas line supplies the majority of local service connections between Union and Madison Streets. This line runs from a connection to the 12-inch main at Madison Street to a dead end north of University Street on the west side of Alaskan Way. A 3-inch gas line provides the majority of local service connections between Madison and S. Washington streets. The 3-inch gas line connection at Madison and continues to a dead end south of Columbia Street (FHWA 2006).

Steam

The Seattle Steam Company provides steam service in the study area. The privately held Seattle Steam main plant is located on Western Avenue just west of the Pike Place Market. It pumps steam through four main boilers with operating pressures of 140 pounds per square inch that service an 18-mile system of underground pipes dating back to the late 1880s. Originally called the Seattle Steam Heat and Power Co. when it opened in 1893, today Seattle Steam operates in Seattle via a franchise agreement with the City. Seattle Steam serves almost 200 customers including businesses located on piers within the study area. Seattle Steam’s service area extends from Blanchard Street to King Street and from the waterfront up over First Hill. Seattle Steam Company operates 24 hours a day, 7 days a week, using natural gas or recovered urban wood (old pallets and used packing material) as fuel to make nearly 500,000 pounds of steam per hour (average during the winter peak season). In the summer, the steam company produces about 100,000 pounds of steam per hour. The three biggest users are Swedish, Harborview, and Virginia Mason medical centers, which use steam to heat their buildings and to sterilize instruments. Hotels are the next biggest customers, using steam for heat and to generate hot water for showers and laundry (Seattle Steam Company 2006; FHWA 2004).

There is a 6-inch steam line that extends along the seaward side of the Seawall from Union Street to Bell Street providing service to the Seattle Aquarium and the Bell Street harbor area. Between Union and University Streets is a line that connects the steam plant with a blow off at the Seawall. In the same location are 2- and 6-inch service lines that extend beyond the Seawall and continue north. At S. Washington Street, there is a 4-inch steam service line that extends from Western Avenue to the Seawall, and at Marion Street a 4-inch steam service extends from a line in Western Avenue to the service on the west side of the Seawall (FHWA 2006).

Telecommunications

According to recorded and as-built drawings, maps, and recent utility survey information, the types of fiber optic and communication lines within the Alaskan Way right-of-way include telephone lines, internet communications, copper lines, cable TV, and other services. Some of these communication lines are listed in survey files as deactivated, empty, or abandoned. Additional information on the various communications services (including ownership) is being gathered as part of the final design of the AWVSRP. Although many of these systems are expected to be privately owned, anecdotal information indicates that the City of Seattle may have a fiber optic network within the study area and there may be a conduit for military communications.

Qwest Communications provides local telephone service to users in the study area and throughout Seattle. Telephone lines in urban areas are typically located within street rights-of-way, aboveground on utility poles in most areas, and underground in others (including part of downtown Seattle). Qwest also has fiber optic lines in the study area. It has underground feeders located along Broad, Wall, Pike, Spring, Marion, and S. Washington Streets (RWE 2002a–e cited in FHWA 2004) and provides service to the Port of Seattle.

Comcast (formerly AT&T Cable Services) is the primary provider of cable television in Seattle and the study area. Several private companies and public utilities also own fiber-optic cable and/or provide long-distance and other telecommunication services in downtown Seattle and in the study area. These providers include but are not limited to 360 Networks; AT&T Broadband; City of Seattle Fiber Optics; Comcast (formerly TCI/AT&T); CNI Locates; Electric Lightwave, Inc.; Global Crossing; Time Warner (formerly GST); Level 3; Looking Glass Network; Metromedia Fiber Network Services; MCI WorldCom (formerly MFS); Sprint; Millennium Digital Media (formerly Summit); Terrabeam; US Crossings; Nextira One (formerly Williams and Staples); Williams Communications; XO Communications; and Yipes Communications (RWE 2002a–e cited in FHWA 2004).

The City of Seattle Department of Information Technology (DoIT) also provides telecommunications, telephone, data network capability, and cable management services in the study area. DoIT provides a data network connecting the City's computers and departments. DoIT also operates and maintains the City's private telephone network, consisting of about 12,000 telephones, voicemail, a telephone management system, and the City's telecommunications and data networking functions (City of Seattle 2003 cited in FHWA 2004).

The basic fiber-optic system typically consists of manholes, conduits, and switching stations. Switching stations are usually located inside buildings. Conduits are either buried or mounted under the existing Viaduct. From where they are mounted on the Viaduct, they are routed down the columns in various locations into the manholes to allow connection to the buried system. Fiber-optic companies sometimes find it necessary to lease copper wire space from the telephone company to access the switching station locations within the buildings (RWE 2002a-e cited in FHWA 2004).

2.4. Physical Oceanography

2.4.1. Study Area

The physical oceanography study area of the Alaskan Way Seawall feasibility study includes the region around Elliott Bay bounded by the Seattle waterfront in the east, the mouth of the Duwamish River to the south, Discovery Park in the north, and Bainbridge Island to the west (Figure 2.4-1). This area, located on the eastern shore of Central Puget Sound, is part of one of the world's largest and deepest estuaries (Kruckeberg 1991). The morphology of Puget Sound is due to the extensive glacial activity that occurred in this area during the Wisconsin Glaciation (locally the Vashon Glaciation), approximately 12,000 years before present. Heavy glaciers moved over the land mass scouring and depositing till and excavating out Puget Sound and Elliott Bay. Later, multiple lahars from Mount Rainier flowed into the area filling the south end of Elliott Bay, near the mouth of the Duwamish River, with sediment and debris (Downing 1983). Following glacial retreat, new physical influences such as changes in sea level, tides, currents, wave action, beach erosion and deposition, freshwater influxing, and human activities have all played a role in shaping Elliott Bay and its shoreline to its present state. The physical setting of the bay has made it ideal for human habitation, facilitating the growth and development in and around the city of Seattle.

Understanding the physical oceanography of Elliott Bay provides a context for how surface waters and associated plant and animal communities interact and is necessary for planning and evaluating future activities around the Alaskan Way Seawall. The waters of Puget Sound originate from both freshwater and marine sources. Freshwater enters the Sound directly as precipitation, from rivers, streams, and springs, and from point and non-point runoff from human sources. Taken together, the rate of freshwater flow into the Sound averages 140 billion cubic feet a year (Kruckeberg 1991). Similarly, the volume of saltwater in Puget Sound is vast, making daily gains and losses during each tidal cycle on a scale of 1.27 cubic miles per day (Kruckeberg 1991). All this water flows over a topographic landscape consisting of a narrow U-shaped submarine trough with numerous lateral canals. The substrate in this area is composed of mainly quaternary glacial drift and alluvium (Kozloff 1993). Though the average depth of Puget Sound and Elliott Bay at mean low water is around 205 feet, there are substantial areas of deeper water ranging up to 930 feet in depth in Elliott Bay (see Figure 2.4-2; Kruckeberg 1991). Tide changes in Elliott Bay are also great with an average daily range of 11.3 feet, a range greater than most other coastal areas of the northwest United States (Kruckeberg 1991). An exceptionally high tide can reach approximately 17.3 feet relative to NAVD88 and an extremely low tide can reach around 1.3 feet relative to NAVD88 (Kozloff 1993) (Table 2.4-1).

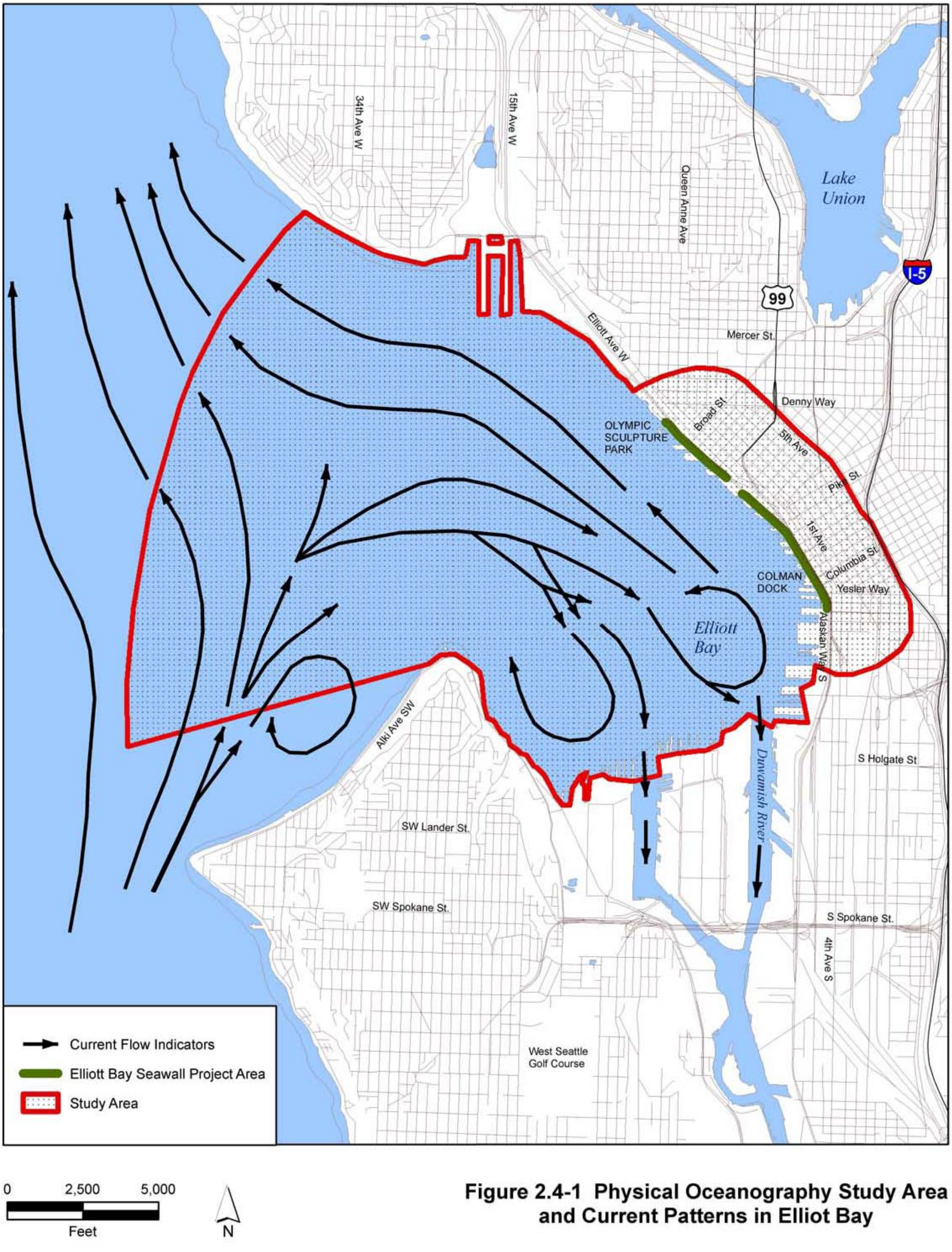


Figure 2.4-1 Physical Oceanography Study Area and Current Patterns in Elliot Bay

Table 2.4-1. Average Monthly Tidal Height for 2007 (NAVD88)

			Mean Tide Height*					
Month	Highest*	Lowest*	MHHW	MHW	MSL	MTL	MLW	MLLW
January	10.84	-5.46	9.24	8.22	4.27	4.43	0.63	-3.26
February	10.75	-4.74	9.27	8.4	4.57	4.66	0.92	-2.29
March	10.62	-3.92	8.81	8.06	4.21	4.2	0.34	-2.09
April	9.87	-5.42	8.77	7.93	4.17	4.2	0.46	-2.15
May	9.63	-6.31	8.75	7.78	3.99	4.04	0.31	-3.04
June	9.58	-6.17	8.91	7.92	4.1	4.2	0.49	-3.27
July	9.77	-5.39	9.01	8.14	4.25	4.36	0.58	-3.1
August	10.02	-4.38	8.82	8.15	4.23	4.29	0.43	-2.46
September	10.25	-3.84	8.55	8	4.13	4.17	0.33	-2.35
October	9.84	-6.2	8.95	8.19	4.31	4.32	0.45	-2.46
November	9.79	-6.9	9.1	8.01	4.15	4.2	0.39	-2.96
December	11.36	-6.6	9.65	8.45	4.62	4.7	0.95	-2.56

* Datum: All data is reported in feet relative to geodetic datum NAVD88. Station ID: 9447130, Seattle, WA.

Note: MHHW (Mean Higher-High Water), MHW (Mean High Water), MSL (Mean Sea Level), MTL (Mean of MHW and MLW), MLW (Mean Low Water), and MLLW (Mean Lower-low Water) reported here are the averages of hourly data collected during the corresponding 1-month period of record. As such, each category represents monthly fluctuations in the tides relative to the geodetic datum NAVD88.

Source: NOAA 2008

2.4.2. Natural Currents & Circulation

The pattern of currents flowing at intermediate depths in Elliott Bay is shaped by a complex interaction between the dynamics of the adjoining waters, local weather patterns, and tidal flow. In general, the currents of Elliott Bay tend to circulate in a weak, counterclockwise gyre through the inner and outer bay (Ebbesmeyer, *et al*. 1998) (Figure 2.4-1). This persistent flow is thought to be driven by the consistent north-bound movement of water in Puget Sound spanning from the Tacoma Narrows, north through Colvos Passage. This flow which has a volume of approximately 92,000 cubic feet per second is split, sending roughly half of the volume northward mostly bypassing Elliott Bay. Despite this, enough volume flows into the Bay to continually circulate its waters (Ebbesmeyer, *et al*. 1998). This flow influences the development of an eddy, which pushes the currents to spin around Alki Point and Duwamish Head into inner Elliott Bay. These currents initially flow through a submarine canyon but branch into an ever-changing network of eddies once they reach the inner Bay (Ebbesmeyer, *et al*. 1998). The flows exiting the lower depths of the inner Bay move westward out of the northern reach of the submarine canyon. A portion of the inflowing water recirculates into the outflow which tends to follow bottom contours to the outer Bay and out of the study area (Ebbesmeyer, *et al*. 1998).

In the nearshore, along the Elliott Bay Seawall, the current at intermediate depths generally flows northward, although vessel traffic and a naturally occurring westward flowing current also influence its direction (Ebbesmeyer et al. 1998). In contrast, surface water currents tend to flow in a westward direction until they move out of the Bay. This flow direction however, is inconsistent and episodic in nature and often has periods of well-defined flow in other directions, such as from wind driven currents that flow eastward, or periods of little or no defined flow (Ebbesmeyer, *et al*. 1998; NOAA 1998).

The speeds of the currents in Elliott Bay are variable across different water depths but are overall, relatively slow. In the outer portion of Elliott Bay near the seafloor, the near-bottom tidal currents tend to be quite low in speed, keeping to around 0.6 inches per second (NOAA 1998). These slow bottom currents can be clearly seen in the nature of the sediments located in this region which are composed of fine silt and clay deposits. Tidal currents flowing near the surface, in contrast, tend to move at a much faster speed ranging up to 8-12 inches per second (NOAA 1998). In general, the characteristics of the currents found in Elliott Bay imply a potential net residence time to be around 5 days for the surface layer and around 14 days for the deeper layers (NOAA 1998).

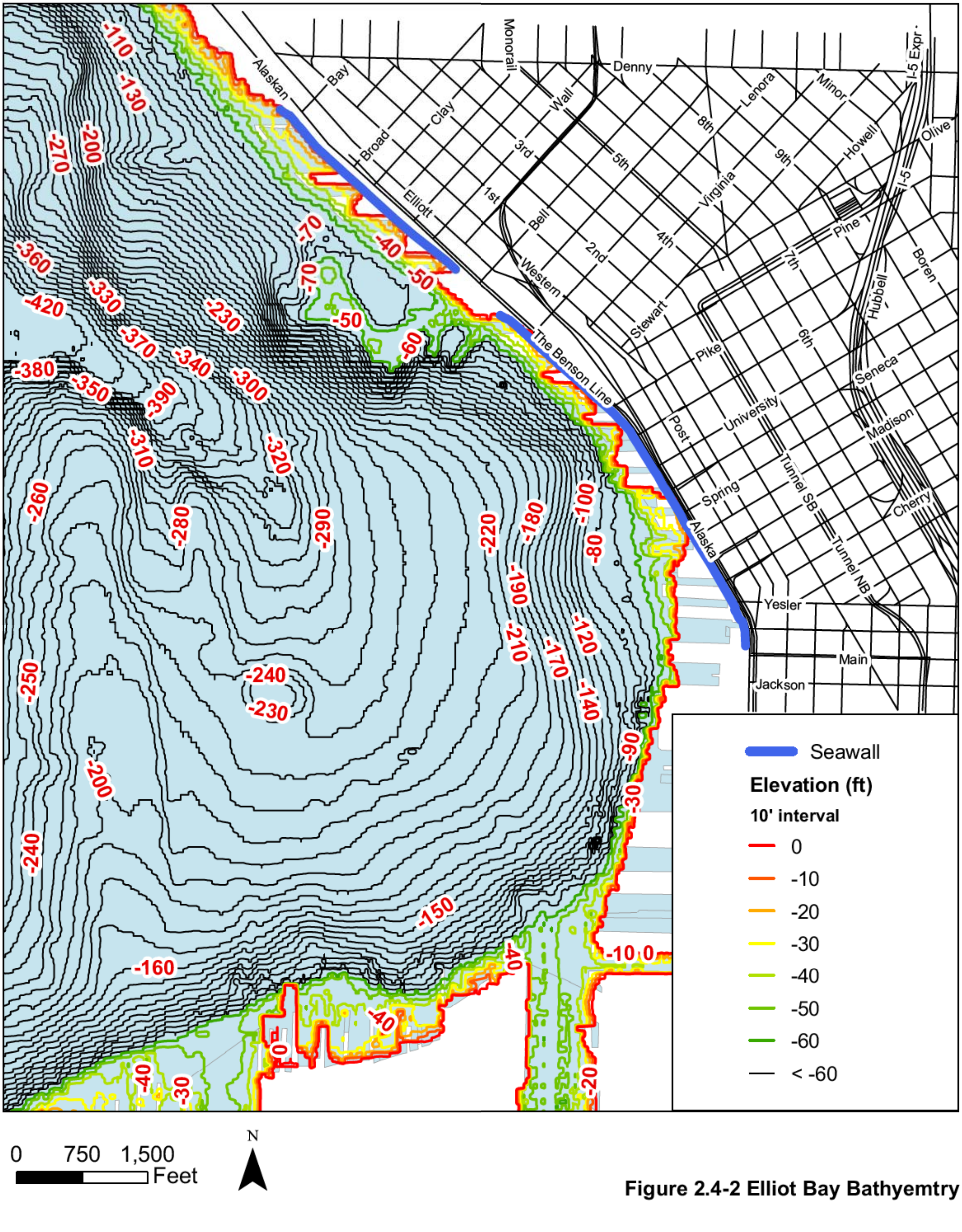
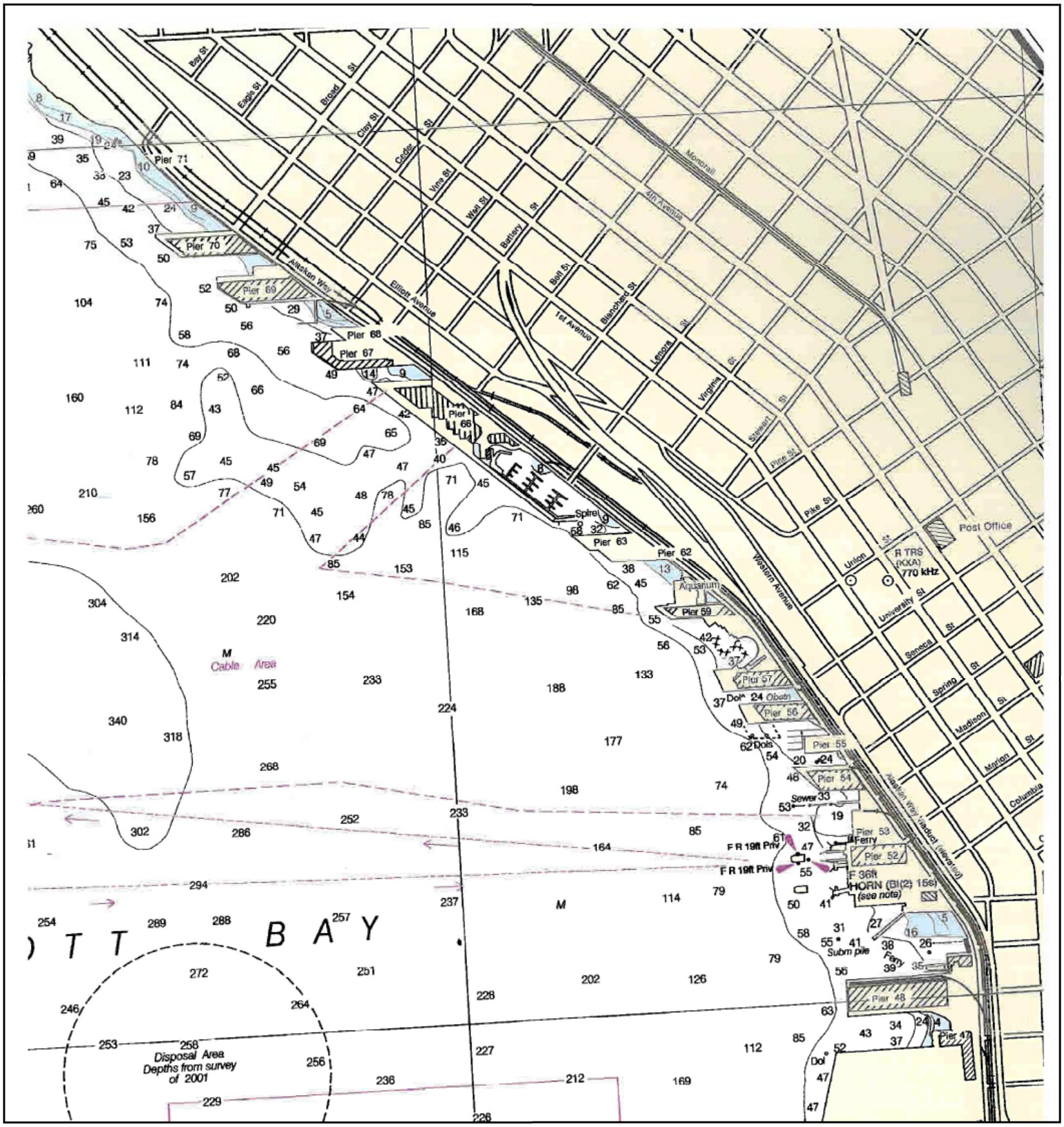


Figure 2.4-2 Elliot Bay Bathyemtry



Tetra Tech, 2008. Source: Seattle Harbor Coast Survey. September 2002. National Oceanic and Atmospheric Administration (NOAA).

0 860 Yards

N

Figure 2.4-3 Elliot Bay Nearshore Bathymetry

2.4.3. Water Composition

The waters of Elliott Bay emanate from two major sources; subsurface saltwater from Puget Sound flowing in large volume into the bay and a relatively small freshwater discharge from the Duwamish River and other minor sources. It should be noted that stormwater runoff, while significant in terms of increasing levels of toxins found in the nearshore (Michelsen, *et al*. 1998), supplies less than 0.4% of the Duwamish River water volume (NOAA 1988). Relative to other rivers in the area, the Duwamish has a relatively low total output averaging only 1,790 cubic feet per second (NOAA 1988). Brackish water forms within the Duwamish estuary when the tidal inflow into the Duwamish is strong enough to bring saltwater in from the Bay. When tidal forces become less than the outflow forces of the river, the brackish water flows out into Elliott Bay increasing the salinity of the upper freshwater layer (NOAA 1998). This water layer flows northward along the Seawall while more saline water moves southward into the estuary from Duwamish Head (NOAA 1998). Such water mixing and flow, however, is not uniform and produces a patchy distribution of salinity levels with areas of high salinity being found between the east and west waterways of the Duwamish and around the aquarium (NOAA 1988) and a thin lens of freshwater (2-12 feet thick) being found in the inner Bay (Ebbesmeyer, *et al*. 1998). The scale and form of these patches are also highly variable, a pattern driven by three factors; tidal forces, wind speed and duration, and volume of the outflow of the Duwamish River (NOAA 1988). On average, the interaction between these forces results in the surface salinity of Elliott Bay (2 parts per thousand) to often be lower than that of the Duwamish River (Baker, *et al*. 1983; NOAA 1988).

2.4.4. Nearshore Wave Action & Vessel Currents

Wave energy in Elliott Bay, which is a sheltered embayment protected from open water and southerly winds, is much lower than that seen in more exposed areas of Puget Sound. Under moderate winds, waves in Elliott Bay tend to have relatively short wave periods ranging from 2 to 2.5 seconds, low energy, and increase little in intensity during storms (Downing 1983; King County DNR 2007). As a result, natural wave action is usually very light in Elliott Bay and at the Alaskan Way Seawall and usually has little impact on the nearshore environment. A recent study that modeled the maximum depth of scour along the seawall estimated scour to be 4 feet below the existing toe elevation, though it is worth noting that in many locations along the Seawall, the substrate has already adjusted, reaching its equilibrium since the Seawall has been in place (WSDOT 2002).

Compared to natural waves, anthropogenic sources of wave action at the Alaskan Way Seawall tend to produce high energy waves at a much higher rate, affecting the nearshore environment. The major source of these anthropogenic waves is the heavy vessel traffic that frequents the area (Ebbesmeyer, *et al*. 1995; Michelsen *et al*. 1998). Research has shown that a 94 foot, 1,200 horsepower tugboat can a produce a wake from 1.13 to 2.54 feet in height with an average period of 2.3 seconds. This anthropogenic wave is comparable to a natural wave produced by a northern wind blowing 49 feet per second over Elliott Bay for 44 hours (Ebbesmeyer *et al*. 1995). Such high wave energy can increase the rate of erosion along the shoreline and Seawall (USEPA 2001). In addition, the currents produced by the heavy vessel traffic present in the nearshore of Elliott Bay, and in particular, from the large ferries that frequently idle near the Seawall, the bow thrusters of cruise ships (which produce currents with speeds ranging from 2 to 4 feet per second), and from general prop-wash (which produce currents with speeds >10 feet per second) all circulate and transport sediments throughout the nearshore waters (Ebbesmeyer, *et al*. 1995; Michelsen, *et al*. 1998). In general, these anthropogenic currents not only can cause erosion along the shoreline and Seawall, they also play a key role in the resuspension and redistribution of various sediments, with mean net sedimentation rate measured at the Seawall to be 0.11 grams per square inches per year (Michelsen, *et al*. 1998)

Often, sediments in the nearshore of Elliott Bay are ladened with hazardous materials washed into the bay from the heavily urbanized and industrialized surroundings (STCE 1988; McLaren & Ren 1994; Ebbesmeyer, *et al*. 1995; Romberg, *et al*. 1995; Michelsen, *et al*. 1998). Unlike the relatively weak natural tidal currents of the nearshore (Ebbesmeyer, *et al.* 1995), those created by vessel traffic are sufficient to resuspend and redistribute these hazardous sediments (NOAA 1988). Similarly, construction activities near the Seawall have also been shown to resuspend hazardous surface and subsurface sediments (Ecology 1996; Michelsen, *et al*. 1998). Most types of nearshore construction activities have this capacity; both large-scale ferry terminal renovations (Michelsen, *et al*. 1998) and small, routine pier maintenance projects involving the replacement of pilings have both been documented to have caused resuspension (Ecology 1996). In addition, it is thought that vessel currents and construction disturbances can work in conjunction to resuspend and redistribute sediments throughout the nearshore area suggesting that these forces could be considered one dynamic of the nearshore waters (Michelsen, *et al*. 1998). It should be noted, however, that deep water suspended sediments located in the outer bay are only transported by naturally occurring currents, rendering the anthropogenic effects generally only an issue of the nearshore (NOAA 1988; Ebbesmeyer, *et al*. 1998).

2.4.5. Sea Level Change

Changing sea level is a key feature of physical oceanography that will most likely hold future implications for the Alaskan Way Seawall and is therefore discussed in this section (Table 2.4-2). In recorded history, the sea level near Elliott Bay has shown a marked increase in elevation over the last 109 years. Throughout this same time interval, the rate of sea level rise has also shown a dramatic increase (Downing 1983). In Elliott Bay, the corresponding rise in sea level has been measured to be around 8.2 inches from 1899 to the present (at a rate of 0.076 inches per year) and 6.0 inches from 1972 to the present (at a rate of 0.084 inches per year) (Hicks & Crosby 1974; Vanicek 1978; WSDOT 2002; NWF 2007). In contrast, sea level changes in more coastal areas, such as Neah Bay, Friday Harbor, Vancouver B.C., and Victoria B.C., have all been much less dramatic than in Elliott Bay, with each showing much lower rates of increase or even negative rates through the same time interval (Hicks & Crosby 1974; Vanicek 1978). The marked difference between these geographically close areas can be traced to localized tectonic processes such as subsidence and uplift (Canning 2006), in addition to sedimentation and marsh accretion (Park, *et al*. 1993). Subsidence, (i.e. lowering of a land mass) in general, has played a major role in the high rate of sea level rise in Elliott Bay. Long term studies have shown that the land around Elliott Bay has been subsiding at a rate of 0.6 in/year; a relatively high rate compared to neighboring areas of Puget Sound which have shown little or no net change (Canning 2006). This rate of increase in sea level of Elliott Bay is high even on a global scale, rising at a rate roughly twice the global average (Downing 1983). Despite this, it remains unclear whether local geological subsidence and uplift rates are linear in space and time (Canning 2007) rendering any projections for the future rather speculative. WSDOT has predicted Sea Level Rise in downtown Seattle as presented in Table 2.4-2.

Table 2.4-2. Predicted Sea level Rise - Seattle

Year	10% Probability of Exceeding (ft)	50% Probability of Exceeding (ft)	90% Probability of Exceeding (ft)
2025	0.6	0.4	0.2
2050	1.1	0.7	0.2
2075	1.6	0.9	0.4
2100	2.3	1.4	0.7

Source: WSDOT 2002

Today, climate change is also clearly a concern that may push the rates of sea level rise even higher than the rates we see today. Though no specific data illustrating the impact climate change may have on the waters and shoreline of Elliott Bay exists, an extensive amount of data does exist on its impact on the greater Puget Sound region. According to a recent report prepared by the Climate Impacts Group at the University of Washington, the Puget Sound region warmed 2.3°F during the 20th century, a rate substantially greater than the global warming trend (Snover, *et al.* 2005). In addition, the dates of peak snow accumulation and snowmelt-derived streamflow across the West have shifted 10-30 days earlier over the past century, and average snowpack has declined significantly (Steward, *et al.* 2004). The Intergovernmental Panel on Climate Change (IPCC) has found that the global average sea level has already risen about 6.7 inches over the past century, which is about 10-times faster than the rate of sea-level rise over the last 3,000 years (2007). As a result, the rate of sea-level rise is expected to accelerate during this century. Projections vary, but it is thought that there will be an additional 7 to 23-inch rise in global average sea level by 2090-2099 relative to 1980-1999 (IPCC 2007). This means that the current shoreline areas of Elliott Bay will almost certainly experience higher tide levels and storm surges than currently occur.

2.5. Water Resources and Water/Sediment Quality

2.5.1. Study Area

The water resources study area of the Alaskan Way Seawall feasibility study includes Elliott Bay bounded by the Seattle waterfront in the east, the mouth of the Duwamish River to the south, Discovery Park in the north, and Bainbridge Island to the west. This area, located on the eastern shore of Central Puget Sound, is part of one of the world's largest and deepest estuaries (Kruckeberg 1991).

Understanding the water resources; their source, movement, and how they have been influenced by urban development and land uses in the area is necessary for planning and evaluating future activities around the Alaskan Way Seawall. The waters of Puget Sound are derived from both freshwater and marine sources. Freshwater enters the Sound directly as precipitation, from rivers, streams, and springs, and from point and non-point runoff from the surrounding urban landscape. Together these sources combine to provide approximately 140 billion cubic feet of fresh water inflow into the Sound per year (Kruckeberg 1991). The huge volume of saltwater that exists in the Bay fluctuates daily during tidal cycles on a scale of 1.27 cubic miles of water moving in and out per day (Kruckeberg 1991).

Water in Elliott Bay generally circulates in a counter-clockwise fashion (see Section 2.5 for more details on currents). Fresh water enters from the Duwamish River, moves north along the Inner Harbor, and then flows out to Puget Sound (Ecology 1995; FHWA 2004). Water currents along the Seawall are generally low and oriented parallel to the downtown waterfront pier faces (FHWA 2004a). Ubiquitous localized current accelerations result from prop wash and ship wakes from ferries, Port of Seattle harbor traffic, and vessels traveling in the Puget Sound shipping lanes. The combination of heavy vessel traffic and natural currents can redistribute the toxic contaminants that have reached the aquatic environment by way of industrial and municipal discharges, groundwater seepage, atmospheric deposition, and resuspension of sediments (Hart Crowser 1994; Ebbesmeyer, *et al*. 1995; Hart Crowser 1997; Michelsen, *et al*. 1998).

2.5.2. Methodology

Water resources in the Alaskan Way Seawall feasibility study area were evaluated using the most recent available information and data that have been collected in the study area or in other applicable areas in the region. The various sources that were used include Hart Crowser (1994, 1997), EVS Environmental Consultants (2003), Federal Highways Administration (FHWA 2004); Parametrix (2007), U.S. Army Corps of Engineers (USACE 2007), King County Department of Natural Resources (King County DNR 2007), and Puget Sound Partnership (PSP 2007).

2.5.3. Hydrology

Tides in Elliott Bay are mixed semi-diurnal with two high and two low tides of unequal magnitude occurring each day (see Table 2.4-1 for details on tidal fluctuations). Because Elliott Bay is a tidal marine environment, water elevation is entirely determined by daily tides and is independent of the hydrology of its tributaries.

The tidal difference between mean higher-high water (MHHW) and mean lower-low water (MLLW) in Elliott Bay is on average 13.7 feet (NOAA 2008). This translates to the water level reaching approximately 7.7 feet below the top of the Seawall at MHHW and 19.0 feet below the top of the Seawall at MLLW. The highest observed tide recorded in Elliott bay was 17.2 feet which caused the water level to reach 4.2 feet from the top of the Seawall (NOAA 2008).

Stormwater runoff in Elliott Bay is extensive, with approximately 42 square miles of highly developed land covered with impervious surfaces that shed water directly into the Bay (King County DNR 2006) through exposed drains embedded in the Seawall (Parametrix 2007). The combined sewer overflows (CSOs) discharged from this area results in approximately 1.6 billion gallons of untreated water flowing into the Bay on average per year (King County DNR 2006, Parametrix 2007).

The current structure in Elliott Bay is influenced by three major factors: semi-diurnal tidal exchange, fresh water input from the Duwamish River, and wind effects. In general, the currents in the nearshore off of the Seawall are generally weak (< 2 inches/second) though non-natural currents made by the vessel traffic common to the area are very high in intensity. For a detailed summary of currents in Elliott Bay, refer to chapter 2.4, Physical Oceanography.

2.5.4. Surface Water Quality

Pollutants reach the aquatic environment through a variety of sources and human activities. In the Puget Sound area, industrial and municipal discharges, groundwater seepage, atmospheric deposition, and resuspension of sediments can result in high levels of various toxins accumulating in the environment. Pollutants found in Elliott Bay include petroleum products, polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), and polychlorinated dibenzo-dioxins (PCDDs); heavy metals from vehicles and industrial sources; fertilizers, animal wastes, pesticides, surfactants, and hormones; medications from homes and farms; and sediment from construction sites (King County DNR 2007) (Table 2.5-1).

Table 2.5-1. Pollutants of Concern in Puget Sound

Pollutant	Sources
Heavy Metals	
Lead, mercury, copper, zinc, others	Vehicles, batteries, paints, dyes, stormwater runoff, spills, pipes
Organic Compounds	
Polycyclic aromatic, hydrocarbons (PAHs)	Burning wood and fossil fuels as well as oil spills, leaking underground fuel tanks, creosote, asphalt, and coal
Polychlorinated biphenyls (PCBs)	(Banned in the U.S. in 1976; it can still be found in the environment). Hydraulic fluids, solvents, electrical coolants, lubricants
Dioxins & furans	Byproducts of combustion and industrial processes
Dichloro-diphenyltrichloroethane (DDT)	(Banned in the U.S. in 1972, it can still be found in the environment). Used in the U.S. as a pesticide, it is still used in many countries in agricultural practices and disease control
Phthalates	Plastic materials, including food packaging, garden hoses, medical equipment and toys, and personal care products such as soap, shampoo, deodorant, and lotion
Polybrominated diphenyl esters (PBDEs)	Added to electronics, textiles, and plastics as a flame retardant

Source: PSP 2007

The sediments in Elliott Bay have been listed on the 303(d) list for numerous pollutants including mercury, silver, and multiple organic compounds. The most recent 303(d) list (Ecology 2005; Table 2.5-2) designated various areas of Elliott Bay surrounding the study site that comprises approximately a quarter of the Bay's area, as Category 5 for fecal coliform bacteria (Ecology 2005). Despite this, these same waters have an overall rating as excellent for aquatic life uses and primary contact recreational uses (Ecology 2005). The exceedence of standards for dissolved oxygen and temperature appear to be entirely a result of natural conditions and not a result of anthropogenic sources.

Table 2.5-2. 2004 Ecology 303(d) List for Elliott Bay

Media	Parameter	Category
Water	Fecal coliform	5
	Endosulfan	2
	pH	2
	Dissolved oxygen	1
	Ammonia-N	1
	Temperature	1
Sediment	2-Methylphenol	5
	Acenaphthene	5
	2,4-Dimethylphenol	5
	1,2-Dichlorobenzene	5
	1,2,4-Trichlorobenzene	5
	Benzo(a)anthracene	5
	2-Methylnaphthalene	5
	Phenanthrene	5
	Fluorene	5
	Sediment bioassay	5
	Hexachlorobenzene	5
	Dibenzofuran	5
	Naphthalene	5
	Benzoic acid	5
	Mercury	5
	Benzyl alcohol	5
	LPAH	5
	Silver	5
	Hexachlorobutadiene	5

High levels of toxins such as PAHs, PCBs, and mercury have been documented in some animal species such as mussels, market squid, planktonic larval marine fish, Chinook salmon, coho salmon, osprey, orca, grey whale, and harbor seals that reside in the study area (NOAA 1993; KCEL 1998; Ross, *et al*. 1998; USEPA 1999; Cullon, *et al*. 2001; Lambourn, *et al*. 2001; NOAA 2002; NOAA 2007; PSP 2007; WDFW 2008). Histopathology studies have indicated that biological impacts such as malignant liver tumors (hepatic neoplasms), accumulations of waste products in cell lysosomes (intracellular storage disorders), and lesions on fish are pollution related and found most frequently near industrial or urban areas, such as Elliott Bay. Fish with such disorders frequently have much higher concentrations of organic chemicals and trace metals in their tissues than non afflicted individuals (NOAA 2002).

Stormwater runoff in particular, is a leading cause of trace metal pollution in the water bodies around Seattle. In many areas that have separate storm-sewer systems, stormwater receives minimal treatment, if any, before being discharged directly into Elliott Bay. Combined sanitary and storm sewers, which are prevalent throughout the Seattle area, often discharge a mixture of stormwater and raw sewage directly into

Elliott Bay during heavy rainstorms (PSP 2003). Runoff from bridges and roads during periods of high-volume traffic often has up to three times higher concentrations of metals, especially copper and zinc, than the neighboring waterbodies they discharge directly into (PSP 2003). When most of these contaminants enter Elliott Bay, they dissolve and remain in a very thin, freshwater plume that transports them rapidly throughout the Bay and into the main basin of Puget Sound (PSP 2007; WDFW 2008).

2.5.5. Sediment Quality

Elliott Bay nearshore sediments contain high levels of various metals and chemical compounds (Table 2.5-2) (EPA 1988; Romberg, *et al*. 1985; Hart Crowser 1994; Michelsen, *et al.* 1998; PSP 2003; summarized in Parametrix 2007). These sediments have been listed on the 303(d) list for exceeding state standards for numerous pollutants of concern. Exceedances of sediment criteria are generally associated with previous industrial activities and stormwater and CSO outfalls (see Figure 2.3-1). Nearshore sediments along the outside of the wave-action zone of the study area have a high percentage of fine sediment (40 to 70 percent if not disturbed by vessel activity, cap placement, or dredging) (NOAA 2002; Parametrix 2007). Nearshore sediments are often further classified as either surface or sub-surface sediment and may have different levels of contamination.

Several entities have undertaken sediment sampling adjacent to the Seawall in Elliott Bay and on uplands to the east of the Seawall (FHWA 2004; Parametrix 2007; USACE 2007). Figure 2.5-1 shows the locations of previous samples and surface sediment sampling recently completed by Parametrix (2007).

Samples analyzed for Parametrix (2007), Appendix E (Table 2.5-3), show that arsenic, cadmium, copper, lead, mercury, molybdenum, nickel, selenium, silver, and zinc were detected in nearly all of the sediment samples, but at levels below the Sediment Cleanup Screening Levels (SMS) and the Puget Sound Dredge Material Management Program (DMMP). Concentrations generally ranged from 0.1 to 600 μg/kg. Mercury exceeded screening levels in 8 of the 13 samples. Cadmium, silver, and zinc exceeded screening levels in one or more samples. Total DDT and alpha and gamma chlordanes exceeded screening levels in one or more samples. Total PCBs exceeded screening levels in 7 samples. PAHs, 2,4-dimethylphenol, 4-methylphenol, phenanthrene exceeded screening levels in multiple samples.

Studies indicate that mercury may be the most widespread chemical of concern in both sub-surface and surface sediments within the project area (USACE 2007). It is important to note that resuspension of sediment toxins is prevalent in the nearshore areas of the study site. For a detailed summary of current sediment resuspension, refer to chapter 2.4, Physical Oceanography.

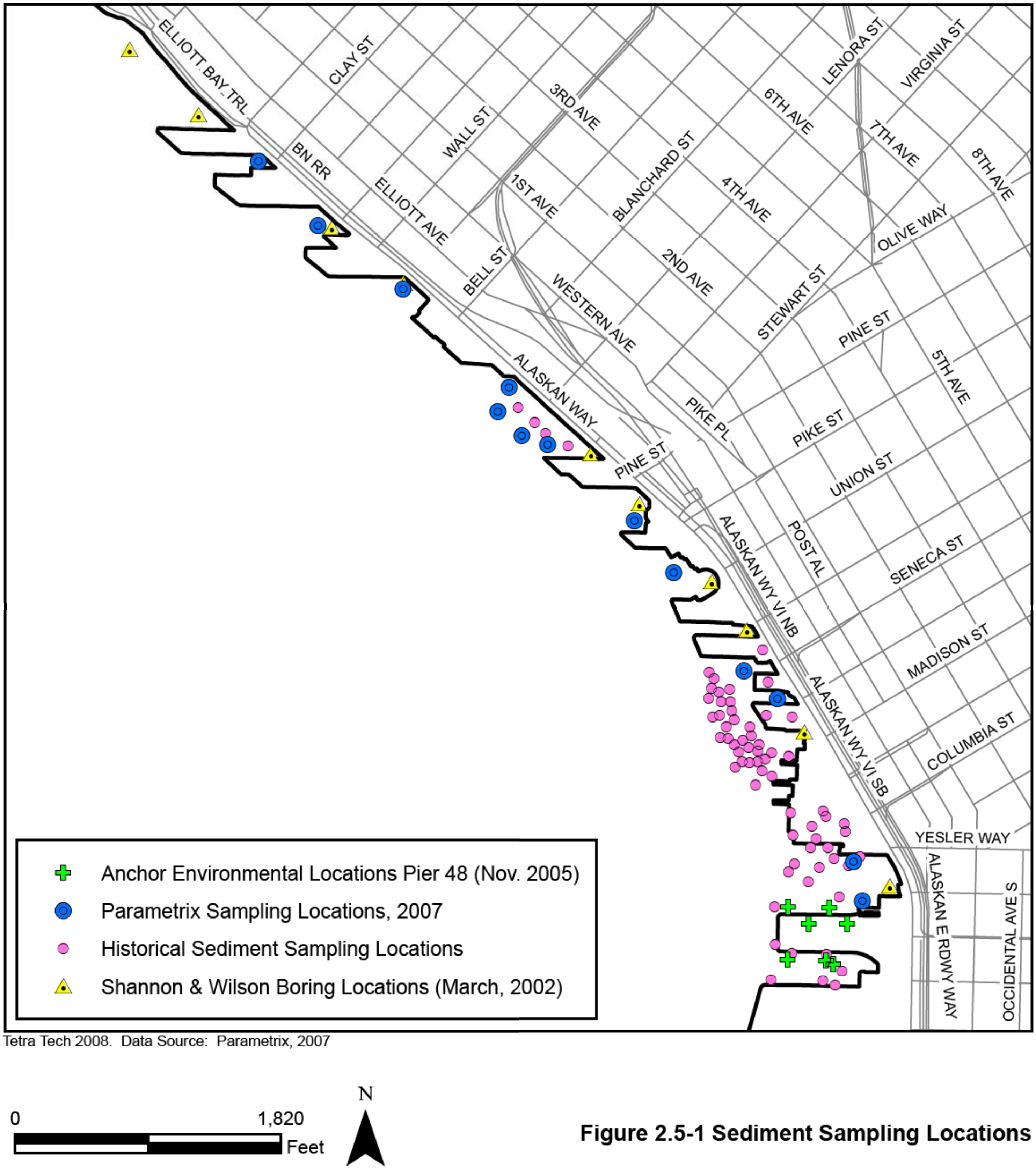


Figure 2.5-1 Sediment Sampling Locations

Several sediment remediation projects have been completed to improve the sediment quality of nearshore sediments along Elliott Bay (Romberg, *et al*. 1985). These projects have employed the technique of placing clean sediment (generally sand) on top of contaminated sediment; a method of sediment remediation known as capping. The cap of clean sediment protects benthic organisms from coming into contact with contaminated sediment and prevents or reduces resuspension of the contaminated sediments into the water column. Within the project area, capping has been completed at Pier 51 (under a portion of the ferry terminal, 1989), Pier 53–55 (1992), and at the end of Denny Way (1992). Though it has been determined that discharges from stormwater outfalls and CSOs do not contain enough pollutants to result in recontamination of remediated sediments higher than chemical safety levels (Ecology 1995), the numerous outfalls in the vicinity may still be an ongoing source of pollutants. Recontamination may occur from non-point sources, spills, and creosote pilings and bulkheads.

2.5.6. Upland Sites and Sources of Contamination

The USACE (2007) conducted a Level 1 Environmental Site Assessment that reviewed records of spills, sources of contaminants, and provided an evaluation of the potential risk for a project at the Seawall. Areas they identified as having known sediment contamination (contaminants exceeding threshold for concern) were the areas along the shoreline of the central waterfront in the vicinity of Piers 52-57, the Puget Sound Power and Light steam plant immediately upland of Pier 57, and the Brotherhood Dye Works site upland of Pier 48.

Areas listed as posing a moderate risk of contamination include several former industrial sites (Savage Lumber and Manufacturing Co., Empire Laundry Co., Walter N. Boysen Co., and Bell Street Machine Shop) adjacent to Pier 66, a former gas station site adjacent to Pier 59, a warehouse that included a machine shop adjacent to Pier 56, two warehouse site with multiple uses including a printing company, cleaners, engine company and gas stations adjacent to Pier 52, and multiple use warehouses (primarily printing and manufacturing) adjacent to Pier 48.

The USACE (2007), Parametrix (2007) and FHWA (2004) summarized the documented contaminant release sites along the waterfront which total 18 sites from Pier 48 to Pier 70 (and below 1st Avenue). The findings of the USACE (2007) assessment are that multiple sites are likely to or have contaminants above screening levels. However, the detected concentrations were generally not above state cleanup criteria. It is likely that actions taken to rehabilitate the Seawall will encounter contaminated sediments and soils, and materials will likely need to be hauled to an appropriate upland disposal location.

2.6. Vegetation, Fisheries, and Wildlife

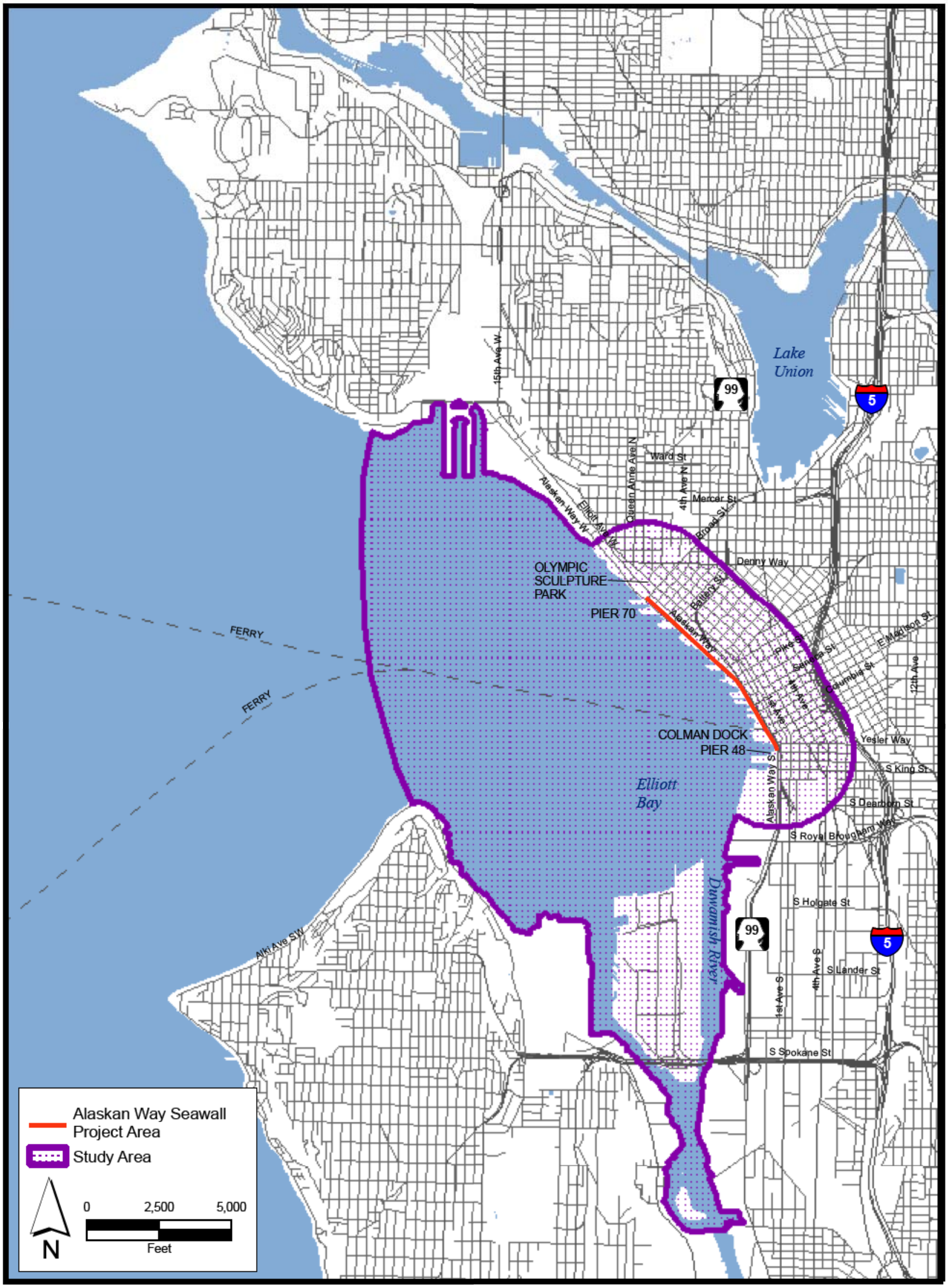
2.6.1. Study Area

The Alaskan Way Seawall study area is composed of approximately 8 square miles of Elliott Bay and its surrounding areas. Elliott Bay, located on the eastern shore of Central Puget Sound, is part of one of the world's largest and deepest estuaries (Puget Sound) with nearly 2,300 miles of shoreline and freshwater input from 11 major rivers and 10,000 streams (Kruckeberg 1991). However, Elliott Bay is regarded as one of the most heavily urbanized and polluted areas in Puget Sound. The majority of terrestrial, nearshore, and offshore habitats that naturally occurred in the area either no longer exist or are degraded. Many species have been affected by extensive development of the shoreline including those that are now federally or state listed, or state priority species. In addition, the terrestrial landscape surrounding the study area is dominated by industrial and commercial development that produces solid wastes, noise, and air and water pollution. Recently, however, as part of the Olympic Sculpture Park's seawall retrofit, an area of nearshore habitat, including a natural beach area, was created on the waterfront in front of the Sculpture Park and just south of Myrtle Edwards Park (King County DNR 2003; POS 2005).

This section on vegetation, fisheries, and wildlife presents the existing conditions of the marine and terrestrial environment around the Alaskan Way Seawall. The study area considered in this document stretches from Denny Way in the north, down to South Main Street to the south and westward to include Elliott Bay in its entirety (Figure 2.6-1). Although the nearshore habitat is the primary concern of this study, the study area includes all of Elliott Bay because recent findings suggest that nearshore construction activities can affect species in adjacent habitats such as terrestrial habitats, airspace, and offshore habitats (Feist 1991; Stotz & Colby 2001; Nedwell, *et al*. 2003; WSDOT 2006b). All plant and fish and wildlife species known or likely to occur in the study area will be discussed in this chapter.

2.6.2. Methodology

Data for this section was collected from multiple sources. Species data was obtained by field observations (Tetra Tech 2008a) and from available species lists for the Elliott Bay study area (King County DNR 2000; WSDOT 2004; Toft, *et al*. 2004; Buchanan 2006; Toft & Cordell 2006; WSDOT 2006a, 2006b, Penttila 2007). Ecological information was obtained from two major sources; field surveys (Tetra Tech 2008a and 2008b) and scientific descriptions of nearshore, offshore, or terrestrial species that use the study area during some portion of their life (Wydoski & Whitney 1979; Kruckeberg 1991; Page & Burr 1991; Kozloff 1993; Buchanan 2006; Dethier 2006; Fresh 2006; Brennan 2007; Kriete 2007; Mumford 2007; Penttila 2007; Guiry & Guiry 2008).



Source: King County (2006)

Figure 2.6-1
Study Area for Fisheries, Wildlife, and Vegetation

Two field surveys were performed; 6 and 7 November 2007 and 14 February 2008. The dates for each survey were chosen because they coincided with daytime low tides. The area covered by the first field survey included the nearshore and seawall between Pier 48 and Myrtle Edwards Park. A kayak was used to closely examine the nearshore environment throughout this area while a walk along the Seawall and associated piers allowed for a close examination of the terrestrial environment. The second field survey was conducted entirely on foot but covered a larger area from Pier 48 up to Pier 86. During the field surveys, all observed species were documented and their behavior, location, and surrounding habitat described (Appendix C).

Additional information was obtained on various fish species that reside in the nearshore of the study area and on various nearshore fisheries with interviews of fishermen and other people familiar with sport or subsistence fishing in the study area. During each interview, the interviewees were asked to answer standard questions in order to capture their knowledge specific to fishing in the study area (Appendix D). Little or no data on creel surveys or fishing licenses was available for the study area and therefore is not included in this document.

2.6.3. Species and Habitats

The species addressed in this section include vegetation, fish, and wildlife species that are commonly found in the marine and terrestrial environments around the Alaskan Way Seawall. This includes marine algae and terrestrial plants; benthic, epibenthic, pelagic, and terrestrial invertebrates; resident marine/estuarine fish and anadromous salmonids; waterbirds and terrestrial birds; and marine and terrestrial mammals. There are several species that have been listed either under the Federal Endangered Species Act (ESA) or by the State of Washington as species of concern. Listed species are discussed in more detail in the section on Threatened and Endangered Species (Section 2.7).

Habitat quality surrounding the Alaskan Way Seawall is generally poor as a result of the extensive development found throughout the area. Despite this, an extensive littoral zone with mixed substrates and two small sandy beaches can be found along the length of the Seawall (Tetra Tech 2008a). Habitat also exists in the deeper waters of both the nearshore and offshore, though these areas have been degraded by navigation facilities and pollution. Terrestrial habitat exists almost exclusively in a manmade state composed of a seawall, bulkheads, piers, and other urban structures (Tetra Tech 2008a). As a result, the species composition in the terrestrial habitat is composed almost entirely of non-native or weedy species.

Vegetation

Vegetation found in the Alaskan Way Seawall study area includes marine algae, riparian vegetation, and upland vegetation. The majority of the vegetation found in the study area is the nearshore community of marine algae that occupies the areas of open water along the seawall (Tetra Tech 2008a). This community is composed of a variety of green, red, and brown macroalgae commonly found in other shallow nearshore areas of Puget Sound. These algal species essentially cover the substrate at the base of the Seawall to depth of about 30 feet wherever sufficient large quarry spalls, gravel, cobbles, or appropriate debris are present for attachment. Terrestrial vegetation is very limited and is only found as the occasional riparian species living on the Seawall or a pier, or as street trees or ornamental plantings.

Marine Algae

The waters of Elliott Bay host a wide diversity of marine algae; a pattern tied to the presence of three major substrate types and somewhat protected waters throughout the area (albeit disturbed by human activity). Multiple species of green, brown, and red algae reside throughout the littoral zone around the Seawall. Man made substrates such as floating docks and pilings are dominated by two algae species; sea lettuce (*Ulva lactuca*) (20-40% of cover) and rockweed (*Fucus gardneri*) (20-40% of cover). Other species, however, are also common, with sugar wrack (*Saccharina latissima*), *Codium fragile* subsp. *fragile*, *Polyneura latissima*, and *Membranoptera platyphylla* having patchy distributions and relatively low densities (Tetra Tech 2008a). Substrates found throughout the littoral and shallow subtidal zones tend to be composed of either riprap lying at the base of the Seawall, quarry spalls scattered from the low tide mark down through the subtidal zone, and sand which is dominant at deeper subtidal depths, but found only at two littoral locations; immediately north of Pier 48 and north of Pier 70 (Tetra Tech 2008a). Algae species common to rocky areas include *Fucus spiralis*, *Endocladia muricata*, *Gigartina papillata*, feather boa kelp (*Egregia menziesii*), *Corallina* sp., and winged kelp (*Alaria* sp.). Mats of bull kelp (*Nereocystis lurtkeana*) are present in small pockets at various locations along the northern Seawall, north of Pier 56 and south of Piers 67, 69, and 70. Three particularly large mats of bull kelp are found between Piers 53 and 54, 67 and 69, and north of Pier 63 on the south side of Bell Street Marina (Tetra Tech 2008a; WDNR 2007). This distribution seems to be associated with rocky substrate for attachment, water depths between 7 and 15 feet, and areas between piers that are absent of docks or boat launches and therefore, disturbances by boats. Sandy substrate, though limited to only a few small areas north of Pier 48 (~200 square feet at low tide), north of Pier 57, south of Pier 62/63, and north of Pier 70, could provide suitable habitat for eelgrass (*Zostera marina* and *Z. japonica*). However, no eelgrass was observed in the study area during field observation of environmental conditions and habitat (Kozloff 1993; NRC 2001; COS 2006; Tetra Tech 2008a; Mumford 2007; Guiry & Guiry 2008).

Terrestrial Plants

Terrestrial plants are also present on the Seawall and its associated piers, though many species are non-native and the available habitat is limited to planters or areas of neglect on these man made structures. Butterfly bush (*Buddleja* sp.), Himalayan blackberry (*Rubus discolor*), and mosses can be found growing out of the top of the Seawall while licorice fern (*Polypodium glycyrrhiza*), sword fern (*Polystichum munitum*), and trailing blackberry (*Rubus ursinus*) are present in areas on various piers (Tetra Tech 2008a). Although native trees are almost entirely absent in the study area, a few street trees have been planted along the edge of Alaskan Way and woody plants can occasionally be found in planters on the piers. North of the Seawall, in Myrtle Edwards Park, various ornamental conifers and deciduous trees are found distributed across an expanse of mowed grass. Some native species such as quaking aspen (*Populus tremuloides*), shore pine (*Pinus contorta* var. *contorta*), and various native grasses and wildflowers have also been restored in this area.

Invertebrates

Various invertebrate species occur in the nearshore and benthic environments off of the Alaskan Way Seawall (Tetra Tech 2008a). Invertebrates that are present in this area include various species of cnidarians (anemones), poriferans (sponges), mollusks (gastropods), arthropods (crustaceans), echinoderms (starfish and allies), and terrestrial insects, which are often an important prey item for juvenile salmonids. The various invertebrates discussed in this section will be grouped as benthic and epibenthic invertebrates, pelagic invertebrates, and terrestrial insects.

Benthic and Epibenthic Invertebrates

The most ubiquitous intertidal invertebrate along the Alaskan Way Seawall is the acorn barnacle (*Balanus glandula*) (~75% of the invertebrate species composition), which can be found in various life stages blanketing the entire littoral zone of the Seawall (Tetra Tech 2008a). Another common barnacle is *Chthamalus dalli*, though it is almost exclusively limited to rocky habitats of the nearshore (Kozloff 1993; Tetra Tech 2008a). Blue mussels (*Mytilus edulis*) and black turban snails (*Tegula funebralis*), are also very common on the pilings adjacent to the Seawall, although they are in lower densities relative to either of the barnacle species (Tetra Tech 2008a).

North of Pier 55, the diversity of marine invertebrates increases and species such as ochre starfish (*Pisaster ochraceus*), sea snail (*Littorina* sp.), mask limpets (*Notoacmaea persona*), and giant green anemones (*Anthoplura xanthogrammica*) begin to appear in low densities (Tetra Tech 2008a). Two species of sponges; (*Haliclona* sp. and *Halichondria bowerbanki)* are also present in very low densities in this area. Hairy crabs (*Telmessus cheiragonus*), coonstripe shrimp (*Pandalus hypsinotus*), and Pacific octopus (*Enteroctopus dofleini*) are often present around Pier 59 (COS 2006). Sunflower star (*Pycnopodia helianthoides*), bat star (*Patiria miniata*), and Pacific henricia (*Henricia leviuscula*) are also present near the Seawall in the protected waters, such as those found at the Bell Street Marina, near Pier 66. Occasionally, Dungeness crab (*Cancer magister*), spider crab (Majidae), shore crab

(*Hemigrapsus* sp.), and helmet crab (Cheiragonidae), are also found in this area (WSDOT 2004; Toft & Cordell 2006; Tetra Tech 2008a).

The diversity and density of invertebrate species increases as one moves north along and past the Seawall, with the areas between Pier 70 and Pier 86, adjacent to the Olympic Sculpture Park and Myrtle Edwards Park having the highest densities (Tetra Tech 2008a). Some species such as kelp crab (Epialtidae) and red rock crab (*Cancer productus)* were only seen in this area while other species that were present in more southerly areas along the Seawall, such as ocher starfish and bat star tend to be in higher densities in this area (Tetra Tech 2008a).

Pilings and other structural components associated with docks and piers host the same species found on the Seawall though densities tend to differ. Blue mussels and acorn barnacles dominate these areas while giant green anemones, ocher starfish, black turban snails, and mask limpets are present in relatively lower densities (Tetra Tech 2008a). Two clear patterns observed in this area are that the highest densities of species are associated with surfaces facing away from wave action and on substrates not composed of steel (Tetra Tech 2008a). Steel structures only hosted two species; blue mussels and giant acorn barnacles with both having very low densities relative to other substrates. Various non-native invertebrates have been reported to also be present in the nearshore habitat of the Seawall. These include club tunicate (*Styela clava*), Manila clam (*Venerupis philippinarum*), European green crab (*Carcinus maenas*), freshwater hydroid (*Cordylophora caspia*), mud snail (*Batillaria attramentaria*), slipper limpet (*Crepidula fornicate*), mouse-ear marshsnail (*Myosotella myosotis*), giant oyster (*Crassostrea gigas*), blue mussel (*Mytilus galloprovincialis*), soft-shelled clam (*Mya arenaria*), and savoury clam (*Nuttallia obscurata*) (Kozloff 1993; KCEL 1998; Cohen, *et al*. 2001; Tetra Tech 2008a).

Various benthic and epibenthic invertebrate species are important as food sources for salmonids found in the nearshore of Elliott Bay. Harpacticoid copepods and gammarid amphipods, in particular, tend to be the most important prey items for juvenile salmon in these areas (Fresh 2006).

Pelagic Invertebrates

Squid species such as *Loligo opalescens* and *Gonatus fabricii* are common nocturnal visitors to the pelagic waters off of the Seawall (Kozloff 1993; KCEL 1998; Tetra Tech 2008b). These species are most common in the nearshore of Elliott Bay in October and November, during breeding season, and are often attracted to the Seawall by the various lights present in the area. A popular fishery exists for these species with most of the fishing occurring off of Pier 86 though all piers in the study area are used at times (Tetra Tech 2008b). The substrate and characteristics of the deep nearshore waters of Elliott Bay, suggest that squid may lay eggs in the study area (Kozloff 1993; Tetra Tech 2008b). Little else is known about the demographics of these species.

Zooplankton represents an extremely diverse group of animals that include the larval stage of dozens of marine and estuarine phyla. In Puget Sound, including Elliott Bay, copepods dominate the zooplankton composition, while amphipods, mysids, various species of fish larvae, and euphausiids are all in abundance (Toft & Cordell 2006).

Terrestrial Invertebrates

Terrestrial insects are an important prey component for many insectivores in the nearshore including salmonids such as Chinook salmon and cutthroat trout, and various crab species. Some of the various insects found near the Seawall are dipteran flies (Chironomidae), springtails (*Collembola*), bark lice (Psocoptera), aphids (Homoptera), ants (Hymenoptera), and mites (Acarina) (Toft, *et al*. 2004). Densities of terrestrial insects in the nearshore is at its lowest where overhanging terrestrial vegetation has been reduced or eliminated, and man made structures dominate the landscape (Toft, *et al*. 2004). Because the entire length of the Seawall has minimal vegetation, densities of terrestrial insects are likely to be low (Tetra Tech 2008a). The more natural vegetation and beaches in Myrtle Edwards Park are expected to provide greater densities of terrestrial insects.

Fish

The nearshore waters of Elliott Bay adjacent to the Alaskan Way Seawall provide habitat for various species of marine fish (Appendix B). For this report, fish will be separated into two groups; resident marine/estuarine species and anadromous salmonid species.

Resident Marine/Estuarine Fish

Studies conducted just north of the Alaskan Way Seawall on fish assemblages documented many resident species in the nearshore (Toft, *et al*. 2004; Toft & Cordell 2006). Shiner perch was found to be the most abundant fish in the area, while pile perch and striped seaperch were also common. Pacific sand lance and Pacific herring were also found in relatively high densities, albeit only during the summer months. Similarly, larval fish were most abundant during the summer months. Predatory species which have been known to prey on salmonid fry were found to be rare. Examples of these species are bay pipefish, penpoint gunnel, kelp perch, lingcod, ratfish, buffalo sculpin, and tube-snout. Other species found in the areas of deeper water along the Seawall are English sole, rock sole, starry flounder, and various rockfish and smelt, and (Toft, *et al*. 2004).

Anadromous Salmonids

Eight species of native anadromous salmonids occur in Elliott Bay and are known to utilize the nearshore and offshore of the study area as both juveniles and adults (WSDOT 2004). These include Chinook salmon (*Oncorhynchus tshawytscha*), chum salmon (*Oncorhynchus keta*), pink salmon (*Oncorhynchus gorbuscha*), sockeye salmon (*Oncorhynchus nerka*), coho salmon (*Oncorhynchus kisutch*), steelhead trout (*Oncorhynchus mykiss*), bull trout (*Salvelinus confluentus*) (or Dolly Varden [*Salvelinus malma*]), and sea-run coastal cutthroat trout (*Salmo clarki clarki*) (Toft, *et al*. 2004; WSDOT 2004; Brennan & Higgins 2004; Toft & Cordell 2006; Fresh 2006). Juvenile salmon are especially prevalent in the nearshore and are sensitive to habitat modification, disturbance, and underwater noise (Feist 1991). As a result, they are the main focus of this section. Though overlaps in emigration and residence timing of juvenile salmon essentially ensure that at least one species can be found in the nearshore environment any time of year (Brennan & Higgins 2004), each species has different temporal and spatial patterns and therefore will be discussed separately. It should be noted that very little information is currently available on the distribution of salmonids immediately adjacent to the Alaskan Way Seawall or on recreational or commercial fishing for these species at or near the Seawall.

Chinook Salmon

Despite the highly urbanized nature of the Alaskan Way Seawall nearshore environment, juvenile Chinook salmon can be found in high densities at intermediate depths from spring to fall, though they can occur year round (Brennan, *et al*. 2004; Shannon & Taylor 2005; Fresh 2006). Peak use is normally observed in June, but there is significant year-to-year variability (Shannon & Taylor 2005). Chinook salmon migrate from their natal streams during two temporal peaks; in early summer for northern runs and in late summer for southern runs (Shannon & Taylor 2005). Their affinity for the nearshore is due primarily to the presence of structure and cover from predators (NMFS 2005) and its proximity to the terrestrial environment where terrestrial insects are available for prey (Brennan, *et al.* 2004; Toft & Cordell 2006). In addition, the nearshore environment provides optimal conditions necessary for plankton and other marine invertebrates to thrive, further enhancing the prey base in these areas (NMFS 2005). The diet of juvenile Chinook salmon varies seasonally and geographically, with insects being the dominant prey source one year in one location while planktonic organisms are the dominant prey source another year in another location (Duffy, *et al*. 2005). Juvenile Chinook salmon tend to prefer prey items such as bark lice (psocoptera), aphids (aphididae), midges (chironomidae), ants (formicidae), and various species of zooplankton (Brennan, *et al*. 2004). Once juvenile Chinook salmon begin their migration away from the nearshore, they seem to move long distances across deep open water to other nearshore habitats to mature (Brennan, *et al*. 2004). This tendency for Chinook salmon to remain and feed in the nearshore environment make them susceptible to accumulating toxins through biomagnification (from eating prey with high toxin levels) (PSP 2005).

Adult Chinook salmon occur near the Seawall between mid-June and early November (peaking in August) as they return to spawn in the Duwamish River (Brennan, *et al*. 2004; Duffy, *et al*. 2005; Fresh 2006). Though their route of migration is not fully understood, it is thought adults move across the open waters of

Puget Sound to the nearshore environments of Elliott Bay (Brennan, *et al*. 2004; Duffy, *et al*. 2005; Fresh 2006) where they remain briefly before they migrate up their natal stream. The population of Chinook salmon found in Elliott Bay is composed of a combination of native and hatchery stocks that originated in the Duwamish or other nearby river systems (Shannon & Taylor 2005).

Chum Salmon

Juvenile chum salmon are generally abundant in the nearshore waters of Elliott Bay (Brennan, *et al*. 2004; Fresh 2006), especially in the shallow surface waters around Pier 70 (Feist 1991; Toft & Cordell 2006). Peak abundance for juvenile chum salmon is in April but the high numbers tend to quickly taper down towards the end of May (Brennan & Higgins 2004; Toft & Cordell 2006). After leaving their natal streams, chum salmon reside in the nearshore environment for a few months with the exact duration and migration time varying across years and between regions (Duffy, *et al*. 2005). Compared to other salmonids, juvenile chum salmon tend to be the smallest in size when they enter the nearshore environment (Duffy, *et al*. 2005). They quickly develop; however, as they shift to a more varied nearshore diet incorporating epibenthic and insect prey such as bark lice (psocoptera), ants (formicidae), aphids (aphididae), and midges (chironomidae) (King County DNR 2000; Brennan & Higgins 2004; Duffy, *et al*. 2005). Little information is available on the demographics of adult chum salmon near the Alaskan Way Seawall or in Elliott Bay. Adult chum salmon tend to arrive in Elliott Bay around July and migrate up the Duwamish River or other rivers around August (Feist 1991).

Pink Salmon

Pink salmon in Puget Sound generally exhibit an odd-year spawning presence (Wydoski & Whitney 2003). Juvenile pink salmon are the second smallest salmonids found in the nearshore environment, also due to a rapid exodus from their natal streams after redd emergence (Duffy, *et al*. 2005). Because of their small size, juvenile pink salmon tend to be particularly dependant on marine nearshore food sources such as small copepods (King County DNR 2000; Duffy, *et al*. 2005). Juvenile pink salmon often congregate in high densities along stretches of beach towards the northern portion of Elliott Bay, from Myrtle Edwards Park to Discovery Park (Brennan & Higgins 2004). Their abundance peaks in April but their numbers drop dramatically after May (Brennan & Higgins 2004). Similar to chum salmon, little information is available on the demographics of adult pink salmon near the Alaskan Way Seawall or in Elliott Bay. No information on temporal patterns of adult pink salmon in Elliott Bay is available.

Sockeye Salmon

Juvenile sockeye salmon rear in freshwater lakes, such as Lake Washington (Fresh 2006) which are not directly connected to Elliott Bay. The time they spend in their natal lakes lasts between one and three years and is followed by migration to the ocean (WDFW 2006). Juvenile sockeye salmon tend to be found in the nearshore from the months of June and July (Brennan & Higgins 2004) with no peak in numbers being described. Little additional information is available on the demographics of adult sockeye salmon near the Alaskan Way Seawall or in Elliott Bay though it seems that they are present in the area from April through October (Tetra Tech 2008b).

Coho Salmon

Of all the salmon species, coho have the shortest duration and lowest abundances in the nearshore environment of Elliott Bay. Peak abundances tend to occur in May but small numbers of juveniles are still observed in the nearshore well into October (Brennan & Higgins 2004). Coho have a very regular life history with little variation in timing across years and among regions (Duffy, *et al*. 2005). Juvenile coho rear for at least one year in streams before they move to marine waters (Fresh 2006). Recent smolts tend to congregate in the greatest concentrations in the shallow waters of the nearshore (Toft & Cordell 2006). Favorite prey items for juvenile coho salmon are crustaceans such as *Cumella vulgaris* and *Lamprops quadriplicata* (King County DNR 2000). Coho, generally a year older than other salmonids in the nearshore, are often the largest juvenile salmonids found in the study area (King County DNR 2000). Little information is available on the demographics of adult coho salmon near the Alaskan Way Seawall or in Elliott Bay though they seem to be present in the study area during the late summer from August through September prior to migrating into their natal streams (Tetra Tech 2008b).

Steelhead Trout

Steelhead trout tend to occur within the nearshore study area in very low densities (Brennan & Higgins 2004; Toft & Cordell 2006; Tetra Tech 2008b). Even though most juvenile steelhead reside in freshwater for 2 years before migrating to marine habitats, multiple age classes have been known to be present in the nearshore environment (Brennan & Higgins 2004; Tetra Tech 2008b). The migration pattern of steelhead in Puget Sound is not well understood; however, once in the marine environment, it is believed that steelhead smolts move quickly offshore to open water (Hartt & Dell 1986). Adult steelhead occur in Puget Sound for summer and winter runs and may be present in the nearshore during anytime of the year, though their local demographics have not been studied fully (Toft & Cordell 2006). Evidence suggests, however, that steelhead congregate near southern Elliott Bay and migrate up the Duwamish River in mid December (Tetra Tech 2008b)

Bull Trout & Dolly Varden

Bull trout and Dolly Varden are very closely related and once were considered the same species. These species exhibit differences in size, body characteristics, coloration, and behavior across their range. Even though bull trout are mainly an inland species while Dolly Varden are more common in coastal areas, both are present in Elliott Bay and exhibit seemingly similar life histories and therefore, will be discussed together (USFWS 1997 and 1998; Berge 2001; USFWS 2003).

Anadromous populations of these species exhibit a spectrum of behaviors from being non-migratory (resident) to anadromous, to those that switch life histories from year to year (Goetz, *et al.* 2004). Juveniles in Puget Sound typically migrate from freshwater natal areas throughout late winter into spring. They forage in estuarine and marine nearshore environments, feeding primarily on smelt, herring, small salmonids, perch, sand lance, and invertebrates (Goetz, *et al.* 2004). They then re-enter fresh water in late spring through summer to feed, seek temperature refuge, or to spawn, returning to the sea the following spring (Goetz, *et al*. 2004). Individuals may alternate this behavior from year to year with it not being fully manifested in younger fish. It is important to note, however, that even though these species may occasionally use the study area for foraging or migration, no specific data is available in the study area.

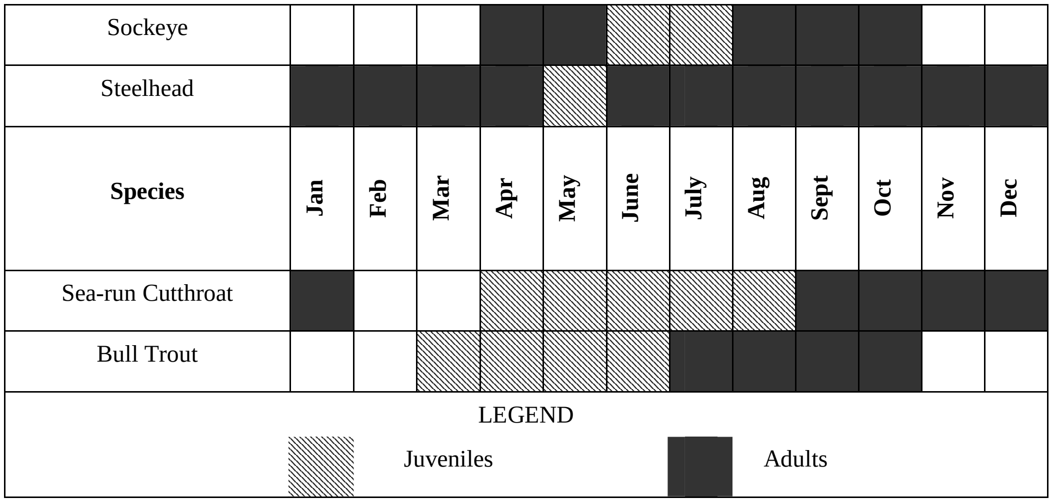
The few accounts of these species in the area include an observation of a single bull trout in the vicinity of Pier 90/91 along the Seattle waterfront (Goetz, *et al.* 2004), reports of bull trout migrating into Elliott Bay from rivers to the north and the south of the bay, (Goetz, *et al*. 2004; Berge & Mavros 2001) and some individuals of possibly either species being present in the Duwamish River estuary.

Coastal Sea-Run Cutthroat Trout

Cutthroat trout have been known to use the nearshore and deep waters of Central Puget Sound (Brennan & Higgins 2004). Of these individuals, those found in the nearshore have been noted to belong to multiple year classes (Brennan & Higgins 2004). Smolts generally migrate to estuaries from April through June and may remain in marine and estuarine waters for several months. Adults typically return to streams from October through January and spawn in late winter (Wydoski & Whitney 2003).

Table 2.6-1 Salmonid Seasonal Timing in the Elliott Bay Nearshore

Species	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**June**	**July**	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**
Chinook												
Coho												
Chum												
Pink												



Birds

Many bird species use the Alaskan Way Seawall study area throughout the year. These species include a diverse mix of waders, shorebirds, waterfowl, seabirds, passerines, and raptors. Only a few of these species can be found on the waterfront and only urban birds, such as pigeons and house sparrows nest in the area (COS 2006). In this section, birds will be categorized as being either water birds (waterfowl or seabirds) or terrestrial/shoreline birds (raptors, waders, shorebirds, or passerines). This designation is based on where these species are typically seen when in the project area.

Waterbirds

Waterbird species composition and density varies widely by season around the Alaskan Way Seawall. A few species, however, can be found around the nearshore year round with some of the most common being herring gull (*Larus argentatus*), California gull (*Larus californicus*), and ring-billed gull (*Larus delawarensis*) (Eissinger 2007; Tetra Tech 2008a). Examples of other common species that can be found in the study area most of the year are double-crested cormorant (*Phalacrocorax auritus*), pigeon guillemot (*Cepphus columba*), common goldeneye (*Bucephala clangula*), surf scoter (*Melanitta perspicillata*), common merganser (*Mergus merganser*), and western grebe (*Aechmophorus occidentalis*). All of these species are more common north of Piers 62/63 though they are occasionally seen around the southern half of the Seawall (Tetra Tech 2008a).

Winter at Elliott Bay typically hosts the highest numbers of waterbirds with total densities often ranging from 125 to 250 individuals per square mile (Nysewander, *et al.* 2005; Tetra Tech 2008a). These high densities are attributed to the large influx of migrant species that seek shelter and feeding habitat in the mostly protected waters of Elliott Bay, particularly south of Pier 86 (Tetra Tech 2008a). Some species regularly seen in the study area during the winter season are red-necked grebe (*Podiceps grisegena*), lesser scaup (*Aythya affinis*), American wigeon (*Anas americana*), hooded merganser (*Lyphodytes cucullatus*), glaucus gull (*Larus hyperboreus*), pigeon guillemot (*Cepphus columba*), common murre (*Uria aalge*), rhinoceros auklet (*Cerorhinca monocerata*), and Canada goose (*Branta canadensis*).

The summer season attracts few birds beyond those that are resident in the area year round. Of these birds, most have the ability to nest close to areas frequently disturbed and heavily altered by human activities. Total bird densities during this season range from 45 to 125 individuals per square mile with the highest densities being found off shore (Nysewander, *et al*. 2005).

Terrestrial/Shoreline Birds

Introduced species are the most prevalent terrestrial and/or shoreline birds in the study area with house sparrow (*Passer domesticus*), European starling (*Sturnus vulgaris*), and rock pigeon (*Columba livia*) being ubiquitous around the entire Seawall and north into Myrtle Edwards Park (Tetra Tech 2008a). American crow (*Corvus brachyrhynchos*), Northwestern crow (*Corax caurinus*), and Brewer's blackbird (*Euphagus cyanocephalus*) are also common around the area but in lower densities. Belted kingfisher (*Ceryle alcyon*) are usually heard calling around Piers 62/63 and great blue heron (*Ardea herodias*) often hunt at the water line along shore (Eissinger 2007; Tetra Tech 2008a and 2008b). Black-capped chickadee (*Parus atricapillus*) are native to the area and commonly nest in the ornamental trees planted along Alaskan Way and in Myrtle Edwards Park (WSDOT 2004; WDFW 2007; Tetra Tech 2008a). Similarly, purple martin (*Progne subis*) and violet-green swallow (*Tachycineta thalassina*) also nest in the area, though they mostly rely on artificial nest structures or cavities in buildings (WDFW 2007; Tetra Tech 2008a).

Four raptor species are seen periodically in the study area; bald eagle (*Haliaeetus leucocephalus*), peregrine falcon (*Falco peregrinus*), osprey (*Pandion haliaetus*), and red-tailed hawk (*Buteo jamaicensis*) (WDFW 2007; Tetra Tech 2008a). The infrequency of sightings is attributed to these species only using the study area part time as foraging habitat. Although both bald eagle and osprey nest south of the study area along the Duwamish River (WSDOT 2004; Buchanan 2006; USFWS 2007), these species only use the nearshore and offshore waters of the study area to hunt (WSDOT 2004; WDFW 2007; Tetra Tech 2008a). Similarly, peregrine falcon are commonly seen hunting in the airspace around the study area, however, they tend to nest inland on various tall structures in downtown Seattle such as high-rise buildings and towers (WDFW 2007; FRG 2008). Up to two pairs of peregrine falcons have been documented to nest in the Seattle area during a single breeding season (FRG 2008, WDFW 2007). Red-tailed hawk are the most infrequent raptor in the study area (USFWS 2007); a trend most likely due to their need for more open, less frequently disturbed terrestrial habitat for hunting. Similar to the peregrine falcon, red-tailed hawk has been documented nesting on various manmade structures in the urbanized areas around Elliott Bay (WDFW 2007).

Mammals

Various mammal species are found or are potentially found in the sparse vegetation and highly urbanized habitat of the terrestrial environment along the Seawall or in the nearshore and offshore waters of Elliott Bay. The majority of terrestrial mammals commonly found in the study area are non-native. In contrast, all marine mammals that are found in Elliott Bay are native, but are infrequent in their occurrence.

Marine Mammals

The marine mammal species addressed in this section include all marine mammals that permanently or seasonally occur within the study area. This section will focus on those species that may overlap with the nearshore waters of Elliott Bay and therefore have the potential to be affected by construction activities at the Seawall. Species that are found in the study area include orca (*Orcinus orca*), Dall's porpoise (*Phocoenoides dalli*), and gray whale (*Eschrichtius robustus*) which are seen offshore in Elliott Bay. Harbor seal (*Phoca vitulina*) and California sea lion (*Zalophus californicus*) are more common and occur in the nearshore around various piers near the Seawall (Gretchen 1986; Osborne, *et al*.1988).

It should be noted that various marine mammals that use the waters of Elliott Bay have been shown to have elevated levels of various anthropogenic toxins in their systems (NOAA 1993; Ross, *et al*. 1998; USEPA 1999; Cullon, *et al*. 2001; Lambourn, *et al*. 2001; NOAA 2007). The high levels of persistent organic pollutants such as PCBs (polychlorinated biphenyls), DDT (dichloro-diphenyl-trichloroethane), and PBDE (polybrominated diphenyl ethers) that persist in the study area are most likely the cause of unusual physical problems seen in these mammals; such as compromised immune and reproductive systems that often leads to reduced fecundity and increased mortality rates (NOAA 1993; Ross, *et al*. 1998; USEPA 1999; Cullon, *et al*. 2001; Lambourn, *et al*. 2001; NOAA 2007).

Orca

Two populations of orcas have been documented in the waters of Elliott Bay; southern resident orcas and transient orcas (Kriete 2007). Southern resident orcas, while in the study area, feed primarily on salmon and other fish species while transient orcas hunt marine mammals such as harbor seals and bottom fish (Osborne, *et al*. 1988; Kriete 2007). As a community, southern resident orcas are composed of three pods, numbering between 90 and 100 whales that only reside in the inland waters of Puget Sound, the Strait of Juan de Fuca and the Strait of Georgia (CWR 2008). These orcas are often found in central Puget Sound during the summer and early fall, but commonly travel through Elliott Bay while they follow migrating chum and Chinook salmon (Osborne, *et al*. 1988; Osborne 1999; Kriete 2007). During late autumn, winter, and early spring, the ranges and movements of southern resident orcas are not well understood. This population has experienced a marked decline in size triggering a recent listing under the Endangered Species Act (NOAA 2008). It is thought that this decline has been caused by a combination of natural factors, including El Niño and La Niña ocean temperature fluctuations, and human pressures that have led to reductions in prey resources, disturbance from vessel traffic, and increasing toxin levels in their environment (Osborne, *et al*. 1988).

Transient orcas in Puget Sound have somewhat unpredictable movements that appear to be coupled to the location of their preferred prey species; harbor seals and bottom fish (Osborne, *et al.* 1988; Kriete 2007). These orcas have been known to appear almost anywhere in Puget Sound including shallow estuaries and dead-end bays, almost anytime of the year (Osborne, *et al*. 1988; Kriete 2007). Most transient orcas along the Puget Sound shoreline are recorded during the summer and early fall; a time period that coincides with seal pupping (Osborne *et al*. 1988; Kriete 2007). Because of infrequent observations of these orcas, the distribution of this group is poorly understood and therefore, little is known about its use of the study area.

Despite the relative frequency of orca sightings in the nearshore and offshore environments of Puget Sound, orcas have not been documented using the nearshore waters of Elliott Bay. It is therefore unknown if or how frequently they may utilize the waters around the Alaskan Way Seawall.

Dall's Porpoise

Dall's porpoises are common in the offshore waters of Elliott Bay throughout the year. This species tends to feed on fish, krill, and squid that are found in the area (Osborne, *et al*. 1988). Little else is known about where this species occurs in Elliott Bay.

Gray Whale

Gray whales have been observed in Elliott Bay in the offshore waters of the study area (Glover 1999). One gray whale sighted in April of 1999 was observed swimming near the Colman Dock ferry terminal and may have been circling the inner and outer bay and around Vashon Island for over a month (Glover 1999). Most of these sightings occurred between March and May during and immediately following their northward migration with some whales possibly using the greater Puget Sound area as a summering ground (NOAA 1993; Osborne, *et al.* 1988). In general, gray whales rarely move through the offshore waters of Elliott Bay and as a result, no further information exists on this species in the study area

Harbor Seal

Harbor seals are the only pinniped found in the waters of Washington State year round and are the only seal that breeds in the area (Ross, *et al.* 1998, USEPA 1999, Jeffries, *et al.* 2000). Harbor seals prefer to haul out on protected beaches, spits, bars, rocks, and log rafts in the area to bask and sleep. Though haul-out sites have been documented on the shores surrounding Elliott Bay including near Pier 86 (Osborne, *et al*. 1988), none are present immediately along the Seawall. Harbor seals are opportunistic feeders, primarily consuming bottom dwelling and schooling prey (Osborne, *et al*. 1988). Common prey species include herring, flounder, and perch. They will also consume octopus, squid, and shrimp. A harbor seal's diet varies seasonally and regionally and often is subject to local prey availability (Ross, *et al*. 1998; USEPA 1999; Jeffries, *et al*. 2000; TGBPSWG 2002). Harbor seals are often seen in the study area; however, little information is available on their demographics in the area.

California Sea Lion

Male California sea lions migrate to central Puget Sound and Elliott Bay in the fall and remain until the late spring after which most return to breed in California and Mexico (Osborne, *et al*. 1988; Jeffries, *et al*. 2000). The main haul-out and rafting area near the Seawall is located near Pier 86 (Jeffries, *et al*. 2000). California sea lions primarily feed on hake and herring, although some also prey upon salmon and steelhead that are confined to small areas such as the Ballard locks (Everitt, *et al*. 1981; Gretchen 1986; Osborne, *et al*. 1988).

Terrestrial Mammals

Very few species of terrestrial mammals are present within the study area. Species that occur include non-native species such as the black rat (*Rattus rattus*), Norway rat (*Rattus norvegicus*), house mouse (*Mus musculus*), and eastern gray squirrel (*Sciurus carolinensis*). Rats and mice may occur in buildings or in vegetated areas under the Alaskan Way Viaduct or in Myrtle Edwards Park and the Olympic Sculpture Park to the north of the study area. Eastern gray squirrels are most likely to be in or near parks, where there are trees available for cover and food (Tetra Tech 2008a). Domesticated animals such as dogs and cats may also be present as feral or human companion animals. Native species that may occasionally be present in the study area are include opossum (*Didelphis virginiana*), raccoon (*Procyon lotor*), and coyote (*Canis latrans*). These species most likely frequent nearby parks.

Several native bat species occasionally roost in buildings or other structures and forage in the study area. WSDOT (2004) identified eight species of bats that may occur in the project area. Of these, Townsend’s big-eared bat (*Plecotus townsendii*) is a candidate for listing in Washington State (WDFW 2007). Regular large concentrations of bats in the genus *Myotis* (four have been identified as potentially occurring in the study area) and big brown bat (*Eptesicus fuscus*) (WSDOT 2004) are also considered species of interest by the WDFW (2006). It should be noted that the PHS database does not contain records of any of these species within the study area (WDFW 2007).

2.6.4. Fishing

In order to quantify sport fishing patterns in this area, a concerted effort was made to survey the anglers who fish from the many structures associated with the Alaska Way Seawall. Despite this effort, anglers proved to be rare and few actual interviews could be conducted. This outcome occurred due to the seasonality of fishing in this area and the timing of the survey period. The few interviews completed, however, did provide insight into how sport anglers utilize the study area. See Appendix D for more information on the interviews.

Fishing in the study area is a favored activity for many Seattle area residents. While most fishers prefer to fish from boats, a significant number fish off of the various piers along the Seawall and from the shores of Myrtle Edwards Park (Tetra Tech 2008b). The favored fishing spot is north of the Seawall at Pier 82 (Elliott Bay Park Fishing Pier). This popular spot is the most consistently used and has been known to attract over 50 people per-evening during peak runs but averages between 2 and 10 fishermen per evening during the remainder of the fishing season. The relative popularity of Pier 82 is due to the widely held notion that compared to surrounding areas; its waters attract more fish species in higher densities with individuals being of larger size. Piers 62/63 are also relatively popular with sport anglers although on average, they are used less frequently than Pier 82 (Tetra Tech 2008b).

Fishing occurs year-round in the study area for species such as shiner perch, pile perch, and Pacific herring; however, most fishing occurs from late summer through to late winter when most of the fisheries are open. Squid fishing has become one of the most popular fisheries in the study area attracting evening crowds to well lit piers from October through to the end of January. The various salmonid runs that move through the study area also have very popular fisheries. Coho fishing occurs in the late summer, blackmouth Chinook occurs in the winter, and chum, silver, sockeye, and Chinook all occur from April through to October. The two trout species that occur in the study area, bull trout and steelhead trout, are apparently rare and not often targeted by fisherman (Tetra Tech 2008b). Other species that are fished for in the study area include ling cod and rock fish from May through June and crustaceans such as red and Dungeness crab from July through September (Tetra Tech 2008b).

2.7. Threatened and Endangered Species

2.7.1. Overview

Nineteen listed, proposed, candidate, or species of concern, as listed by the state of Washington (WDFW 2007) or U.S. Fish and Wildlife Service (USFWS 2007), are known to or potentially occur in the Alaskan Way Seawall project are (Table 2.7-1). For each species, existing conditions including natural history, preferred habitat, listing status, and likelihood of occurrence in the study area are discussed below.

Table 2.7-1. List Of Endangered, Threatened, Candidate Species, and Species of Concern

Scientific Name	Common Name	Preferred Habitat	Status Federal/ State	Listing Date (Citation Page)	Likelihood of Occurrence in the Action Area
Endangered Species					
Dermochelys coriacea	Leatherback turtle	A pelagic turtle, that forages in coastal waters. They are the most wide ranging sea turtle species. Adults can tolerate a wide range of water temperatures, and have been sighted along the entire coast of the US. Feeding leatherbacks are occasionally sighted in the Strait of Juan de Fuca.	E/E	June 02, 1970 (35 FR 8491 8498)	U
Orcinus orca	Southern resident killer whale	They reside in inland waters of WA and southern BC from early spring until late fall. Early autumn they move into Puget Sound to feed on Chinook and chum salmon.	E/E	November 18, 2005 (70 FR 69903)	C
Megaptera novaeangliae	Humpback whale	Humpback habitat is usually in offshore waters; continental shelf and seaward; and only occasionally wander into coastal bays. They regularly migrate through the Strait of Juan de Fuca.	E/E	June 02, 1970 (35 FR 8491)	U
Eumetopias jubatus	Steller sea lion	Forage mostly near shore and over the continental shelf for various fish species. Frequents rocky shores where they often haul out and the coastal waters along them. They often winter in protected bays and occasionally swim up rivers. They occur in Puget Sound.	E/T	November 26, 1990 (55 FR 49204)	C

Table 2.7-1. List Of Endangered, Threatened, Candidate Species, and Species of Concern

Scientific Name	Common Name	Preferred Habitat	Status Federal/ State	Listing Date (Citation Page)	Likelihood of Occurrence in the Action Area
Threatened Species					
Howellia aquatilis	Water howellia	Aquatic environment with dry autumns and wet springs with fertile, highly organic soils that typically flood from snowmelts and spring rains and dry out during the growing season.	T/--	July 14, 1994 (59 FR 35860 35864)	U
Oncorhynchus tshawytscha	Chinook salmon (Puget Sound)	Adults reside in open ocean until they migrate through nearshore waters of Puget Sound to their natal stream to spawn. Fry reside in estuaries and their associated wetlands prior to their departure to the open ocean.	T/C	June 28, 2005 (70 FR 37160)	C
Oncorhynchus mykiss	Steelhead trout (Puget Sound)	Reside in marine and estuarine waters of Puget Sound until ready to ascend natal streams to spawn. May spawn multiple times.	T/--	May, 11 2007 (72 FR 26722)	C
Salvelinus confluentus & *S. malma*	Bull trout & Dolly Varden	They require especially clean, cold water from headwater lakes and streams that drain high mountainous areas. The anadromous form moves from spawning and rearing habitats to foraging and overwintering habitats in nearshore and open ocean.	T/C & P/--	November 01, 1999 (64 FR 58909) & January 09, 2001 (66 FR 1628)	C
Chelonia mydas	Green turtle	Found in convergence zones in the open ocean and benthic feeding grounds in coastal areas. Small individuals reside in the offshore where they feed near the surface, large turtles travel to nearshore benthic habitats to feed. They have been seen north; up to southern Alaska but most commonly occur south of San Diego.	T/T	July 28, 1978 (43 FR 32800 32811)	U
Caretta caretta	Loggerhead turtle	They occupy the oceanic zone and the neritic zone but reside close to the water surface. They have been reported as far north as Alaska. Occasional sightings off the coast of WA but most northern records are of juveniles off the coast of California.	T/T	July 28, 1978 (43 FR 32800 32811)	U

Table 2.7-1. List Of Endangered, Threatened, Candidate Species, and Species of Concern

Scientific Name	Common Name	Preferred Habitat	Status Federal/ State	Listing Date (Citation Page)	Likelihood of Occurrence in the Action Area
Lepidochelys olivacea	Olive ridley turtle	Mainly a pelagic turtle but has been known to inhabit coastal areas, including bays and estuaries. They occur from Southern California to Northern Chile; rarely seen north.	T/--	July 28, 1978 (43 FR 32800 32811)	U
Charadrius alexandrinus nivosus	Western snowy plover	Occurs along the west coast. Preferred habitats include sandy coastal beaches and shallow alkaline lakes. Occasionally seen in Puget Sound region.	T/E	March 05, 1993 (58 FR 12864 12874)	U
Brachyramphus marmoratus	Marbled murrelet	Spends majority of time at sea in small groups or pairs; on calm, protected coastal waters just beyond breakers in Puget Sound. They forage in nearshore waters to depths of 160 feet. Nests in old growth coastal conifer forests.	T/T	October 01, 1992 (57 FR 45328)	U
Species of Concern					
Acipenser medirostris	Green sturgeon	Found in both freshwater and saltwater; spawn in deep pools in large, turbulent, river mainstems with cold, clean water and rocky substrates. Adults reside in bays and estuaries. Sometimes recovered in Puget Sound as incidental harvest.	C/M	na (na)	P
Lampetra ayresi	River lamprey	Adults are anadromous, feeding in estuaries and at sea and spawning over gravel riffles in clear freshwater streams.	C/C	na (na)	C
Oncorhynchus kisutch	Coho salmon (Puget Sound)	Adults reside in open ocean until they migrate through nearshore waters to their natal stream to spawn.	C/--	na (na)	C
Sitta carolinensis aculeata	Slender-billed white-breasted nuthatch	Common and widespread, inhabits mixed deciduous and coniferous forests; prefer the presence of oak trees.	C/C	na (na)	U
Corynorhinus townsendii townsendii	Pacific Townsend's big-eared bat	They rely heavily on caves and mines for roost sites and are very sensitive to disturbances. They tend to not use bat houses but often are found roosting in old buildings or in other manmade	C/C	na (na)	U

Table 2.7-1. List Of Endangered, Threatened, Candidate Species, and Species of Concern

Scientific Name	Common Name	Preferred Habitat	Status Federal/ State	Listing Date (Citation Page)	Likelihood of Occurrence in the Action Area
		structures. Ten of twelve maternity roosts known in WA are in the western part of the state.			
Species of Concern (WA)					
Lampetra tridentata	Pacific lamprey	Anadromous. Adults spawn in runs and riffles in shallow depressions, on rock, sand, or gravel of clear streams. In open marine waters, they reside at depths around 600 to 3,000 ft.	--/M	na (na)	C
Delisted Species					
Oncorhynchus clarki clarki	Coastal cutthroat trout	Prefer small, low gradient coastal streams and estuarine habitats with cool water with an abundance of instream cover. Adults winter in streams, pools, and open ocean migrating back to their natal streams to spawn. Taxonomic revision and delisting based on improved understanding.	--/--	April 26, 2000 (65 FR 24420 24422	C
Haliaeetus leucocephalus	Bald eagle	Timber with large trees near marine water, lake or river shore. Large trees along shorelines are important perch sites for foraging. Regularly seen around Puget Sound.	D/C	July 09, 2007 (72 FR 37345 37372)	C
Falco peregrinus	Peregrine falcon	Preferred habitats include tundra, savannas, coasts, mountains, and tall buildings. Preys mainly on birds but also on small mammals and reptiles.	D/S	October 13, 2006 (71 FR 60563)	C

Sources: Steiger & Calambokidis 1986, Adams et al. 2002, Tsao et. al 2005, USFWS-TESS 2007, WDFW 2007, Kriete 2007, Tetra Tech, Inc. 2007, 2008a, Tetra Tech, Inc. 2008b
Note: No federally or state protected invertebrate, amphibian, or reptile species potentially occurs in the study area.

Federal Status:	State Status:	Likelihood of Occurrence in the Action Area:
C = Species of Concern	C = Species of Concern	U = Unlikely
D = Delisted Taxon	E = Endangered	P = Potential
E = Endangered	S = Sensitive	C = Confirmed
P = Proposed Species	M = Monitor	na = No information Available
T = Threatened	T = Threatened	
-- = No Listing	-- = No Listing	

2.7.2. Study Area

The Alaskan Way Seawall region of interest is composed of approximately 8 square miles of Elliott Bay stretching from Denny Way in the north, down to S. Main Street to the south and westward to include Elliott Bay in its entirety (see Figure 2.6-1). Elliott Bay is regarded as one of the most heavily urbanized and polluted areas in Puget Sound. The majority of terrestrial, nearshore, and offshore environments that existed naturally in the area either are no longer present or are compromised. Many species have been affected by extensive development including those that are now federally or state listed (USFWS 2007), or Washington Department of Fish and Wildlife Priority species (WDFW 2007). Recently, however, some terrestrial and marine environments north of the Seawall have been partially restored to a natural state in an effort to increase wildlife habitat in the area (see King County DNR 2003, POS 2005).

2.7.3. Methodology

This section presents information on the threatened and endangered marine and terrestrial species that may reside in the Alaskan Way Seawall study area. Information presented for each species consists of natural history, distribution information, likelihood of occurrence, and other pertinent issues. Information was collected from the most current sources to date, such as the WSDOT Biological Assessment – *SR 99: Alaskan Way Viaduct & Seawall Replacement Project* (2006a), USFWS – *Threatened and Endangered Species System* (2007); WDFW – *Species of Concern* (2007), and recent field observations (Tetra Tech, Inc. 2008a) and interviews with people involved in various fisheries (Tetra Tech, Inc. 2008b). Recent findings have suggested that construction activities can affect species in the surrounding areas such as terrestrial habitats, airspace, and both nearshore and offshore habitats (Feist 1991; Stotz & Colby 2001; Nedwell, *et al*. 2003; WSDOT 2006a). Only the species that are likely to be present in the study area are discussed in more detail below.

2.7.4. Species and Habitat

Endangered Species

Leatherback Turtle

Status: The leatherback turtle was listed as endangered under the ESA in 1970 (35 FR 8495). There is no proposed or designated critical habitat in the study area.

Biology: The leatherback is the largest living reptile in the world. Mature adults can be over 80 inches in length and weigh over 2000 pounds. They have a ridged carapace and relatively large flippers that allow them to make long distance foraging migrations common to this species. Their pointed tooth-like cusps, sharp edged jaws, and backward-pointing spines in their mouth and throat are adapted for a diet of soft-bodied pelagic prey, such as jellyfish and salps. Leatherbacks are commonly known as pelagic animals, but also forage in coastal waters. They are long distance migrants, often journeying thousands of miles between their nesting sites in the tropics and wintering areas in the temperate Pacific and Atlantic oceans. After nesting, female leatherbacks migrate from tropical waters to more temperate latitudes, which support high densities of jellyfish prey in the summer (NOAA 2008a).

The population of leatherback turtles in the Pacific has declined 97% since 1982 making their conservation critical. They are very rare in Puget Sound and have not been documented in Elliott Bay. This species is naturally uncommon in the region and is not known to occur in the study area.

Southern Resident Orca

Status: The Southern resident killer whale (orca) was listed as endangered under the ESA on November 18, 2005 (70 FR 69903). Critical habitat, designated on November 29, 2006 (71 FR 69054), occurs in the study area.

Biology: The southern resident orca community is composed of three pods, numbering a total of 90 to 100 whales that only reside in the inland waters of Puget Sound, Juan de Fuca Strait and the Strait of Georgia (CWR 2008). The pods aggregate temporarily throughout the year, and are often seen traveling and socializing together (Baird 2000; Ford, *et al*. 2000; Osborne, *et al*. 1988; Osborne 1999; Kriete 2007; CWR 2008). Breeding must also take place during these social encounters, though it has never reliably been observed in the wild. Southern resident orcas feed primarily on salmon and other fish species and are often found around Elliott Bay during the summer and early fall pursuing migrating chum and Chinook salmon (Osborne, *et al*. 1988; Osborne 1999; Kriete 2007). During late autumn, winter, and early spring, the ranges and movements of southern resident orcas are not well understood. This community has experienced a marked decline triggering a recent listing under the Endangered Species Act (NOAA 2008b). It is thought that this decline has been caused by a combination of natural factors, including climate cycles and human pressures that have led to reductions in prey resources, disturbance from vessel traffic, and increased toxin levels in their environment (Osborne, *et al*. 1988).

Humpback Whale

Status: The humpback whale was listed as endangered under the ESA on June 2, 1970 (35 FR 8491). There is no proposed or designated critical habitat in the study area.

Biology: There appears to be a distinct stock of humpback whales present in the California/Oregon/Washington-Mexico area. This stock of around 800 individuals winters off the coast of Mexico and migrates north to summer grounds between central California and southeastern Alaska (Darling & Jurasz 1983; Darling & McSweeney 1985).

Humpback whales inhabit waters over continental shelves, along continental shelf edges, and around oceanic islands (Balcomb & Nichols 1978; Whitehead 1987). During the summer, they may be found closer to shore, in areas such as coastal embayments and channels (Brueggeman, *et al*. 1988). They feed on a variety of species including fish, krill, mysids, pelagic amphipods, shrimps, and copepods (Frost & Lowry 1981). Humpback whales are known among baleen whales to have the widest variety of feeding behaviors, including cooperative behavior between individuals, both short- and long-term, and various techniques that concentrate or disable prey.

Although seasonally common off the Washington coast, humpback whales only rarely enter Puget Sound. In recent years, there has been an increase in the number of sightings of humpback whales in the inland waters of Washington State (Calambokidis 1990; Falcone, *et al*. 2005). In Puget Sound, there have been several recent sightings, including reports in May and June of 2004 of a whale near Vashon Island, a May 2005 report of a humpback in central Puget Sound, and an individual in central Puget Sound in September of 2004 (Falcone, *et al*. 2005).

Steller Sea Lion

Status: The eastern population of the Steller sea lion was listed as threatened under the ESA on November 26, 1990 (55 FR 49204). The endangered western population (62 FR 24345) only occurs in western Alaska. Critical habitat was designated on August 27, 1993 (50 CFR 226.202) although none of it occurs in the study area.

Biology: Steller sea lions are usually seen at haul out sites such as rocks or buoys, which are thought to provide protection from predators, severe climate or sea surface conditions, and are close to prey resources. They occur year-round in Washington waters but their numbers decrease during the summer months when many migrate to Oregon and British Columbia rookeries to breed (NMFS 1992).

Locally, around Elliott Bay, Steller sea lions are only an infrequent visitor; with no observations being made near the Alaskan Way Seawall. Similarly, breeding rookeries and major haul-out sites have not been documented in Puget Sound. Steller sea lions are opportunistic predators, feeding primarily of a wide variety of fishes and cephalopods. Pacific hake, Pacific herring (*Clupea harengus*), Pacific sand lance (*Ammodytes hexapterus*), Pacific cod (*Gadus macrocephalus*), and various salmon species (*Oncorhynchus* spp.) compose the bulk of their diet (Gearin, *et al.* 1999). Steller sea lions have also been known to prey on harbor seal, fur seal, ringed seal, and possibly sea otter pups, but this would represent only a supplemental component to the diet.

The number of Steller sea lions in the western stock declined by 75% between 1976 and 1990. The extent of this decline led the National Marine Fisheries Service

(NMFS) to list the Steller sea lion as threatened throughout its range in April 1990 (NMFS 1992). Many factors have contributed to the decline of the Steller sea lion. Factors that cause direct mortality such as incidental take in fisheries, illegal and legal shooting, predation or certain diseases have impacted the population. However, factors that indirectly affect Steller sea lions such as effects of climate change on fish stocks, competition with humans for prey, as well as the effects of certain diseases or contaminants may have taken the greatest toll on the population.

Threatened Species

Chinook Salmon (Puget Sound)

Status: The Puget Sound stocks of Chinook salmon were originally listed as threatened under the ESA on March 24, 1999 and reaffirmed as threatened on June 28, 2005 (70 FR 37160). Critical habitat that occurs in the study area was designated on September 2, 2005 (70 FR 52630).

Biology: Adult Chinook salmon are mostly found in offshore ocean waters though many can remain nearshore, close in proximity to their natal stream (PSP 2005). Spawning occurs in various streams of Puget Sound including the Green/Duwamish River (Wydoski & Whitney 2003). Before completing their migration to spawning grounds, adult Chinook salmon congregate in high numbers in Elliott Bay from June to July, moving up the Duwamish River in early August. Juvenile summer/fall run Chinook typically rear in the river for several months from January through July before migrating to the ocean (Shannon, *et al*. 2005; Fresh 2006). Out migration occurs primarily during the months of April, May, and June. Juvenile fall run Chinook salmon exhibit longer residence times in estuaries than do other anadromous salmonids, where they feed heavily before starting their oceanic migration (Fresh 2006).

Steelhead Trout (Puget Sound)

Status: Puget Sound stocks of steelhead were listed as threatened under the ESA on May, 11 2007 (72 FR 26722). Critical habitat, which occurs in the study area, is slated to be designated in 2008.

Biology: Steelhead trout in the Green/Duwamish system are primarily winter-run (native), with a very small summer run (hatchery) (WDFW 2002). Unlike many other anadromous salmonids, steelhead trout spawn multiple times throughout their lives beginning when they are in their fourth or fifth year and extending to a maximum age of around 11 years (PSP 2005). Generally, males mature at two years and females at three. In Elliott Bay, adult steelhead trout likely use nearshore habitat to forage in preparation for spawning though documented sittings are rare (Brennan & Higgins 2004; Shannon 2006; NOAA 2007b). Puget Sound steelhead smolts tend to migrate to the ocean to feed and mature after spending two years in fresh water in estuarine areas near their natal stream (PSP 2005). In these areas, young steelhead trout feed primarily on zooplankton while adults feed on aquatic and terrestrial insects, mollusks, crustaceans, fish eggs, minnows, and other small fishes (including other trout) (Duffy, *et al*. 2005).

Bull Trout & Dolly Varden

Status: Coastal/Puget Sound bull trout were listed as threatened under the ESA on November 1, 1999 (64 FR 58909). Critical habitat was designated on September 26, 2005 (70 FR 56212) and includes the study area.

Dolly Varden was proposed for listing as threatened under the ESA on January 9, 2001 (66 FR 1628). This is an unusual listing because it is based on the fact that to most observers, Dolly Varden and bull trout are indistinguishable. Accordingly, Dolly Varden, which are common, are proposed for listing in an effort to reduce the threat that Dolly Varden fishermen pose to bull trout. Critical habitat, which does occur in the study area, would be proposed only if the species were to be listed.

Biology: Bull trout and Dolly Varden are very closely related and once were considered the same species. These species exhibit differences in size, body characteristics, coloration, and behavior across their range. Even though bull trout are mainly an inland species while Dolly Varden are more common in coastal areas, both are present in Elliott Bay and exhibit seemingly similar life histories and therefore will be discussed together (USFWS 2003).

Adults can live up to ten years, sexually maturing after four. Similar to steelhead trout, they spawn multiple times throughout their life; often every year or every other year after reaching maturity (USFWS 2003). They tend to spawn in the fall after water temperatures drop below 48° F, in unpolluted streams with a clean gravel and cobble substrate, and gentle gradient. Juveniles eat terrestrial and aquatic insects but shift to preying on other fish as they grow larger. Adults in Puget Sound typically migrate from freshwater to estuarine and marine nearshore environments between late winter and spring to feed on smelt, herring, small salmonids, perch, sand lance, and invertebrates (USFWS 2003). Following this period, they re-enter fresh water from late spring through summer to feed, seek temperature refuge, and to spawn (Goetz, *et al*. 2004). Though few confirmed sightings of either Dolly Varden or bull trout have been documented in the study area, like other salmonids, they are assumed to use the nearshore waters of Elliott Bay for feeding and maturing.

Green Turtle

Status: The green turtle was listed as threatened under the ESA in 1978 (43 FR 32808). There is no proposed or designated critical habitat in the study area.

Biology: Green turtles are the largest of all the hard-shelled sea turtles, but have a comparatively small head. While hatchlings are just 2 inches long, adults can grow to more than 3 feet long and weigh 300-350 pounds. Scientists estimate green turtles reach sexual maturity anywhere between 20 and 50 years, at which time females begin returning to their natal beaches every 2-4 years to lay eggs. The nesting season varies depending on location. In the southeastern U.S., females generally nest between June and September, while peak nesting occurs in June and July. Adult green turtles are unique among sea turtles in that they are herbivorous, feeding primarily on seagrasses and algae. This diet is thought to give them greenish colored fat, from which they take their name (NOAA 2008a).

Green turtles use three habitat types; oceanic beaches (for nesting), convergence zones in the open ocean, and benthic feeding grounds in coastal areas. Adult females migrate from foraging areas to mainland or island nesting beaches and may travel hundreds or thousands of miles each way. Once juveniles move to nearshore benthic habitats, adult green turtles become almost exclusively herbivores, feeding on sea grasses and algae (NOAA 2008a). The green turtle is globally distributed and generally found in tropical and subtropical waters along continental coasts and islands between 30° North and 30° South. In the eastern North Pacific, green turtles have been sighted from Baja California to southern Alaska, but most commonly occur from San Diego south (NOAA 2008a). They are rarely seen in Puget Sound.

Loggerhead Turtle

Status: The loggerhead turtle was listed as threatened under the ESA in 1978 (43 FR 32808). There is no proposed or designated critical habitat in the study area.

Biology: Loggerheads were named for their relatively large heads, which support powerful jaws and enable them to feed on hard-shelled prey, such as whelks and conch. Mean carapace length of adults is approximately 36 inches and weight is around 250 pounds. Loggerheads reach sexual maturity at around 35 years of age. Mating occurs in late March to early June and females lay eggs between late April and early September (NOAA 2008a).

In the eastern Pacific, loggerheads have been reported as far north as Alaska, and as far south as Chile. In the U.S., occasional sightings are reported from the coasts of Washington and Oregon, but most records are of juveniles off the coast of California. The west coast of Mexico, including the Baja Peninsula, provides critically important developmental habitats for juvenile loggerheads. The only known nesting areas for loggerheads in the North Pacific are found in southern Japan (NOAA 2008a).

Olive Ridley Turtle

Status: The olive Ridley turtle was listed as threatened under the ESA in 1978 (43 FR 32808). There is no proposed or designated critical habitat in the study area.

Biology: The olive Ridley is considered the most abundant sea turtle in the world, with an estimated 800,000 nesting females annually. Adult turtles are relatively small, weighing on average 100 pounds. The size and morphology of the olive Ridley varies from region to region. Olive Ridleys reach sexual maturity around 15 years and nesting females vary in size between 22 and 31 inches, with the largest animals being observed on the Pacific coast of Mexico.

The olive Ridley is mainly pelagic but has been known to inhabit coastal areas, including bays and estuaries. Olive Ridleys have an annual migration from pelagic foraging, to coastal breeding and nesting grounds, back to pelagic foraging. These turtles are omnivorous, feeding on a wide variety of food items, including algae, lobster, crabs, tunicates, mollusks, shrimp, and fish.

Trans-Pacific ships have observed olive ridleys over 2,400 miles from shore. Two satellite telemetry studies showed both males and females can migrate out to Pacific waters deeper than 9800 feet. (Plotkin, *et al*. 1994). No records of olive Ridleys have been documented in Puget Sound.

Marbled Murrelet

Status: The marbled murrelet in Washington State was listed as threatened under the ESA on October 1, 1992 (57 FR 45328) as a federally threatened species in California, Oregon, and Washington. A 5-year review of this designation began on April 21, 2003 (68 FR 19569). Critical habitat was designated on May 24, 1996 (61 FR 26255) and includes 11 units in Washington, including 1.2 million acres of Federal land, 421,500 acres of State Forest land, and 2,500 acres of private land (USFWS 1997). On September 12, 2006, the USFWS proposed to substantially reduce the area of designated critical habitat (71 FR 53837). No critical habitat is identified in the project area.

Biology: Marbled murrelets are small seabirds of the family Alcidae that occur along the north Pacific coast from the Aleutian Islands and southern Alaska south to central California (USFWS 1997; COS 2004). Murrelets feed on small fish and invertebrates usually within 2 miles of shore in open but somewhat sheltered marine waters, such as bays or sounds where water depth is less than 330 feet (USFWS 1997). The nesting period begins around the end of March and continues through mid-September (Hamer and Nelson 1995). Nest sites are restricted to stands of mature and old-growth forest (Carter 1984). Because of the scarcity of such stands, it is common for murrelets to fly inland many miles to nest; over 40 miles in Washington State (Cooper et al. 2006, 2007). Marbled murrelets only fly to and from their nest sites during crepuscular hours, spending their diurnal hours foraging. The loss of old growth forests is the main cause for the decline of this species. In addition, it is believed that forest fragmentation forces nests closer to forest edges making them vulnerable to predation by jays, crows, ravens, and great horned owls. Other threats to this species include fishing nets and oil spills.

Marbled murrelets have not been documented in the nearshore environment near the Seawall, however, nests have been documented in many areas surrounding Elliott Bay (COS 2006). The close proximity that these nest sites have to the study area makes it likely that marbled murrelets may occasionally reside in the waters of Elliott Bay, though this has not been confirmed.

Species of Concern

Green Sturgeon (Northern DPS)

Status: Green sturgeon north of and including the Eel River (northern DPS) does not warrant listing under the ESA. The presence of two spawning populations in the northern DPS and likely continued spawning in other rivers reaffirms this determination. Because of concerns over the uncertainty and availability of data, the northern DPS is designated as a species of concern.

Biology: Green sturgeon is a long-lived and slow-growing fish that has the most marine-oriented tendencies of sturgeon species. Mature males range from 4.5-6.5 feet and do not mature until they are at least 15 years old. Mature females range from 5-7 feet and do not mature until they are at least 17 years old. Maximum ages of adult green sturgeon are likely to range from 60-70 years. North American green sturgeon have been shown to be genetically distinct from similar species in Asia.

Green sturgeon are believed to spend the majority of their lives in nearshore oceanic waters, bays, and estuaries. Early life-history stages reside in freshwater, with adults returning to freshwater to spawn when they are more than 15 years of age and more than 4 feet in size. Spawning is believed to occur every 2-5 years (Moyle 2002). Adults typically migrate into freshwater beginning in late February; spawning occurs from March-July, with peak activity from April-June (Moyle, *et al*. 1995). Green sturgeon spawn in deep pools in large, turbulent, freshwater river mainstems (Moyle, *et al*. 1992). Specific spawning habitat preferences are unclear, however eggs are likely broadcasted over large cobble substrates, clean sand, or bedrock (Moyle, *et al*. 1995). Juvenile green sturgeon spend 1-4 years in fresh and estuarine waters before dispersal to saltwater (Beamesderfer & Webb 2002). They disperse widely in the ocean after their out-migration from freshwater (Moyle, *et al*. 1992).

Adults live in oceanic waters, bays, and estuaries when not spawning. Green sturgeon are known to forage in estuaries and bays ranging from San Francisco Bay to British Columbia. Though little is known on the diets of adult green sturgeon, they are believed to eat mostly benthic invertebrates including shrimp, mollusks, amphipods, and small fish (Moyle, *et al*. 1992).

Pacific Lamprey & River Lamprey

Status: A 90-day finding on a petition to list the Pacific lamprey and river lamprey as threatened or endangered under the ESA stated that listing these species may be warranted; December 27, 2004 (69 FR 77158). Until then, they received a status of species of concern.

Biology: Pacific lamprey and river lamprey are anadromous, parasitic fishes that reside in the nearshore waters of Puget Sound. In Washington State, spawning occurs in the spring following migration into coastal river systems (Wydoski & Whitney 2003) such as the Green/Duwamish River. Pacific lamprey are unique in that they are the only species of lamprey that are known to spawn more than once (Page & Burr 1991), though many still die after only one spawning cycle. After spawning, lamprey larvae, or ammocoetes remain in their natal streams 4-6 years to filter-feed on microscopic plant and animal material and metamorphose into adults.

In the past, lampreys represented a large portion of the biomass in streams, thus making them an important component along with aquatic insects in nutrient processing, storage, and cycling (Close, *et al.* 2002). The formerly large numbers of young adult lampreys migrating downstream may have buffered juvenile salmonids from predation by birds and fishes or may have been an important buffer for upstream migrating adult salmon from marine mammal predators. Current causes of declining numbers of lampreys are most likely river obstructions such as dams that block upstream passage (Weeks 1991). Little is known about lamprey use of the Elliott Bay nearshore.

Coho Salmon (Puget Sound)

Status: The listing of Puget Sound stocks of coho salmon under the ESA has been found to be not warranted and they were listed as a species of concern on April 15, 2004 (69 FR 19975).

Biology: Adult coho salmon can be found in Elliott Bay from June until October when they move up coastal drainages such as the Green/Duwamish River to spawn in late fall and early winter (Wydoski & Whitney 2003). Coho juveniles typically rear in fresh water for one year, utilizing most available reaches of their natal stream (PSP 2005). Juvenile coho typically begin migrating to sea through Elliott Bay as smolts during their second spring, with peak downstream migration typically occurring from April through mid-May (Fresh 2006). Most coho salmon spend 2 to 3 years in saltwater. Some fish migrate only a short distance into good feeding areas, and stay there; others travel extensively through the open ocean (NOAA 1997).

Slender-billed White-Breasted Nuthatch

Status: Species of concern.

Biology: The largest of the three species of nuthatch in Washington, the white-breasted nuthatch has a bright white breast and face. Like all of Washington's nuthatches, the white-breasted has strong legs and toes, long, curved talons, and a long, strong bill. This rare subspecies in western Washington is found primarily in equally rare Garry oak woodlands. This species breeds in April-May and nests in natural cavities in trees or abandoned holes. In spring and summer, this nuthatch primarily eats insects. In the non-breeding season, it eats acorns and pine nuts. (Csuti, *et al.* 2001)

Pacific Townsend's Big-Eared Bat

Status: The Pacific Townsend's big-eared bat was listed as a species of concern under the ESA in November 15, 1994 (50 CFR Part 17). There is no proposed or designated critical habitat in the study area.

Biology: The Pacific Townsend's big-eared bat is approximately 4 inches in length with a wing span of 10 to 10.5 inches, and has relatively large ears. The fur color of the bat varies, but most often is a slate gray tipped with brown. Adult Townsend's bats weigh between 0.25 and 0.50 ounce.

They reside at elevations ranging from sea level to 3,500 feet and are dependent on cliffs, caves, and old mines for roosting, nursery, and hibernation sites. The bats are highly sensitive to disturbance by people who explore caves or other curious humans and will abandon their roost if repeatedly disturbed. They tend to not use bat houses but often are found roosting in old buildings or in other manmade structures. Ten of twelve maternity roosts known in WA are in the western part of the state.

Delisted Species

Coastal Cutthroat Trout

Status: This species was delisted because of taxonomic revision leading to improved understanding of species distribution and abundance.

Biology: Coastal cutthroat trout have a variable life history. Like salmon, sexually mature coastal cutthroat trout return to their natal streams to spawn. Puget Sound coastal cutthroat trout migrate to spawn in large river systems such as the Green/Duwamish River in July and peak in September-October (King County DNR 2000). Very few overwinter in saltwater. Spawning generally takes place in late winter and spring (King County DNR 2000). Although cutthroat trout are repeat spawners, post-spawning mortalities are sometimes high due to weight loss and physical degradation. The fish that survive migrate downstream in early to late spring.

The fry are sensitive to many kinds of environmental changes; logging, increased temperatures, loss of cover, reductions in food supply, and siltation can all increase larval mortality. A number of natural sources of mortality are also present, including interspecific competition with other salmonids, intraspecific competition, and crowding induced by low summer flows, but habitat alteration is thought to be the greatest threat to cutthroat trout stocks (PSP 2005). Juveniles may migrate up and downstream several times, however, downstream movement of smolts into Puget Sound takes place from March to June and peaks mid-May.

Coastal cutthroat trout are opportunistic feeders. Aquatic insects, generally the most available food in streams, are the dominant item in most cutthroat diets (Romero, *et al.* 2005). Other foods, such as zooplankton and fish, are important locally or seasonally in nearshore waters. In the marine environment, they feed on gammarid amphipods, sphaeromid isopods, callianassid shrimp, immature crabs, and various fish, including chum salmon, pink salmon, and Pacific sand lance; herring and sculpins are also eaten (Romero, *et al*. 2005).

Although there have been few studies of coastal cutthroat trout movements at sea, it appears that they overwinter in the marine environment and stay close to shore (PSP 2005). Coastal cutthroat trout remain at sea varying lengths of time, returning to freshwater the same year that they migrated out to sea. In Puget Sound, coastal cutthroat trout feed and migrate along beaches, mostly in water less than 9 feet deep. In general, their movement along the coast is believed to be correlated with onshore ocean currents, with the fish staying close to the shoreline (PSP 2005).

Bald Eagle

Status: The bald eagle was listed as threatened at the time the ESA was enacted in 1973. It was proposed for delisting on July 6, 1999 (64 FR 36453). The bald eagle has no designated critical habitat. Though the U.S. Fish and Wildlife Service removed the bald eagle from the federal list of threatened and endangered species in 2007, they and their nests are still protected by the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act.

Biology: Bald eagle reside near large water bodies that contain high densities of prey species such as fish, ducks, coots, muskrats, small mammals, various reptiles, and carrion. Small patches of residual large trees and second growth forest near these water bodies is required for roosting and nesting. The large trees along Puget Sound and Elliott Bay used by eagles are a diminishing resource, as more shoreline is dedicated to development and urbanization.

Bald eagles also overwinter in several areas of western Washington including Puget Sound and Elliott Bay. These eagles usually arrive in late October and disperse to their breeding grounds by March (Watson & Rodrick 2000). No bald eagle nests or roosts are located within the study area, though birds can often be seen north of the Seawall and west of the Duwamish River (Watson & Rodrick 2000). Bald eagles are known to forage in Elliott Bay and may occur within the study area throughout the year. Perching bald eagles have been observed in tall conifers south of the study area (FHWA 2006).

Peregrine Falcon

Status: The peregrine falcon was listed as threatened at the time the ESA was enacted in 1973. It was proposed for delisting on August 25, 1999 (64 FR 46542). The Peregrine falcon has no designated critical habitat.

Biology: Peregrine falcons are typically found hunting in open areas, especially along the coast and near by bodies of water that provide habitat for their prey. Their diet consists mainly of other birds such as rock pigeons, European starlings, ducks, shorebirds, and various seabirds. They typically nest on cliffs and on cliff-like structures such as buildings and bridges in cities. While the female incubates the eggs exclusively, the male hunts in the surrounding area for the female, feeding her at the nest (CLO 2008). Like with the bald eagle, the peregrine falcon population has had a marked recovery in the United States. As a result, they have been delisted federally and down-listed from Endangered to Sensitive in Washington State. Peregrine falcons are an infrequently seen resident of Seattle, occasionally seen hunting around Alaskan Way in the study area. Numerous nesting pairs have been documented in Seattle, all of which have been close enough in proximity to the study area as to suggest that the population may use the study area as a hunting ground.

2.8. Native American Interests

American Indian Issues and Concerns

Current Tribal use of the fish and shellfish of Elliott Bay is based on the exercise of rights protected under treaties and a tradition of subsistence use inherent in the tribal culture of the Pacific Northwest. The treaties are viewed as a way of guaranteeing the continuation of Tribal life that revolves around the use of fisheries resources. In 1974, the treaty Tribes won a landmark decision in *United States v. State of Washington* in which Judge Boldt recognized the "…generally paramount dependence upon the product of an aquatic economy... These fish were vital to the Indian diet, played an important role in their religious life, and constituted a major element of their trade economy." *United States v. State of Washington* specifically reserves for the Tribes the aboriginal right to take fish and shellfish from their "…usual and accustomed grounds and stations." In many cases, usual and accustomed areas overlap and extend beyond the areas ceded under the treaty.

Most affected tribes place an importance on protection and restoration of their socially and traditionally significant fishing and hunting places. All culturally significant fish-bearing capable streams, estuaries, bays, rivers, and lakes found within a tribe's area of interest should be considered probable locations of a tribe's fishery or interest. This includes legally recognized, tribal usual and accustomed fishing grounds and stations both on and off reservations for federally recognized tribes.

Government-to-Government Relations

The U. S. Government has a unique relationship with federally recognized American Indian tribes. As federal agencies undertake activities that may affect tribes' rights, property interests, or trust resources, care should be taken to implement agency policies, programs, and projects in a knowledgeable and sensitive manner respectful of tribes' sovereignty and needs.

The basis of a tribe's legal status rests within the context of U.S. Constitutional provisions for federal government's powers for treaty making with other sovereign nations, and American Indian tribes' inherent sovereignty. The treaty-making period between the U.S. Government and American Indian tribes ended in 1871. The federal government thereafter relied upon Agreements to legally acquire Indian lands, allow tribes to cede lands, establish reservations, provide federal recognition of tribes, and remove Indian peoples to reservations.

A tribe's legal status is also derived through agreements with the U.S. government; congressional and executive branch recognition of the tribe; and federal court interpretations of Indian law and legal documents (e.g., treaties, executive orders, agreements, federal statutes and other government-to-government agreements). Tribes also have constitutions and bylaws, which formalize their governmental organization and state their relationship with the U.S. government.

Affected Tribes and Bands

Muckleshoot Tribe

The Muckleshoot Indian Tribe is composed of the descendants of the area's original Coast Salish peoples. The Muckleshoot Tribe has lived in this area for thousands of years, possibly since the last glaciers receded. The Muckleshoot's ancestral homeland, now known as the Muckleshoot Usual and Accustomed Area, consists of a vast area stretching along the eastern and southern reaches of Puget Sound and the western slope of the Cascade Range.

Suquamish Tribe

The Suquamish Tribe is a southern Coast Salish people; they spoke a dialect of Lushootseed, which belongs to the Salishan language family. Like many Northwest Coast natives, the Suquamish relied on fishing from local rivers and Puget Sound for food and built plank longhouses to protect themselves from the wet winters that are typical west of the Cascade Mountains.

The usual and accustomed fishing places of the Suquamish Tribe, at which members also hunted and gathered plant materials, extend well beyond their reservation boundaries. This area includes marine waters of Puget Sound from the northern tip of Vashon Island to the Fraser River in Canada, including Haro and Rosario Straits; and the streams draining into the western side of Puget Sound and Hood Canal. The usual and accustomed area of the Suquamish Tribe extends west into Jefferson County, south into Mason County, and includes most of Kitsap County.

Tulalip Tribe

The Tulalip Tribes is a federally recognized Indian Tribe located on the Tulalip Reservation in the mid-Puget Sound area. The Tulalip Reservation exterior boundaries enclose a land base of 22,000 acres, over 50% of which is in federal trust status. The Reservation is rich with natural resources: marine waters, tidelands, freshwater creeks and lakes, wetlands, forests, and developable land. The Tulalip Reservation was reserved for the use and benefit of Indian tribes and bands signatory to the Treaty of Point Elliott of January 22, 1855. Its boundaries were established by the 1855 Treaty and by Executive Order of President Ulysses S. Grant dated December 23, 1873. It was established to provide a permanent home for the Snohomish, Snoqualmie, Skagit, Suiattle, Samish, and Stillaguamish tribes and allied bands living in the region.

Duwamish Tribe

The Duwamish Tribe is an American Indian Tribe in western Washington, and the indigenous people of the metropolitan Seattle area. The Duwamish Tribe today includes the People of the Inside (Elliott Bay) and the People of the Large Lake (Lake Washington). By language, the Duwamish are Lushootseed Salish. The Duwamish Tribe is not a federally recognized tribe and its members have been seeking formal recognition since 1979. In that they are not formally considered a treaty tribe, they have not been afforded fishing rights in usual and accustomed waters.

2.8.2. Areas Fished, Patterns and Seasons

Elliott Bay, the East and West Waterways, and the Duwamish Waterway include aquatic area and bank line treaty fishing access locations used seasonally by the Muckleshoot and Suquamish Indian Tribes. The principal focus of treaty-authorized fishing is harvest of anadromous fish, adult salmon and steelhead, using free-floating and fixed gill nets. However, recent treaty fishing activity in Elliott Bay has included harvest of subtidal clams using diving equipment and a pot-fishery targeting shrimp.

Salmon fishing gear includes free-floating drift nets, up to 1200 feet long and 60 feet deep, deployed in Elliott Bay and fixed or set nets in the East and West Waterways and the Duwamish Waterway. Set nets are tied to points on the shoreline and extend into deep water in adjacent channel areas, held in place with anchors. Set nets may be up to 300 feet in length and 60 feet deep (Port of Seattle 2006).

Typically, treaty fishing takes place from August through February of each year. Chinook salmon fishing is in August. Fishing for coho salmon begins in September and, generally, concludes in late November. In October, fishing expands to include chum salmon, followed by steelhead fishing in late fall through February (Port of Seattle 2006).

Chinook salmon fishing periods in August consist of brief 12-hour-long openings. In recent years, Chinook salmon fishing has begun at 8:00 p.m. on Wednesday evenings, finishing at 8:00 a.m. the following morning. A single 12-hour opening may be repeated in the following Wednesday/Thursday period, with the potential for a third 12-hour fishery the subsequent week. The openings include drift nets in Elliott Bay and set nets in the East and West Waterways and the Duwamish Waterway (Port of Seattle 2006).

Coho salmon fishing generally begins in mid-September. In past years, fishing has begun at 6:00 p.m. on Sunday evenings and continues without interruption to 12:00 noon on Friday. Each week of coho salmon fishing includes 114 hours of continuous fishing during the week, with nets removed from the water on weekends. In 2004 and 2005, coho salmon fishing began with 2 weeks of uninterrupted fishing through the end of September, followed by the more typical weekly tempo described above. It is expected that the 7-day, around-the-clock opening pulse of fishing observed in the past 2 years will be repeated in the coming years. Coho salmon fishing initially includes drift and set nets; however, after the first weeks of fishing, set nets are most common (Port of Seattle 2006).

Chum salmon harvest includes weekly fishing openings identical to the latter periods of coho salmon fishing. Fishing openings in late fall and early winter, combining chum salmon and steelhead harvest, are often conducted with several consecutive open days followed by closures. Clam harvest can occur year-round, while shrimp fishing occurs during the spring and summer months (Port of Seattle 2006).

2.8.3. Traditional Cultural Properties

The following discussion is excerpted from the *Archaeological Resources and Traditional Cultural Places Technical Memorandum* developed in 2004 for the SR 99: Alaska Way Viaduct and Seawall Replacement Project (FHWA 2004: Appendix M). It is provided here to highlight the ethnographic and ethnohistoric use of Elliott Bay in particular and the Puget Sound region in general by native peoples.

The project area is within the aboriginal territory of the Duwamish, a Puget Salish or Lushootseed speaking group that lived in winter villages on the shores of Elliott Bay, Lake Washington, Lake Union, and Salmon Bay; and on the banks of the Duwamish, Black, and Cedar rivers (Petite 1954, United States Court of Claims 1927; Waterman ca. 1920, 1922). The number of plank winter houses within Duwamish villages ranged from a single building to house clusters with up to 10 houses. The Duwamish also established temporary camps at fishing and plant gathering areas throughout their aboriginal territory.

Much of the proposed project area is in the area of former tideflats of Elliott Bay at the mouth of the Duwamish River, which provided habitat for a variety of marine food resources for the Duwamish and neighboring groups. The Green and White River people, now known as the Muckleshoot, and the Suquamish were neighbors of the Duwamish (Lane 1987). The Duwamish, Muckleshoot, and Suquamish probably camped together at fishing grounds on Elliott Bay and the Duwamish River (Lane 1987). Duwamish and neighboring groups also continued to visit fishing camps in the historic period to acquire fish for their own use and for sale to local fish markets.

The Duwamish left their winter houses at various times in the spring, summer, and early fall to fish for salmon, gather clams and oysters, pick berries, hunt land game, and collect plant resources. Hunting, fishing, and food collecting trips coincided at locations with maximum seasonal productivity and the highest quality of multiple food resources. Groups traveled to berry grounds when edible berries ripened and went to salmon streams during seasons when salmon returned to spawn. Winter houses were nearly deserted during peak resource gathering times in the warm months.

Salmon was the main food source for the Duwamish and their Puget Sound neighbors. Several salmon fishing stations were on Elliott Bay, including historically documented fishing places at the mouth of the Duwamish River, Smith Cove, and Duwamish Head on Alki (Bagley 1929; Lane 1987). The Duwamish dried and smoked salmon over small fires to prepare the fish for long-term storage in winter houses. The smoked salmon supported the Duwamish during their extended winter residency, which was punctuated by a variety of ceremonial activities. Clams and berries also were dried for winter consumption. Dried clams were a valuable trade item, particularly with the Yakama and other Indian groups who lived east of the Cascade Mountains. All foods were eaten fresh during the gathering season at the seasonal encampments. Some of the dried foods, especially clams, were consumed while traveling by canoe between resource acquisition areas.

The Duwamish villages in the project vicinity were located on Elliott Bay, at the mouth of the Duwamish River, in what is now Belltown, on the shoreline of Lake Union, at Smith Cove, and at Shilshole Bay (Lane 1987; Petite 1954; Waterman 1922). *ď^{z}ziď^{z}əlalič* was a village of eight winter houses on a point that formerly extended south from the Elliott Bay shoreline, in the contemporary Pioneer Square District. *ď^{z}ziď^{z}əlalič* provided the geographic place name for the shoreline, peninsula, tidal lagoon, and inland areas in what is now the Pioneer Square District (Hilbert, *et al*. 2001; United States Court of Claims 1927; Waterman 1922). The *ď^{z}ziď^{z}əlalič* village was approximately 100 feet east of the proposed project area. Watt (1931) described the ruins of an Indian hut south of a stream that is now filled by the right-of-way of Yesler Way. The Indian house may have been associated with the *ď^{z}ziď^{z}əlalič* village.

A second recorded village in the project vicinity was *Baba'kwob*. The exact location of the village is not clearly documented in the ethnographic and historic literature or on early historic period maps. Ethnographers and historians have variously described *Baba'kwob* as a winter village with two houses (Bass 1937; Petite 1954; United States Court of Claims 1927) and as a historic Indian settlement with cabins of milled lumber (Costello 1974 [1895]). Petite (1954) placed the *Baba'kwob* winter houses at a clearing in the forest in what is now the Belltown neighborhood. Waterman (1922) suggested that the *Baba'kwob* place name referred to "open space, or series of spaces, in the forest north of what is now the business district of Seattle." Waterman (1922) mapped *Baba'kwob* east of the contemporary Seattle Center complex. The prairie, which appears to have also encompassed the present Seattle Center grounds, was reportedly used by the Duwamish people for ceremonial gathering (Dorpat 1984). The *Baba'kwob* village described by Petite (1954) and Bass (1937) may have been within the space or forest opening mapped by Waterman (1922) or within one of the series of openings described by Waterman (1922).

An Indian trail, known as *ča?k^{w}səd*, connected Lake Union, the *Baba'kwob* prairie, and Elliott Bay near the north end of the project area (United States Surveyor General

1856; Waterman 1922). A wagon road, which was probably a former Indian trail, linked the *d^{z}zid^{z}əlalič* village to *Baba'kwob* prairie, and appears on the United States Surveyor General 1856 map.

2.9. Social Resources

2.9.1. Overview

This section provides information on social resources within or immediately adjacent to the Alaskan Way Seawall, a dense urban environment along the Seattle waterfront. In general, the study/construction area comprises social elements and resources along or adjacent to Alaskan Way right-of-way, between S. Washington Street on the south and Broad Street on the north. Social resources addressed in this section include population, housing, community facilities, religious institutions, social and employment services, cultural and social institutions, government institutions, military installations, and neighborhood cohesions. Other related topics, including parks and recreation, and public services and utilities, are discussed in separate sections of this report.

The study area includes the residents, neighborhoods, and buildings that would most likely be directly affected by the replacement of the Alaskan Way Seawall. The population of the study area consists of residents, employers, employees, commuters, visitors, and others. The residents may or may not work in the study area. People who visit the waterfront attractions either shop or attend cultural activities and events, and they may reside in other Seattle neighborhoods, cities, and towns in the metro area, or outside of the region.

2.9.2. Methodology

Data focusing on social resources was obtained primarily from discipline reports and technical memoranda completed for the Alaskan Way Viaduct and Seawall Replacement Project Draft Environmental Impact Statement (DEIS) and Supplemental DEIS (SDEIS) (FHWA 2004, 2006). Data collected in the DEIS and SDEIS were derived from a variety of federal, State, and local sources. A major portion of the descriptive analysis relies on 2000 statistics published by the U.S. Census Bureau (USCB 2000). Other sources in the DEIS and SDEIS were local government web pages, and the Yahoo! Yellow Pages that were used to identify businesses as well as community facilities in or near the study area.

The area for analysis of social resources is defined primarily by the area that abuts the Alaskan Way right-of-way between S. Washington Street and Broad Street; however, much of the information gathered is defined by the census tract block groups[1] that encompass the study area. Generally, the area defined by the census tract

[1] Census Block Group: The U.S. Census Bureau (2000) takes the census of population and housing in years ending in zero. The census form includes both a short form (100% survey) and a long form (sample survey of 1 in 6 households). A census block group is a subdivision of a census tract, and a block group includes one or more “blocks,” which are the smallest geographic unit for which the Census Bureau tabulates sample data.

block groups is larger than the Alaskan Way right-of-way. Census demographic statistics were also collected for the City of Seattle. City demographic characteristics were used to evaluate how characteristics of the study area compare to the entire city.

2.9.3. Study Area

The study area includes the width of Alaskan Way, which parallels the Seawall from Broad Street in the north to S. Washington Street in the south. Between Broad and S. Washington Streets, Alaskan Way is constructed over the Seawall's timber relieving platform which varies between 40 and 60 feet in width landward of the Seawall face.

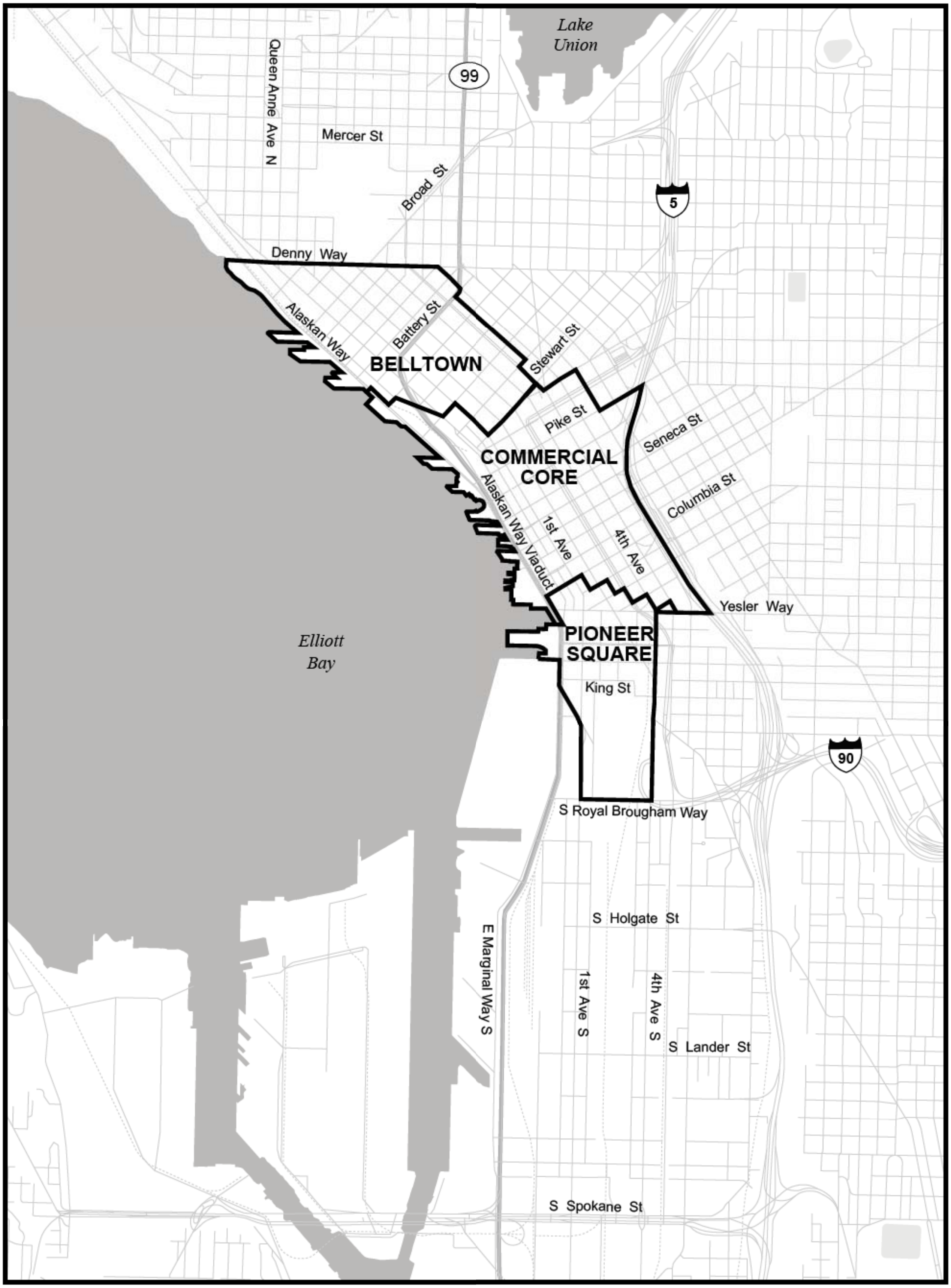
The project traverses several neighborhood planning areas designated by the City of Seattle. Starting from the south and moving north, the study area includes Pioneer Square, the Commercial Core and Belltown (Figure 2.9-1). See Section 2.2, Land Use and Shorelines for more detailed information on these neighborhoods.

Pioneer Square Neighborhood

The historic Pioneer Square neighborhood, formerly the Seattle city center, is generally located between Yesler Way and S. Royal Brougham Way. European descendants settled the area in the mid-1800s.

The Pioneer Square Preservation District was established as both a National Historic District and a local preservation district in 1970. Pioneer Square is protected by Ordinance 112134 and design guidelines focused on preserving its unique historic and architectural character, assuring the sensitive rehabilitation of buildings, promoting development of residential uses for all income levels, and enhancing the district's economic climate for residents, employers, workers, and visitors. Alaskan Way runs through the Pioneer Square Preservation District from S. Washington Street to Columbia Street, where specific development policies apply.

The Pioneer Square neighborhood is popular with visitors and the Seattle Underground Tour operates from this vicinity. The interiors of several old brick warehouse buildings have been remodeled into artists' lofts and office buildings. Pioneer Square residents live in the many older apartment buildings, new condominium buildings, and a few emergency shelters for homeless men, women, and children. East of the study area along First Avenue are popular retail businesses, restaurants, and boutiques. Safeco Field (home of the Seattle Mariners, the professional baseball team) and Qwest Field (home of the Seahawks, the professional football team) attract thousands of sports fans from throughout the region and are both located within the Pioneer Square neighborhood.



Sources: SR99 AWVSRP DEIS (2004, 2006); Jones & Stokes (2006)

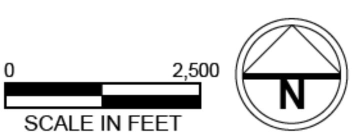


Figure 2.9-1
Map of the Neighborhoods in the Study Area

Commercial Core Neighborhood

The Alaskan Way right-of-way runs through Seattle's Commercial Core from Columbia Street north to Bell Street. The Commercial Core neighborhood is set apart from adjacent neighborhoods by a change in the orientation of the street network to the north and south and is characterized by numerous high-rise office buildings. The Commercial Core encompasses Seattle's downtown retail core, financial center/office core, City, County and Federal government offices, the central waterfront area, and the Pike Place Market Historic District. Tens of thousands of workers commute to the Commercial Core each day. First class hotels, restaurants, museums, theatres, and Benaroya Hall are all located within the Commercial Core. Just east of the waterfront is the popular Pike Place Market. Government office buildings, including the Federal Reserve Bank of San Francisco, Federal Office Building, King County Administrative Center and the U.S. Court House are found in the Commercial Core. A number of high-rise luxury condominiums have been constructed in the past 10 to 15 years within the Commercial Core. The Colman Dock Ferry Terminal and the Seattle Aquarium, along with many tourist shops and other visitor attractions, are also found in this portion of the study area.

Belltown Neighborhood

The northernmost portion of the project area runs through the Belltown (Denny Regrade) neighborhood. Belltown is the northern neighborhood of downtown Seattle bounded by Denny Way to the north, Elliott Bay to the west, Sixth Avenue to the east, and Virginia Street to the south (historically and decades ago, the southern border was Stewart Street). Belltown is an eclectic and diverse neighborhood, and this characteristic permeates the neighborhood in many ways. It is Seattle's densest residential community, and, as an arts center, shopping and dining destination, and home to a wide variety of businesses, this diversity takes form in the neighborhood's social and cultural fabric. It is also reflected in the built environment through its architecture, public art, and other street amenities. Along the waterfront within the study area is the long-established Edgewater Hotel, Bell Street Conference Center, Odyssey Discovery Maritime Museum, Port of Seattle offices, the Pier 66 Cruise Terminal, and the Bell Harbor Marina.

The Belltown neighborhood has undergone substantial redevelopment and revitalization in the past 10 to 15 years. Shops, restaurants, coffee houses, and bars in the Belltown neighborhood cater to the diverse local clientele. Some smaller scale office buildings are located in the neighborhood. Expensive mid-rise condominiums have been constructed along the waterfront. High-rise condominiums and apartment buildings have also been constructed east of the project area on the hill overlooking the waterfront. The neighborhood also retains many of the city's historic hotels and apartment buildings. Many of the older buildings have been converted into subsidized housing for low-income people. The Belltown neighborhood includes the vast majority of social service agencies in comparison to Pioneer Square and the Commercial Core neighborhoods.

2.9.4. Population and Demographics

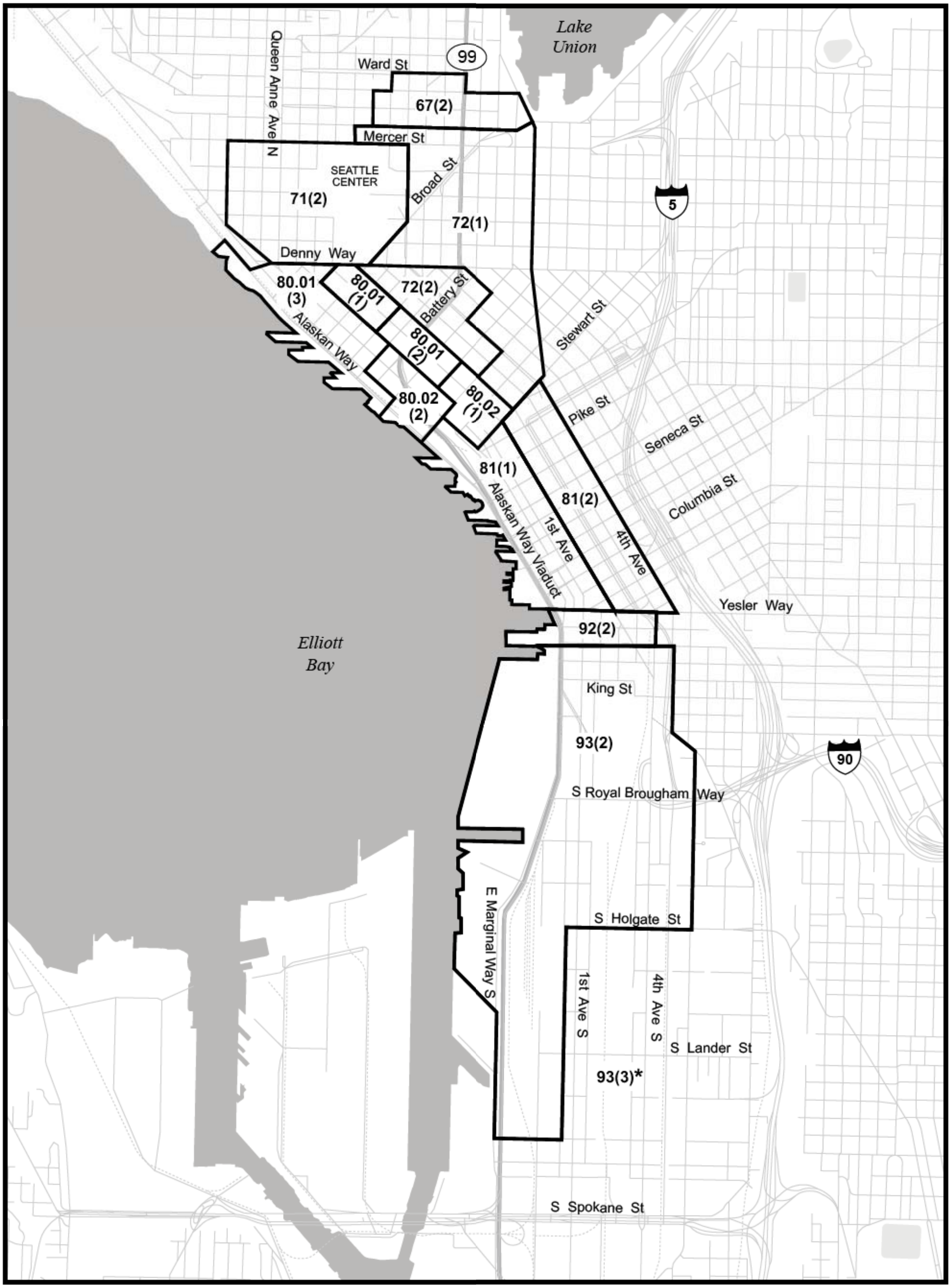
The population trends and demographic characteristics of the study area are both similar and very different from the population of the City of Seattle as a whole. The most comprehensive recent source of demographic information for the study area is information published by the U.S. Census Bureau (2000). The following sections describe characteristics of the study area and compare them to those of the City. Characteristics described include total population, race and ethnicity, language, age, household status, income, disability, housing, and transit dependency. Summary statistics are shown below. For comparison purposes, racial and economic data for the City is at a level necessary to quantify and compare the minority and low-income populations in the study area.

Study Area Block Groups

The study area is located within three 2000 census tracts (Census Tracts 80.01, 80.02, and 81); three census tract block groups encompass all of the study area: Census Tract 80.02, Block Group 2; Census Tract 80.01, Block Group 3; and Census Tract 81, Block Group 1) (Figure 2.9-2).

Environmental Justice Communities – Low Income and Minority Populations

Low income and minority persons are protected under Executive Order 12898 (1994). For the purposes of this study, demographic characteristics of the study area are compared to the demographics of the City of Seattle as a substitute for the demographics of the overall population that would benefit from proposed improvements associated with Seawall replacement. The residents and businesses located in the study area would directly experience the effects of construction activities associated with rebuilding or replacing the existing Seawall. To determine the existing conditions for environmental justice communities (low-income and minority populations), census tracts and block groups within the project vicinity were overlain on the study area to determine the race, ethnicity, and income characteristics of the project area.



Sources: SR99 AWVSRP DEIS (2004, 2006); Jones & Stokes (2006); U.S. Census 2000

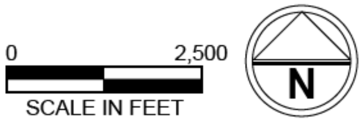


Figure 2.9-2
Map of the 2000 Census Tracts of the Study Area

As specified by Federal Highway Administration (FHWA 2008) and Washington State Department of Transportation (WSDOT 2003) guidance, low-income communities were defined as comprising individuals listed in the 2000 Census as living at or below the federally designated poverty level. Minority populations were defined as individuals listed in the 2000 Census as considering themselves to be nonwhite (Black or African American, American Indian and Alaskan Native, Asian, Pacific Islander, or other race) or Hispanic or Latino (a person of Mexican, Puerto Rican, Cuban, Central or South American, or other Spanish culture or origin, regardless of race). Although minority populations in the Pacific Northwest and the study area include Native Americans, this project does not cross or directly affect tribal lands. Tribes with active interest in the area include the Muckleshoot, Suquamish, Duwamish, Tulalip, Snohomish, Snoqualmie, and Yakama Nation Tribes.

Table 2.9-1 lists percentages of white and minority populations by race/ethnicity. The Census Tract Block Groups have roughly comparable percentages for minority populations compared to the City. Approximately 30% of the City's population consists of minority groups, compared to a range of 27 to 31% for the three Census Tract Block Groups. The percentages of various minority groups in the block groups were similar to the City percentages, except for Asian and Pacific Islanders, which averaged 8% of the block group populations, compared to 14% of the population Citywide.

Table 2.9-1. Percentages of Race and Ethnic Groups for the Study Area and City of Seattle for Census Tract (CT) and Block Groups (BG)

	Race				Ethnicity
Study Area	**White**	**Black/African American**	**American Indian and Alaska Native**	**Asian and Pacific Islander**	**Hispanic or Latino**
CT 80.01 BG 3	69%	**9%**	**2%**	7%	8%
CT 80.02 BG 2	72%	**10%**	1%	9%	3%
CT 81, BG 1	73%	8%	1%	8%	**6%**
City of Seattle	394,889 (70%)	47,541 (8%)	5,659 (1%)	76,714 (14%)	29,719 (5%)

Note: Bold indicates study area values that exceed those for the City of Seattle.
Source: USCB 2000

Language Proficiency

Another U.S. Census statistic that measures ethnic diversity is the primary language spoken at home. A total of four general language categories were reported for census tract block groups in 2000. These included English only, Spanish, Asian and Pacific Islander languages, and other languages. In addition, the U.S. Census assessed whether or not households were linguistically isolated from the community due to the lack of an adult in the household with a good command of the English language. Information on linguistic isolation is available in the U.S. Census by census tract and is presented in Table 2.9-2.

Table 2.9-2. Percentage of Households Speaking Non-English Primary Languages and Linguistic Isolation for Study Area Census Tracts (CT) and City of Seattle

Study Area	Spanish	Other Indo-European Language	Asian and Pacific Island Language	Other Language	Linguistically Isolated
CT 80.01	2%	5%	6%	1%	5%
CT 80.02	2%	4%	6%	2%	4%
CT 81	5%	**7%**	4%	**3%**	**6%**
City of Seattle	5%	6%	9%	2%	5%

Bold indicates study area values that exceed those for the City of Seattle.

Note: A linguistically isolated household is one in which no member 14 years or older speaks only English or speaks a non-English language and speaks English "very well." These statistics are based on a sample survey, not the 100% census; therefore the number of households is predicted rather than the actual number of households. Percentages may not sum to 100 due to excluded data.

Source: USCB 2000

Information on English proficiency is useful in determining whether or not translation services are needed to communicate the project information to the populations in the study area table. A good indication of English proficiency is the extent to which people in each language group speak English (Table 2.9-3). This data suggests that information on the project should be made available to reach potentially linguistically isolated households affected by the project. Project information should be translated into Spanish, and local service providers have indicated that the other linguistically isolated households are typically of Asian background, which may warrant information being translated into Chinese, Tagalog, and Vietnamese in future outreach efforts.

Table 2.9-3. Percentage of English Proficiency for Non-English Primary Language Households for Study Area Census Tracts (CT) and City of Seattle

	Spanish		Other Indo-European Language		Asian and Pacific Island Language		Other Language	
Study Area	Very Well	Well	Very well	Well	Very well	Well	Very well	Well
CT 80.01	1.9%	0.6%	**4.5%**	**0.9%**	3.0%	2.5%	0.7%	0.0%
CT 80.02	0.9%	0.4%	**3.1%**	**0.7%**	1.8%	1.8%	0.7%	0.4%
CT 81	4.4%	0.2%	**4.1%**	**0.7%**	2.0%	1.8%	0.4%	**1.0%**
City of Seattle	2.2%	0.8%	2.9%	0.6%	4.4%	3.0%	0.9%	0.4%

Bold indicates study area values that exceed those for the City of Seattle.

Note: People who speak a language other than English at home and may have learned that language at school would be expected to indicate they spoke English "Very well". People who speak a language other than English, but do not do so at home should have been reported as not speaking a language other than English at home. The detail in which language names were coded may give a false impression of the linguistic precision of these data. These statistics are based on a sample survey, not the 100% census; therefore the number of households is predicted rather than the actual number of households. Percentages may not sum to 100 due to excluded data (USCB 2007).

Source: USCB 2000

Educational Attainment

Data on educational attainment are tabulated for the population 25 years old and over. People are classified according to the highest degree or level of school completed (USCB 2000, 2007). Census Tracts 80.02 and 81 both had a higher percentage of residents who received up to a grade school or high school education than the City of Seattle (Table 2.9-4). Likewise, all the Census Tracts had a higher percentage of residents who went to college or received up to a graduate degree compared to the overall City of Seattle.

Table 2.9-4. Percentage of Seattle Residences that Attained a Formal Education that Reside in Study Area Census Tracts (CT) and City of Seattle

					College Degree Attained		
Study Area	No Schooling	Grade School	High School	College	Associate	Bachelor	Graduate
CT 80.01	0.3%	1.4%	19.9%	**21.0%**	**8.9%**	**32.1%**	16.5%
CT 80.02	0.0%	**4.7%**	**23.7%**	19.8%	2.9%	29.1%	**19.8%**
CT 81	0.3%	**5.6%**	**30.1%**	**23.9%**	5.3%	20.1%	14.7%
City of Seattle	1.3%	3.0%	21.5%	20.6%	6.4%	29.9%	17.3%

Bold indicates study area values that exceed those for the City of Seattle.

Source: USCB 2000

Age Characteristics

In general, the study area exhibits a lower level of diversity with respect to age than the overall City of Seattle, with predominantly an adult population. All three block groups have numbers of children (ages 0-17) well below the City norm, and Block Group 1 of Census Tract 81 shows a higher percentage of seniors (65 years and older) than does the City as a whole. These data are summarized in Table 2.9-5.

Table 2.9-5. Population by Age for Study Area Census Tracts (CT) and Block Groups (BG) and City of Seattle

Study Area	Total Population	0–4 Years	5–17 Years	18–64 Years	65 Years and Older
CT 80.01, BG 3	1,145	9 (1%)	21 (2%)	**1,056 (92%)**	59 (5%)
CT 80.02, BG 2	1,144	13 (1%)	13 (1%)	**1,035 (90%)**	83 (7%)
CT 81, BG 1	2,431	53 (2%)	81 (3%)	**1,892 (78%)**	**405 (17%)**
City of Seattle	563,374	26,215 (5%)	61,612 (11%)	407,740 (72%)	67,807 (12%)

Bold indicates study area percentage values that exceed those for the City of Seattle.

Note: Percentages may not sum to 100 due to rounding.

Source: USCB 2000

Household Characteristics

Compared to the overall City of Seattle, the study area displays a much higher proportion of one-person households and a far lower proportion of households with children. Likewise, the percentages of family households and single-parent families are well below the values for the City as a whole. The study area consists predominantly of one-person households. As seen in Table 2.9-6, the study area's elderly population appears to be concentrated in Census Tract 81, Block Group 1.

Table 2.9-6. Household Characteristics for Study Area and City of Seattle for Census Tract (CT) and Block Groups (BG)

Study Area	Households	One-Person Households	Family Households	Households with Children	Single Parent Families with Children	Elderly Households
CT 80.01, BG 3	757	**569 (75%)**	114 (15%)	21 (3%)	17 (2%)	53 (7%)
CT 80.02, BG 2	841	**579 (69%)**	132 (16%)	21 (2%)	9 (1%)	68 (8%)
CT 81, BG 1	1,444	**997 (69%)**	345 (24%)	42 (3%)	16 1%)	271 (19%)
City of Seattle	258,635	105,439 (41%)	113,400 (44%)	50,783 (20%)	16,366 (6%)	49,171 (19%)

Bold indicates study area percentage values that exceed those for the City of Seattle.

Note: Families are households with more than one person related by blood or marriage or adoption. Households with children are households with one or more child less than 18 years of age residing in the home. Elderly households have at least one member 65 years or older.

Source: USCB 2000

Income Characteristics

With the exception of Census Tract 81, Block Group 1, median household income for the study area is below that for the overall City of Seattle, while per capita income remains higher than that of the City for all study area block groups. This is most likely due to the study area's high proportion of single-person households. The study area also shows a higher percentage of its population living at or below the poverty level, or receiving public assistance. This data is summarized in Table 2.9-7.

Table 2.9-7. Income and Poverty Data for Study Area and City of Seattle for Census Tract (CT) and Block Groups (BG)

Study Area	Households	Median Household Income	Per Capita Income	Households with Public Assistance	Population at or below the Poverty Level*
CT 80.01, BG 3	752	$38,316	$38,091	**33 (4%)**	**255 (22%)**
CT 80.02, BG 2	859	$35,987	$50,940	**44 (5%)**	**177 (15%)**
CT 81, BG 1	1,404	$47,083	$51,384	**53 (4%)**	**592 (24%)**
City of Seattle	258,635	$45,736	$30,306	7,638 (3%)	64,068 (12%)

Bold indicates study area percentage values that exceed those for the City of Seattle.

Note: Income statistics for the 2000 Census are for year 1999.

* When calculating the percentage of people below poverty level, the US Census Bureau does not include unrelated individuals under the age of 15, individuals residing in institutional group quarters (nursing homes, prisons), dormitories, or living situations without conventional housing.

Source: USCB 2000

Low Income

The term "low income" is used for household incomes that are at or below the Department of Health and Human Services (HHS) poverty guidelines for that size of household (WSDOT 2005, USCB 2007, FHWA 2008). HHS poverty guidelines are a simplified version of the U.S. Census Bureau's poverty thresholds. In 2006, the HHS poverty guideline for one person was $9,800; for a family of four, it was $20,000.[2]

[2] Neither the Census Bureau nor the U.S. Department of Health and Human Services prepares tabulations of the number of people below HHS poverty guidelines. The best approximation for the number of people below HHS poverty guidelines in a particular area is the number of persons below the U.S. Census Bureau poverty thresholds in that area.

Disabled Persons

The 2000 U.S. Census estimated the number of persons with disabilities based on responses to questions on the census short form. The U.S. Census short form asked respondents if they had any of the following long-term conditions: 1) blindness, deafness, or a severe vision or hearing impairment (sensory disability); or 2) a condition that substantially limits one or more basic physical activities such as walking, climbing stairs, reaching, lifting or carrying (physical disability). In addition, respondents were asked if they had a physical, mental or emotional condition that made it difficult to perform certain activities, including a) learning, remembering, or concentrating (mental disability); b) dressing, bathing, or getting around inside the home (self-care disability); c) going outside the home alone to shop or visit a doctor's office (go-outside-the-home disability); and d) working at a job or business (employment disability).

Respondents could report more than one type of disability, and the disabilities could cause limitation to one or more activities. Not all limitations, however, can be assumed to affect the mobility of persons. As such, it is not appropriate to report all persons with all disabilities as representative of persons with mobility limitations.

The best statistic to describe disabled persons with mobility limitations is the number of persons 16 years and older that have a disability that affects their ability to go outside of the home alone. This information is not available from the Census Bureau at the Block Group level, but Table 2.9-8 contains Census Tract level data. All three Study Area Census Tracts have a higher proportion of disabled persons than the City of Seattle as a whole.

Table 2.9-8. Percentage of Population Reporting a Mobility Limitation for City of Seattle and Study Area Census Tracts (CT)

Area	Population	Population 16 Years or Older with Mobility Limitation	Percent of Total Population
Study Area			
CT 80.01	3,354	432	**13%**
CT 80.02	2,610	220	**8%**
CT 81	3,210	313	**10%**
City of Seattle	563,374	32,051	6%

Bold indicates study area percentage values that exceed those for the City of Seattle.
Source: USCB 2000

Transit Dependency

The 2000 U.S. Census reported means of transportation available to households. Respondents were allowed to report the number of vehicles available for personal use (as opposed to vehicles available only for business or work that might be kept at home).

The percentages of households without access to a private vehicle in the study area Block Groups far exceed corresponding values for the City of Seattle (Table 2.9-9). Even the least transit-dependent Block Group in the study area has more than double the percentage of housing units without vehicle access as the City as a whole. As a result, it is imperative that outreach efforts in the study area include information on how the project will affect transit in the area.

Table 2.9-9. Occupied Housing Units Dependent on Transit in Study Area and City of Seattle for Census Tracts and Block Groups

Area	Number of Dwellings	Occupied Units	No Vehicle Available	Percent Dependent on Transit
Study Area				
CT 80.01, BG 3	821	759	268	**35%**
CT 80.02, BG 2	1,024	858	332	**39%**
CT 81, BG 1	1,811	1,431	631	**44%**
City of Seattle	270,536	258,510	42,180	16%

Bold indicates study area percentage values that exceed those for the City of Seattle. CT=Census Tract, BG=Block Group
Source: USCB 2000

2.9.5. Housing

Occupancy rates for housing units in the study area are generally lower than for the overall City of Seattle. Census Tract 81, Block Group 1, has a particularly high vacancy rate of 21% (Table 2.9-10). Homeownership rates in the study area are also well below the citywide average.

Table 2.9-10. Housing Occupancy and Ownership Information in Study Area and City of Seattle for Census Tracts and Block Groups

Area	Total Dwellings	Vacant Units	Occupied Units	Owner-Occupied Units	Rented Units	Population in Non-Institutional Group Quarters
CT 80.01, BG 3	821	**62 (8%)**	759 (92%)	199 (26%)	**560 (74%)**	171
CT 80.02, BG 2	1,024	**166 (16%)**	858 (84%)	99 (12%)	**759 (88%)**	0

Area	Total Dwellings	Vacant Units	Occupied Units	Owner-Occupied Units	Rented Units	Population in Non-Institutional Group Quarters
CT 81, BG 1	1,811	**380 (21%)**	1,431 (79%)	410 (29%)	**1,021 (71%)**	470
City of Seattle	270,536	12,026 (4%)	258,510 (96%)	125,151 (48%)	133,359 (52%)	8,921

Bold indicates study area percentage values that exceed those for the City of Seattle. CT=Census Tract, BG=Block Group
Note: Percentages for Vacant and Occupied Units indicate percentage of total dwellings. Ownership and Rental rates indicate percentage of Occupied Units.
Source: USCB 2000

Subsidized and Special Needs Housing

No subsidized or special needs housing is identified as located within a block of the Alaskan Way right-of-way between S. Washington and Broad streets. Special needs housing includes low-cost and low-income housing, senior housing, transitional and long-term residential services, emergency temporary housing, and shelters.

Veteran Status

A civilian veteran is a person 18 years old and over who, at the time of the census, had served on active duty in the U.S. Army, Navy, Air Force, Marine Corps, or Coast Guard in the past (even for a short time), but was not currently on active duty, or who had served in the Merchant Marine during World War II. People who had served in the National Guard or Military Reserves were classified as veterans only if they had ever been called or ordered to active duty, not counting the 4 to 6 months for initial training or yearly summer camps. All other civilians 18 years old and over were classified as nonveterans (USCB 2000). The percent of veterans in the study area was found to be higher than the average for the overall City of Seattle. This pattern is true for all three Census Tracts (Table 2.9-11).

Table 2.9-11. Percentage of Population that are Civilian Veterans for City of Seattle and Study Area Census Tracts (CT)

Study Area	Total Population	Total Population 18+	Civilian Veterans 18+
CT 80.01	3,477	3,367	**14.7%**
CT 80.02	2,711	2,598	**19.7%**
CT 81	3,461	3,380	**18.8%**
City of Seattle	563,375	476,262	10.2%

Bold indicates study area percentage values that exceed those for the City of Seattle.
Source: USCB 2000

2.9.6. Regional and Community Growth

This section provides information on growth trends of the Puget Sound region and helps to establish the socio-economic context of the study area. The discussion addresses regional population, employment, major employers, and regional economic stability.

Regional Population and Employment

The study area is located within the U.S. Census designated Seattle-Tacoma Standard Metropolitan Statistical Area (SMSA). This designation reflects the economic ties between the four centrally located Puget Sound counties (Figure 2.9-3).

The proposed project is within King County, which is located on central Puget Sound; Seattle is the county seat. Snohomish County is the northernmost of the four counties, and its county seat is Everett. Pierce County is located to the south and has Tacoma as its county seat. Kitsap County is located west of King County across Puget Sound; Bremerton is its county seat.

Historically, King County has comprised more than 50% of the Puget Sound region's population and more than 30% of the total population of the state. Table 2.9-12 shows the recent population trends for the four counties in the Puget Sound region. The populations of Pierce and Snohomish Counties are similar, and each accounts for about 20% of the region's total population. The population of Kitsap County is by far the smallest, with only 7% of the region's total population. The three larger counties (King, Pierce, and Snohomish) are the first, second, and third most populated counties in Washington, respectively.

Table 2.9-12. Regional Population Trends, 1980–2006

Area	1980	1990	2000	2003	2006 Estimate	1990–2006 Avg. Annual Increase
King County	1,269,898	1,507,305	1,737,034	1,779,300	1,826,732	1.3%
Kitsap County	147,152	189,731	231,969	237,000	240,604	1.7%
Pierce County	485,667	586,203	700,820	733,700	766,878	1.9%
Snohomish County	337,720	465,628	606,024	637,500	669,887	**2.7%**
Metro area	2,240,437	2,748,867	3,275,847	3,387,500	3,504,101	2%
Washington State	4,132,353	4,844,663	5,894,121	6,098,300	6,395,798	2%

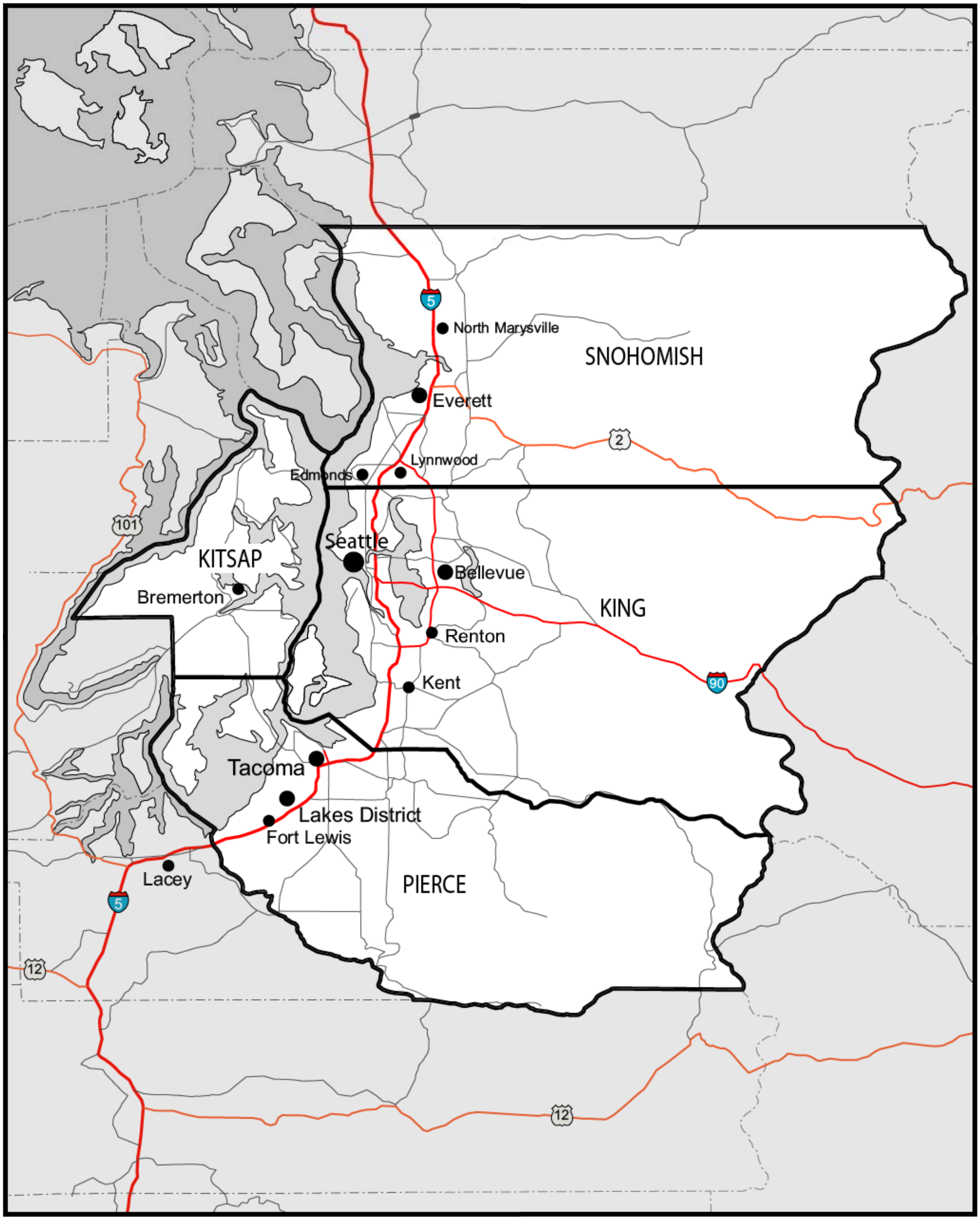
Bold indicates study area percentage values that exceed those for the State of Washington.

Source: FHWA 2004 and USCB 2008

Since 1990, the regional population increased by over 750,000 people. Between 1990 and 2006, the population of King County increased by almost 320,000. Pierce County increased by approximately 181,000, Snohomish County by almost 205,000, and Kitsap County by over 50,000. The average annual population increase for King County between 1990 and 2006 was 1.3%. The average annual increase for Kitsap, Pierce, and Snohomish counties was 1.7, 1.9 and 2.7%, respectively. The average annual increase over this period for the region and the State of Washington was 2%. Although the total population increase in King County was larger than for the other counties, population growth of adjacent counties occurred at a faster rate.

The City of Seattle is the largest city in King County. Of the 39 cities within the county, only six had an estimated population greater than 50,000 in 2003 (OFM 2003a cited in FHWA 2004). In 2006, the estimated population of Seattle was 562,106 and the next largest city, Bellevue, was only 119,678 (USCB 2008). The other large cities include Kent, Federal Way, Renton, and Shoreline. Over 30% of the entire county's population, however, resides in Seattle (FHWA 2004).

Population forecasts for the region indicate that historical growth trends will likely continue. The Washington Office of Financial Management (OFM) published a 20-year population forecast for counties in 2002. In the next 20 years, the population of the Puget Sound region is expected to continue to increase, though at slightly decreased average annual growth rates as compared to past trends. The population of Washington State is expected to increase to over 7.5 million by 2020. The population of King County is forecasted to increase to approximately 2 million (which it is already nearing); Pierce and Snohomish counties are expected to increase to almost 900,000 each, and Kitsap County is expected to increase to approximately 300,000. Average annual increases are anticipated to be less than 2% for the three smaller counties and less than 1% for King County. Though population increases are expected to decrease somewhat, these rates indicate that relatively strong population growth can be expected for the four-county region in the future (FHWA 2004). The primary reason for the increase in population is the overall size of the regional economy. The three larger counties include the first-, second-, and third-largest county-wide work forces of all counties in the State. In 2002, these counties accounted for approximately 68% of all jobs in the State but only 52% of the population (FHWA 2004). A total of 75% of all of the region's jobs are located in King County (FHWA 2004). Many workers commute to jobs in King County from Kitsap, Pierce, and Snohomish counties (FHWA 2004).



Sources: SR99 AWVSRP DEIS (2004, 2006); Jones & Stokes (2006)

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Figure 2.9-3
Map of the Puget Sound Region

As the largest city in King County, Seattle has the major share of all jobs in the county. In 2000, the Puget Sound Regional Council reported a total of 540,419 jobs, which means that approximately 45% of King County's total number of jobs were located in Seattle (PSRC 2003). Approximately 70% of these jobs were equally spread among three sectors: manufacturing, trade/transportation/utilities, and services.

Table 2.9-13 shows that the economic strength of the region and King County are different from the rest of the state. The Puget Sound region has only a small proportion of the total number of workers employed in the resource sectors of the economy. These sectors include agriculture, forestry, fishing, and mining. In contrast, the region has higher employment in the financial, wholesale trade, transportation, services, and manufacturing sectors of the economy (FHWA 2004).

Table 2.9-13. Regional Average Annual Nonagricultural Employment, 2002

Economic Sector	King County	Pierce County	Snohomish County	Metro Area	Washington
Natural Resources and Mining	2,000	1,000	**	3,000	9,000
Construction	78,000	16,000	17,800	111,800	155,000
Manufacturing	165,000	20,000	45,700	230,700	286,000
Wholesale Trade	69,000	9,000	6,000	84,000	116,000
Retail Trade	144,000	29,000	27,000	200,000	306,000
Transportation, Warehousing, and Utilities	51,000	9,000	3,100	63,100	88,000
Information	73,000	3,000	3,700	79,700	94,000
Financial Activities	89,000	13,000	11,200	113,200	146,000
Professional and Business Services	180,000	20,000	16,100	216,100	290,000
Education and Health Services	135,000	37,000	20,300	192,300	307,000
Leisure and Hospitality	119,000	24,000	17,800	160,800	245,000
Other Services	49,000	11,000	8,500	68,500	98,000
Government	200,000	52,000	34,500	286,500	516,000
Total	1,355,000	243,000	212,300	1,810,300	2,655,000

Note: Equivalent 2002 fourth-quarter benchmark data for Kitsap County was not available.

** = data suppressed due to confidentiality

Sums may not total due to rounding

Source: FHWA 2004

Major Regional Employers

The Seattle-Tacoma SMSA region has a diverse economy. It is a national center for manufacturing, high technology industries, services, international trade, and tourism (FHWA 2004). It is a major manufacturing center for transportation equipment and wood products. The region's several seaports, international airport, and extensive network of railroad and trucking services make it one of the nation's largest import-export centers. It is also a regional finance and services center for the Pacific Northwest region. The high-tech and biotech industries are a growing sector of the economy. Furthermore, the region is home to several military bases (FHWA 2004).

The manufacture of wood products has been the foundation of the regional economy for over 150 years in the Pacific Northwest. There are sawmills for lumber and shingles as well as manufacturing plants for doors, window frames, and wood veneers. Products are shipped around the world. Major regional employers include the Weyerhaeuser Company, Simpson Timber Company, and Plum Creek Timber Company. Changes in resource supply, environmental regulations, world trade, and tariff factors, however, have hurt these sectors in recent years (FHWA 2004).

Despite increasing pressures from urban development, the region also has a substantial agricultural sector. Key agricultural centers are located in Snohomish County and the southeastern portions of King and Pierce counties, which produce fruit and vegetable crops, along with dairy and poultry products. (FHWA 2004)

Over the past half century, the regional economy has been heavily dependent upon the manufacturing sector, especially airplane manufacturing. The Boeing Company, one of the world's largest airplane manufacturers, has established assembly plants and offices throughout the region. Major plants are located in Everett, Renton, and Auburn. In more recent years, the Boeing Company has increasingly outsourced functions to independent contractors, which has stimulated the formation of many aerospace-related businesses in the region. The aerospace industry has long been affected by cyclic ups and downs. Since the early 1990s, total regional employment in the aerospace sector has steadily declined from peak employment levels exceeding 100,000 workers. The increasing diversification of the regional economy helps to mitigate the cyclic impacts of changing employment levels at Boeing, although large-scale layoffs still have strong direct and indirect effects on the local economy. Other major transportation-related manufacturing firms in the region include Todd Shipyards and Paccar (FHWA 2004).

Over the past two decades, the computer and high-tech sector of the regional economy has grown considerably and has risen to national prominence. Employment peaked in the late 1990s, and an economic recession caused employment to decline in the early 2000s. The major employer is Microsoft, which now employs about 35,500 workers in the Puget Sound region (Microsoft 2008). The rapid growth of Microsoft has also been the catalyst for the formation of many computer software and Internet companies, which together now employ tens of thousands of workers in the region (FHWA 2004).

Employment in the biotechnology and medical technology sectors has also grown considerably over the past decade. The Fred Hutchinson Cancer Research Center, Amgen (previously Immunex), and other biotechnology firms are located at the south end of Lake Union and in downtown Seattle (FHWA 2004).

The region is the financial hub for Washington State and the Pacific Northwest. The state's banking, financial services, insurance firms, security and commodity brokers, holding companies, and investment firms are headquartered primarily in Seattle. Washington Mutual Bank is headquartered in Seattle. Safeco Insurance Company was headquartered in Seattle until it was recently purchased by Liberty Mutual of Boston. These industries have experienced considerable upheaval as banking institutions merged in the 1990s and currently as much of the national financial industry have suffered mortgage-related losses.

The region has several major port facilities. The Port of Seattle is the fourth largest container shipping port in the nation and the largest in Washington. The Port of Tacoma is the second largest port in Washington. Recently, the volume of goods passing through the Port of Tacoma has rivaled the Port of Seattle, in part due to the intermodal rail system that puts the Port of Tacoma on the cutting edge of container shipping technology. There is also a deepwater port in Everett, which, historically, was involved in the export of raw logs and locally manufactured wood products. In addition, the Port of Seattle's Seattle-Tacoma International Airport facilitates international shipping of large volumes of cargo goods. Together with the interconnected network of railroad and trucking services, these facilities make the region one of the nation's most important West Coast gateways for import-export trade, especially with Pacific Rim countries. The regional economy is further strengthened by the presence of major military facilities in Pierce, Snohomish and Kitsap counties. The army and naval bases and supporting businesses directly and indirectly provide an estimated 11,000 jobs. The economic benefits of the military's presence are not limited to payrolls as numerous contractors supply goods and services to these facilities (FHWA 2004).

Regional Economic Stability

The Puget Sound region has provided, and will continue to provide, a favorable business environment for existing and new businesses. Seattle is an important business and commercial center for the region and plays a major role in the substantial Pacific Rim trade with the East. Key factors that attract businesses include the highly skilled work force, well-recognized major educational institutions, manufacturing capabilities, access to both domestic and international markets, and a diverse regional economy. For residents, the Puget Sound offers a high quality of life, nationally recognized performing arts, professional sports teams, and scenic beauty.

All of these factors contribute to conditions that are expected to bring continued employment and population growth in the region for the foreseeable future (FHWA 2004).

2.9.7. Educational Facilities

This section provides information on educational and community facilities located in the study area. One educational facility occurs within the study area. Several others are located in the Commercial Core of Seattle outside the study area. No religious institutions (places of worship or meditation or gathering places for members) or cemeteries are located within the study area. Cultural and social institutions are described separately in other sections of this report.

The only educational facility identified within the study area was the Art Institute of Seattle. The Art Institute of Seattle is a private professional/technical school abutting the BNSF railroad tracks just east of Alaskan Way in the northern portion of the study area. The main building (South Campus) is located at 2323 Elliott Avenue and the North Campus building (shared with Real Networks) is located at 2600 Alaskan Way. The Art Institute of Seattle is accredited by the Northwest Commission on Colleges and Universities, an institutional accrediting body recognized by the Council for Higher Education Accreditation and the U.S. Department of Education. The mission of The Art Institute of Seattle is to provide higher education programs that prepare students for careers in design, technology, business, and hospitality related fields. In the fall of 2005, the student body consisted of approximately 2,050 students representing more than 40 states and more than 30 countries (Art Institute of Seattle 2006).

The Seattle School District has one facility located in the Commercial Core area. The Center School is located within the Center House Building at the Seattle Center, some distance northeast from the study area. The Center School is a small high school for grades 9 through 12. In October 2005, a total of 280 students were enrolled at the school (Seattle Public Schools 2005).

Located east of the study area in the Pioneer Square neighborhood is the Interagency Academy’s Youth Education Program (YEP) located on the third floor of the Alaskan Building, a commercial office building at the corner of Second and Cherry Streets. YEP offers General Education Diploma preparation and diploma completion courses for youths seeking an alternative education environment. YEP is administered by the Seattle School District, and its curriculum is governed by the Office of the Superintendent of Public Instruction. Through collaboration between the Seattle School District and the City of Seattle, YEP provides small, individualized, computer-assisted classes in reading, writing, math, social studies and science. Students also have the opportunity to earn credit in occupational education and elective courses as needed to help them achieve their goals of graduation and employment.

In downtown Seattle, there are a number of private childcare facilities; however, no childcare facilities were identified within the study area.

2.9.8. Social and Employment Services

No social and/or employment service providers are located within the study area; however, many public and non-profit social service providers are located in the Commercial Core area of Seattle. These social service organizations provide hot meals, food bank services, drop-in hygiene facilities, clothing, employment and mental health counseling and legal services, and referrals for other social services and employment.

2.9.9. Cultural and Social Institutions

There are many cultural and social institutions located in the Seattle Commercial Core area in close proximity to the project area. These include exhibition centers, community landmarks, and museums. They attract residents from the Puget Sound region, as well as business visitors and tourists. Events occur during daytime and evening hours seven days a week. Several museums are located in the study area, or in close proximity, and are open daily and exhibits change on a periodic basis.

Other cultural and social institutions and landmarks within the study area include the Washington State Ferries Terminal at Colman Dock (Piers 50 and 52), Seattle Aquarium, Odyssey Maritime Discovery Center, and Bell Street Pier 66 conference center, all located along the waterfront. The Seattle Art Museum Sculpture Park opened in January 2007 at the north end of the Seawall.

2.9.10. Government Institutions and National Defense Installations

Many government agency offices are located in the Seattle Commercial Core area; however, few are actually located within the study area. The exceptions are the Port of Seattle facilities at Pier 69, which accommodate the Port of Seattle headquarters and the terminal for the Victoria Clipper; Bell Street Terminal, which is home to a cruise ship terminal, conference center, and marina at piers 64, 65, and 66; Seattle Parks facilities; and the Seattle Aquarium.

The only state facility in the study area is the Washington State Ferries Terminal at the Colman Dock.

2.9.11. Neighborhood Cohesion

As described in prior sections, the project study area crosses three Seattle neighborhoods. Land uses, population characteristics, public facilities, community services, and special landmarks all help to define these neighborhoods. Transportation services and infrastructure define accessibility within and between the neighborhoods. A key aspect of cohesion is connectivity of land uses, facilities, services, and population, and the inter-relationships between these elements that define the human environment. The following sections highlight the elements that define the cohesiveness of the study area as a whole and the several neighborhoods traversed by the project corridor.

Transportation Services

Alaskan Way is downtown Seattle's westernmost arterial along the shores of Elliott Bay. It serves as a vital economic, transportation, and social link for Seattle. Alaskan Way parallels the waterfront Seawall from Broad Street in the north to S. Washington Street in the south and has two southbound and two northbound lanes with parking generally provided on both sides of the roadway. The roadway carries approximately 12,000 vehicles per day. Alaskan Way is designated by the City as a Major Truck Street used primarily to accommodate freight movement and oversized loads, carry out local deliveries, and transport hazardous materials prohibited on either State Route (SR) 99 (the Alaskan Way Viaduct) or Interstate 5 (I-5). Alaskan Way accommodates significant freight movement through the City, and to and from major freight traffic generators, including the Port of Seattle facilities. Between S. Washington and Union streets, SR 99 is an elevated structure that runs parallel to Alaskan Way, thus not interrupting the local traffic flow along Alaskan Way. North of Union Street, SR 99 veers northeast (away from Alaskan Way) before entering the Battery Street Tunnel.

Most of the project area is accessible by public transit from outside of the downtown area. Buses and taxis provide transportation service throughout the Commercial Core and waterfront area. In addition, there is no charge to use the buses serving the Commercial Core or along Alaskan Way within the study area. This level of service provided at minimal cost to transit riders is a critical support service to downtown residents, especially those who are low income, homeless, and/or reliant on public transit.

Land Uses

A variety of land uses exist between S. Washington and Broad streets. Land use types vary and include commercial, retail, recreational, governmental and residential uses. Section 2.2 of this report provides a more detailed description of the land uses within the study area.

Population Characteristics

Office workers, residents (including homeless persons), visitors, and others use different portions of the study area. A percentage of this mixed population group lives in the study area, while other segments of the population are present only during weekday business hours, sports events, or tourist seasons.

Linkages to Community Facilities

Most of the residents within the project study area are not linked or associated with the many community facilities found in downtown Seattle. There are no community centers, public schools, preschools, or religious institutions; and only one private professional school is located in the study area. Undoubtedly, some residents within the study area attend events at the cultural and arts institutions in area. However, since a large proportion of low-income and homeless persons residing in the area would have little income to spend on such activities, the linkages between the community facilities in the project study area and surrounding neighborhoods and its residents are presumably weak. The downtown area does host some free arts and cultural events, such as free performances at City Hall, both inside and outside in the plaza area on 4th Avenue.

Unique Community Identity

The Pioneer Square neighborhood, in the south end of the project area, is an important symbol of the City and its historic staging area in the late 1800s for thousands of miners heading for the Klondike Gold Rush in Alaska. In particular, the S. Washington Street Boat Landing is considered an important element of the surrounding historic district. Along the Seattle waterfront, the ferries are a unique symbol of Washington and the City of Seattle. Ferries provide residents and visitors with easy and affordable transportation across Puget Sound. The piers and ferries broadly represent the community’s ties to the waterfront, Puget Sound, the San Juan Islands, the fishing industry, and international trade.

2.10. Visual Quality

2.10.1. Overview

This section identifies and evaluates issues related to visual resources along Alaskan Way that would occur as a result of the Elliott Bay Seawall replacement. This section uses methodology adapted from the Federal Highway Administration's (FHWA) visual impact assessment system (FHWA 1983) in combination with other established visual assessment systems.

2.10.2. Methodology

Approach and Methodology

Identification of visual resources in the study area entailed three steps:

1. Objective identification of the visual features (visual resources) of the landscape;
2. Assessment of the character and quality of those resources relative to overall regional visual character; and
3. Identification of the importance to people, or sensitivity, of views of visual resources in the landscape.

With an establishment of the baseline (existing) conditions, a proposed project or other change to the landscape can be systematically evaluated for its degree of impact. The degree of impact depends both on the magnitude of change in the visual resource (i.e., visual character and quality) and on viewer responses to and concern for those changes. This general process is similar for all established federal procedures of visual assessment (Smardon, *et al.* 1986) and represents a suitable methodology of visual assessment for other projects and areas.

The approach for this visual assessment is adapted from FHWA's visual impact assessment system (FHWA 1983) in combination with other established visual assessment systems. The visual assessment process involves identification of the following:

- Relevant policies and concerns for protection of visual resources;
- Visual resources (i.e., visual character and quality) of the region and the study area;
- Important viewing locations (e.g., roads) and the general visibility of the study area using descriptions and photographs;
- Viewer groups and their sensitivity; and

- Potential impacts.
- The methodology employed for performing the visual assessment included the following:
- Review of the SR 99: Alaskan Way Viaduct & Seawall Replacement Project Draft Environmental Impact Statement Visual Quality Technical Memorandum and Visual Simulations (FHWA 2004);
- Review of the City of Seattle's and U.S. Army Corps of Engineers' policies related to visual or aesthetic resources;
- Walking tour of the entire length of the Seawall project; and
- Review of photos taken during the walking tour and photos previously taken during a 2003 Corps boat tour.

Concepts and Terminology

Visual Character

Both natural and artificial landscape features make up the character of a view. Geologic, topographic, hydrologic, botanical, wildlife, recreational, and urban features influence visual character. Urban features include those associated with landscape settlement and development, such as roads, utilities, structures, earthworks, and the results of other human activities. The perception of visual character can vary significantly seasonally and even hourly as weather, light, shadow, and the elements that compose the viewshed change. Form, line, color, and texture are the basic components used to describe visual character and quality for most visual assessments (U.S. Forest Service 1974; FHWA 1983). The appearance of the landscape is described in terms of the dominance of each of these components.

Visual Quality

Visual quality is evaluated using the well-established approach to visual analysis adopted by FHWA, employing the concepts of vividness, intactness, and unity (Jones, *et al*. 1975; FHWA 1983), as defined below.

<u>Vividness</u> is the visual power or memorability of landscape components as they combine in striking or distinctive visual patterns.

<u>Intactness</u> is the visual integrity of the natural and human-built landscape and its freedom from encroaching elements; this factor can be present in well-kept urban and rural landscapes, as well as in natural settings.

<u>Unity</u> is the visual coherence and compositional harmony of the landscape considered as a whole; it frequently attests to the careful design of individual components in the artificial landscape.

Visual quality is evaluated based on the relative degree of vividness, intactness, and unity, as modified by its visual sensitivity. High-quality views are highly vivid, relatively intact, and exhibit a high degree of visual unity. Low-quality views lack vividness, are not visually intact, and possess a low degree of visual unity.

Visual Sensitivity and Viewer Response

The measure of the quality of a view must be tempered by the overall sensitivity of the viewer. Viewer sensitivity is based on the visibility of resources in the landscape, the proximity of viewers to the visual resource, the elevation of viewers relative to the visual resource, the frequency and duration of viewing, the number of viewers, and the type and expectations of individuals and viewer groups.

The criteria for identifying importance of views are related in part to the position of the viewer relative to the resource. An area of the landscape that is visible from a particular location (e.g., an overlook) or series of points (e.g., a road or trail) is defined as a viewshed. To identify the importance of views of a resource, a viewshed may be broken into distance zones of foreground, middleground, and background. Generally, the closer a resource is to the viewer, the more dominant it is and the greater is its importance to the viewer. Although distance zones in viewsheds may vary between different geographic regions or types of terrain, a commonly used set of criteria identifies the foreground zone as 0.25 to 0.5 miles from the viewer, the middleground zone as extending from the foreground zone to 3 to 5 miles from the viewer, and the background zone as extending from the middleground zone to infinity (U.S. Forest Service 1974).

Judgments of visual quality and viewer response must be made based in a regional frame of reference (U.S. Soil Conservation Service 1978). The same type of visual resource in different geographic areas could have a different degree of visual quality and sensitivity in each setting. For example, a small hill may be a significant visual element in a flat landscape but have very little significance in mountainous terrain.

Generally, visual sensitivity is higher for views seen by people who are driving for pleasure; people engaging in recreational activities such as hiking, biking, or camping; and homeowners. Sensitivity tends to be lower for views seen by people driving to and from work or as part of their work (U.S. Forest Service 1974; U.S. Soil Conservation Service 1978; FHWA 1983). Commuters and non-recreational travelers typically have fleeting views and tend to focus on commute traffic and not on surrounding scenery; therefore, they are generally considered to have low visual sensitivity. Residential viewers typically have extended viewing periods and are concerned about changes in the views from their homes; therefore, they generally are considered to have moderate to high visual sensitivity. Viewers using recreation trails and areas, scenic highways, and scenic overlooks are usually assessed as having high visual sensitivity.

2.10.3. Regulatory Context

City of Seattle Policies

The Seattle Municipal Code (SMC) 25.05.675.P, Public View Protection, indicates "…visual amenities and opportunities are an integral part of the City's environmental quality." Policies in this section identify specific significant natural and human-made features, views of which are protected from specific viewpoints, parks, scenic routes, and view corridors. These specific features include Mount Rainer, the Olympic and Cascade Mountains, the downtown skyline, historic landmarks designated by the Landmarks Preservation Board, and major bodies of water including Puget Sound, Elliott Bay, Lake Washington, Lake Union, and the Ship Canal (SMC 25.05.675 (P) (2) (b) (i))..

Seattle's Central Waterfront Concept Plan also identifies maintaining water views from downtown public places and along view corridors and visually linking the waterfront to downtown. The plan specifically describes development of a visual link between Pike Place Market, the Seattle Aquarium, and the waterfront. In addition, the plan identifies protection of views from the Pike Place Market, from First Avenue intersections (at Pine and Stewart streets), along the Pike Street Hillclimb, and panoramic views from Victor Steinbrueck Park.

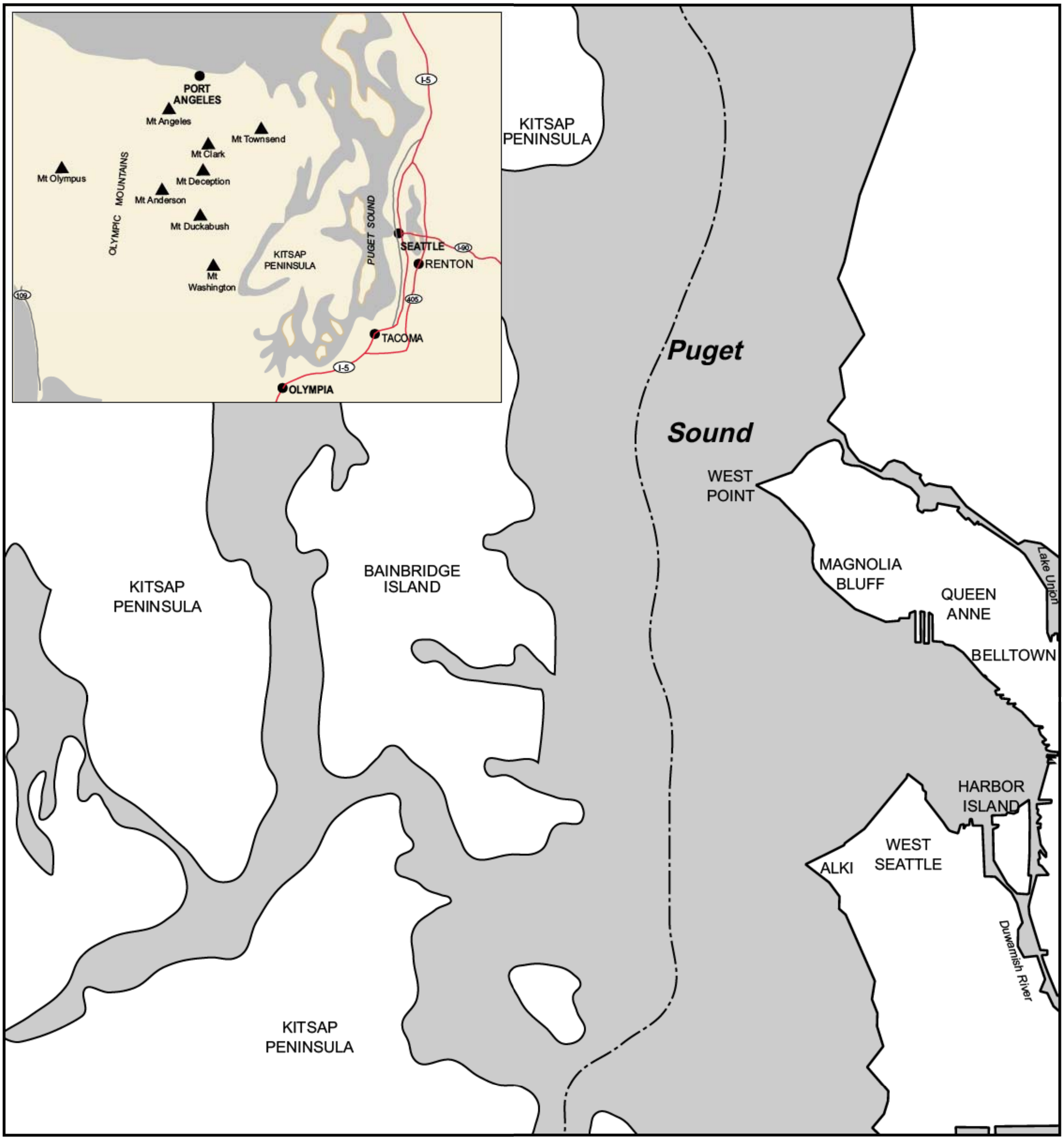
U.S. Army Corps of Engineers Policies

Engineer Regulation 1105-2-100, Section C-5, Aesthetic Resources indicates that aesthetic resources are to be protected in conjunction with other natural resources. Specifically, this section states that a systematic approach (such as the FHWA approach) for assessing aesthetic resources shall be included in planning efforts.

2.10.4. Affected Environment

Regional Character

The Alaskan Way Seawall is located along the east edge of Elliott Bay within the City of Seattle and the overall Puget Sound region. The region is a complex system comprising wooded rolling terrain, urban development, valleys, and waterways and surrounded by nearby mountains, which together create areas that are typical of terrain west of the Cascade Mountain range. The expanse of Elliott Bay and Puget Sound allows for views across to the north of Magnolia Bluff and Queen Anne and to the west of Bainbridge Island, the Kitsap Peninsula, and the peaks of the Olympic Mountains (Figure 2.10-1).



Sources: SR99 AWVSRP DEIS (2004, 2006); Jones & Stokes (2006)

Figure 2.10-1
Landscape Elements in View

Study Area Character

The Seawall study area is composed of the immediate foreground and dominant elements normally within 0.5 miles of the Seawall itself. The prominent visual character within this area includes the waterfront piers and structures, Elliott Bay and its shoreline, the downtown skyline, and the Alaskan Way Viaduct. The vivid downtown environment is shown in photo 1 of Figure 2.10-2 and the typical seaward view of the Seawall and downtown background is shown in photo 2 of Figure 2.10-2.

Visual Character Unit/Key Viewpoint

For this study, key views were selected to represent the range of views in the project area. The view selection process included field reconnaissance of the corridor and assessment of potential “visual character units” from which the existing highway and proposed alternatives are visible.

A visual character unit is a geographic area in which views of the subject have a similar context as defined by features of the setting, such as topography, the location of the viewer in relation to the object being viewed, the character of the landscape (such as vegetation cover) or the character of the urban environment, and the role of the subject viewed in the landscape.

Visual character units were identified and evaluated after review of photographs of various viewpoints in various areas and in accordance with the FHWA DEIS (FHWA 2004). The visual character units are shown in Figure 2.10-3 as follows:

- North Waterfront,
- Central Waterfront,
- Belltown,
- Pike Place Market,
- Commercial Core, and
- Pioneer Square.

Six key viewpoints were also selected and shown in Figure 2.10-3.

North Waterfront

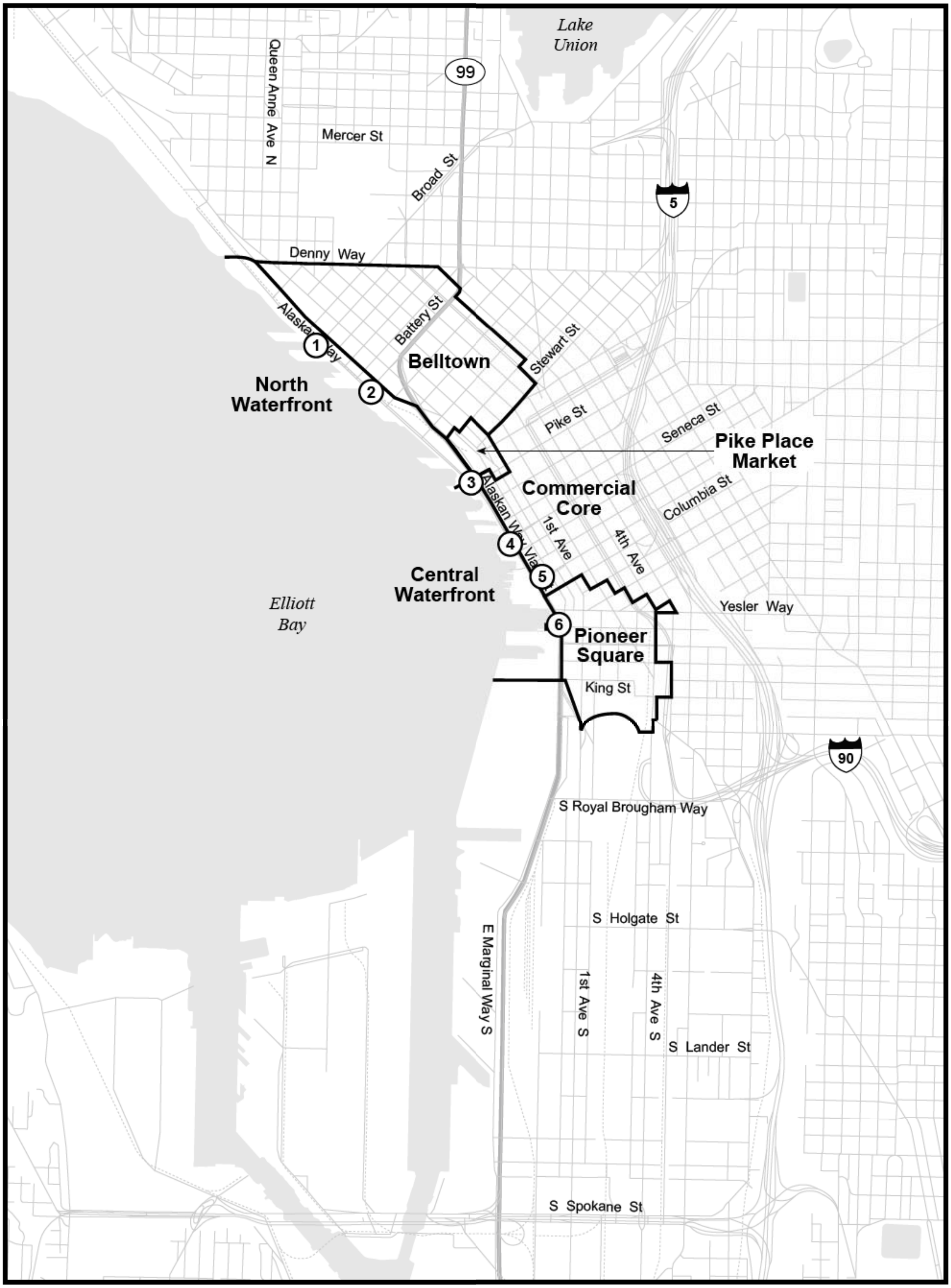
The north waterfront area from Pike Street to Myrtle Edwards Park is characterized by a substantial change in grade in the southerly portion of the site between the waterfront and Belltown to the east. Typical views of the north waterfront area are shown in photos 3 and 4 in Figure 2.10-4. The change in grade becomes less abrupt north of Wall Street, allowing vehicular street connections.

Photo 1. Aerial View of Waterfront and Downtown

Photo 2. Typical View of Seawall with Alaskan Way Viaduct and Downtown in Background

U.S. Army Corps of Engineers (2003); Jones & Stokes (2006)

Figure 2.10-2
Photos 1 and 2



Sources: SR99 AWVSRP DEIS (2004, 2006); Jones & Stokes (2006)

① Key Viewpoint

0 2,500
SCALE IN FEET

N

Figure 2.10-3
Visual Character Units and Key Viewpoints

Photo 3. Key Viewpoint 2, facing north towards Alaskan Way with seawall in foreground.

Photo 4. Key Viewpoint 2, facing southeast, along Alaskan Way towards Pier 66.

Jones & Stokes (2006)

Figure 2.10-4
Photos 3 and 4

The waterfront in this area is oriented to the northwest. A waterfront promenade approximately 12 to 16 feet wide provides a linear walkway along the entire waterfront. North of Pier 59, the historic piers on the waterfront have been removed or substantially remodeled. Piers 62 and 63 were reconstructed in the 1990s when they were purchased by the City of Seattle. The piers provide a single deck area without buildings that is used for passive viewing and special events such as summer concert series. Pier 66 was rebuilt into a cruise ship terminal, marina, shops, restaurants, and retail uses in the late 1990s and includes a pedestrian bridge connection to Elliott Avenue to the east; the bridge is about four stories higher in elevation than Alaskan Way at this location. Pier 67 was replaced by the Edgewater Inn Hotel in the early 1960s and has been remodeled several times since.

Pier 69 was remodeled into offices for the Port of Seattle in the 1990s. Pier 70, at Broad Street, has been remodeled several times. It retains the turn-of-the-20th century heavy-timber internal structure but has been sided with modern materials. It contains offices, parking, and several restaurants. The waterfront north of Broad Street currently includes the waterfront promenade.

The east side of Alaskan Way includes the BNSF railroad between Bell and Broad streets on a franchise within the right-of-way. Between Pine and Bell streets, development on the east side of Alaskan Way includes condominiums, a hotel, and an office building constructed by the Port of Seattle in the 1990s.

Central Waterfront

The central waterfront extends from Yesler Way to about Pike Street, where the Viaduct continues to the east on a separate right-of-way to the Battery Street Tunnel. The existing character of the waterfront is defined to a great extent by the existing Viaduct, which delineates its easterly boundary. Street trees, ivy growing on the Viaduct structure, a multipurpose trail, and the waterfront trolley adjacent to the Viaduct add some softening and complexity to the structure but do not change its overall visual dominance as shown in photos 5 and 6 of Figure 2.10-5.

The waterfront side of the Alaskan Way surface street is characterized by water-oriented structures. The Colman Dock Ferry Terminal between Yesler Way and Madison Street contains a modern passenger terminal in a pier-like configuration surrounded by large deck areas for car and truck queuing. From Marion to Pike Streets, Piers 54, 55, 56, 57, and 59 evoke the maritime legacy when this area was the working waterfront of Seattle, predating current container shipping technology. These piers contain long, low transit sheds with waterways between providing berths for ships. The transit sheds presently are occupied primarily by retail and restaurant uses.

Photo 5. Key Viewpoint 4, facing southwest towards Elliott Bay between Pier 54 and Pier 55.

Photo 6. Key Viewpoint 5, facing northwest, along Alaskan Way towards Pier 53.

Jones & Stokes (2006)

Figure 2.10-5
Photos 5 and 6

The waterways between piers generally provide relatively unobstructed view corridors to the west of Elliott Bay and Puget Sound, the wooded ridges of the Kitsap Peninsula, and the Olympic Mountains in the distance. The Seattle Aquarium is located at the foot of Pike Street, on piers 59 and 60.

The Viaduct contrasts in uniformity of line and color with the variety and complexity of uses and human activities on the waterfront to the west. The view to the north from Yesler Way and the view south from the Waterfront Park are characterized primarily by the Viaduct's two horizontal traffic decks, which continue into the distance where they curve and disappear among the rooflines of buildings. The Viaduct structure bears little relationship to the buildings in downtown to the east of the structure, since streets that break it into blocks define the basic downtown unit. Streets have no particular signature among the uniform rhythm of horizontal elements and vertical supports of the Viaduct. Streets are marked only by the presence of traffic signals and queued cars.

Belltown

The Belltown Visual Character Unit area is generally bounded by Stewart Street on the south, Fifth Avenue on the east, Denny Way on the north, and the waterfront on the west. For the purposes of this analysis, the boundaries of this area end at the east side of the Alaskan Way surface street. The Belltown area is one of the fastest growing neighborhoods in Seattle, with substantial multifamily residential development in the past decade. Retail and restaurant uses are concentrated along First and Second avenues. Typical views of Belltown are depicted in photos 7 and 8 of Figure 2.10-6.

Pike Place Market

For the purpose of this analysis, the Pike Place Market area is defined as stretching from Union Street to Lenora Street on the east side of the existing AWV Corridor and is shown in photos 9 and 10 of Figure 2.10-7. The area of the Pike Place Market Historical District and the Pike Place Development Authority is somewhat smaller. The larger area was selected for this analysis to include related development of a similar character, including the privately owned south arcade that connects to the Pike Place Market and the retail and restaurant uses north of the Pike Place Market on Western Avenue, which add to the retail character of the area.

Commercial Core

The commercial core is the traditional downtown and characterized by high-rise office buildings and is shown in photos 11 and 12 of Figure 2.10-8. The area between Western Avenue and the waterfront is generally flat. Between Columbia Street and Spring Street, the slope between Western and First Avenues is gentle enough to allow through vehicular traffic.

Photo 7. Key Viewpoint 1, facing north up Broad Street across Belltown towards Seattle Center.

Photo 8. Key Viewpoint 1, facing northeast, up Clay Street with seawall railing in foreground.

Figure 2.10-6
Photos 7 and 8

Jones & Stokes (2006)

Photo 9. Key Viewpoint 3, facing northeast up the Pike Hillclimb towards the Pike Place Market.

Photo 10. Key Viewpoint 3, facing south, towards the Pike Street streetcar stop and aquarium.

Figure 2.10-7
Photos 9 and 10

Photo 11. Key Viewpoint 3, facing east towards downtown commercial core with viaduct in foreground.

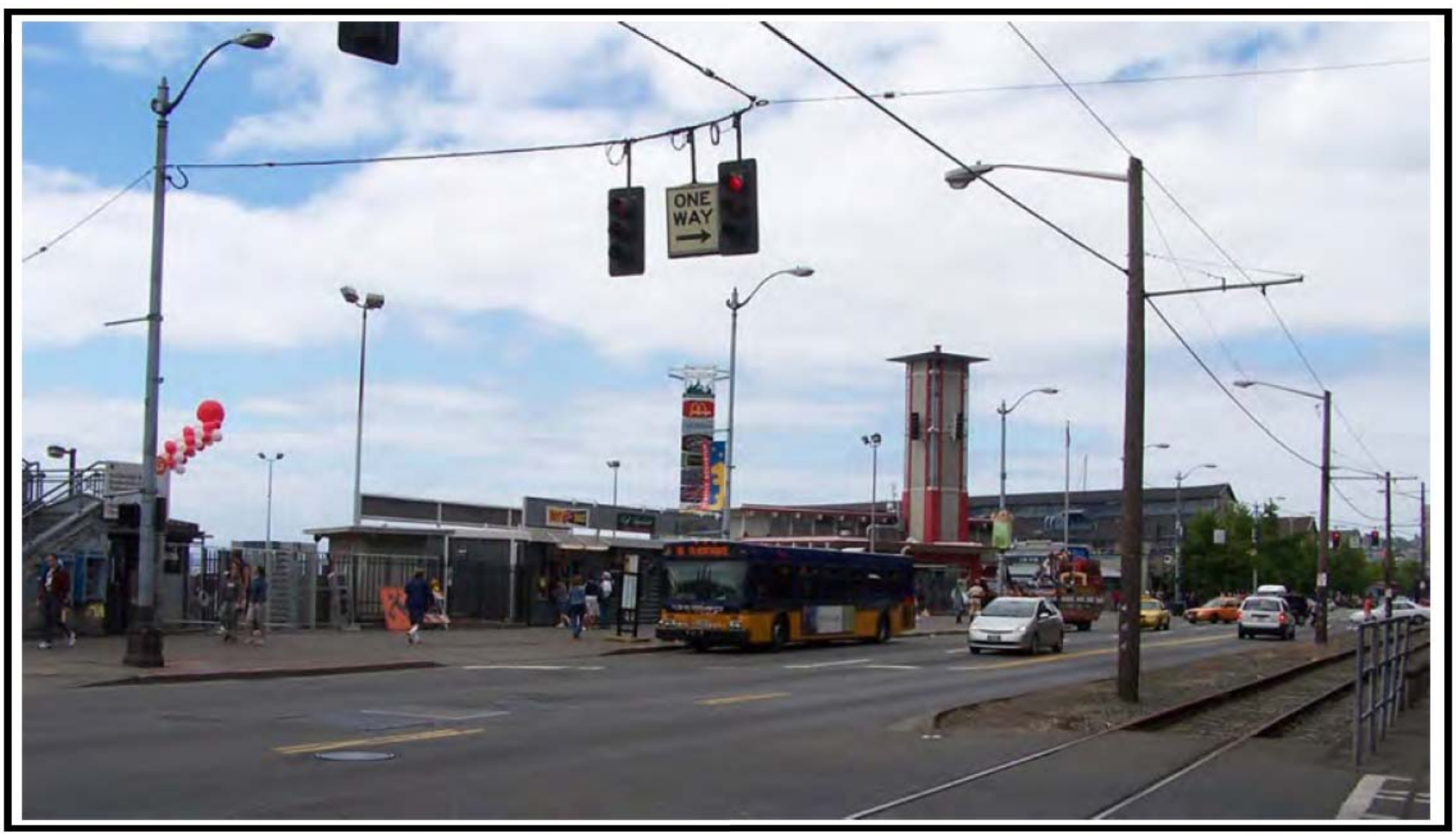


Photo 12. Key Viewpoint 5, facing west, towards Alaskan Way and Pier 53 from commercial core.

Jones & Stokes (2006)

Figure 2.10-8
Photos 11 and 12

North of Spring Street, there is no vehicular surface connection to Alaskan Way. The grade change between First Avenue and the waterfront varies from about three stories at Seneca Street to over eight stories at Pike Street.

The City of Seattle has designated "Green Streets" to include Marion Street from Second Avenue to Alaskan Way, Spring Street from First Avenue to the Alaskan Way surface street, and University Street from First Avenue to the Alaskan Way surface street (Figure 2.10-9) (SMC, 2008). Green Streets are rights-of-way that are designated for a variety of treatments, such as sidewalk widening, landscaping, traffic calming, and pedestrian-oriented features to enhance pedestrian circulation and open space use. Green Street development has been implemented on University Street with Harbor steps and on Spring Street with sidewalk widening and landscaping.

The visual context of the Alaskan Way Viaduct and adjacent private development is similar in the block between the Alaskan Way surface street and Western Avenue. Most buildings are four- to eight-story brick buildings constructed prior to 1930 in a loft style consistent with the area's earlier status as a manufacturing and warehousing district. Most of these buildings have been reconditioned as office buildings since the 1960s. The exception to this is a 12-story building built in the 1980s that occupies the block between Marion and Spring Streets. In addition, parking lots are located at the north face of Columbia Street, between Spring and Seneca streets, and at the north face of University Street.

Pioneer Square

The Pioneer Square area consists largely of turn-of-the-20th century brick buildings built in a consistent style as shown in photo 13 of Figure 2.10-10. Topography is generally flat, although there is a gentle rise to the east along Yesler Way starting at Third Avenue. The unity of architectural style, the inherent interest of the buildings, the unity of composition, and complementary elements such as street trees provide high visual quality throughout the historic district. The main focus of activity in the historic district is along First Avenue to the south, which has a landscaped median and the largest concentration of shops and restaurants. The northern portions of the corridor have generally higher visual quality because of the greater diversity provided by the smaller scale of the buildings and the more complex interactions between the buildings and the streetscape. Buildings to the south are generally larger, have fewer storefronts, and make up a less diverse streetscape. The Pioneer Square Neighborhood Plan includes policies to weave the east–west streets to the waterfront into the fabric of the community by improving pedestrian connections, to emphasize view connections to the waterfront and restore the S. Washington Street boat landing as the centerpiece of the south waterfront.

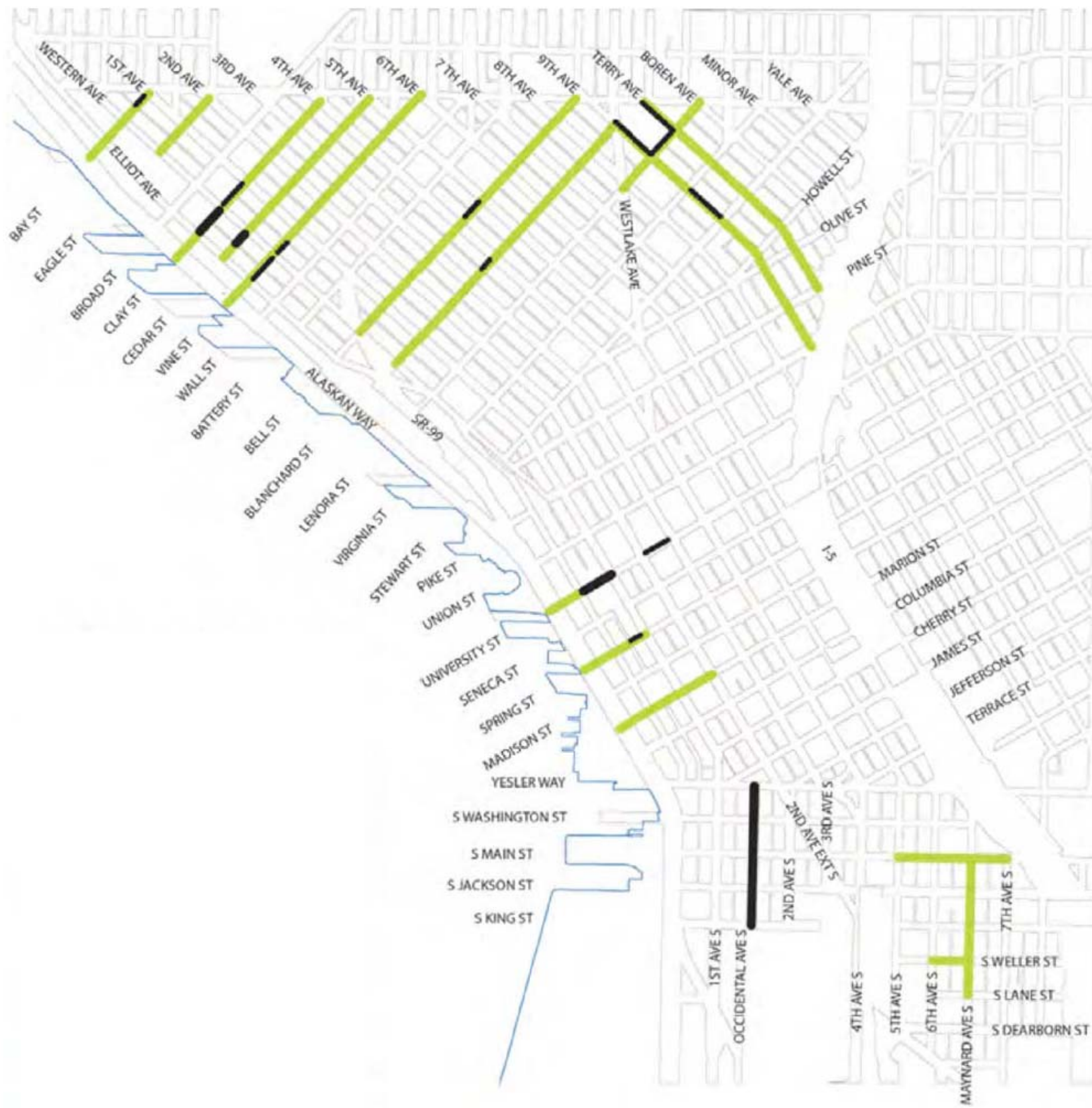


Figure 2.10-9

City of Seattle Green Street Locations

LEGEND

Designated

Implemented

N W E S NOT TO SCALE

Sources: City of Seattle Right-of-Way manual (2005); Jones & Stokes (2006)

Photo 13. Key Viewpoint 6, facing southeast towards Pioneer Square with viaduct in foreground.

Photo 14. Typical view of Alaskan Way and seawall from inland direction.

Jones & Stokes (2006)

Figure 2.10-10
Photos 13 and 14

Views from the Project

Views from the project were identified and evaluated after review of photographs of various viewpoints in various areas and in accordance with the FHWA DEIS (FHWA 2004).

In the North Waterfront Visual Character Unit, the surface roadway generally comprises two travel lanes in each direction with parking on both sides. Views available to occupants of vehicles traveling northbound on the surface street include port facilities such as grain elevators and office buildings along the street alignment. The Alaskan Way Viaduct is not visible from this area. However, train tracks remain present and run parallel to the water through the North Waterfront. Views to the west, between historic waterfront piers, include Elliott Bay, Puget Sound, and the peaks of the Olympic Mountains. On clear days, these views toward Elliott Bay with the Olympic Mountains in the background are key components of the local visual landscape for pedestrians, tourists, and residents. The Olympic Sculpture Park is a key visual element for visitors to the North Waterfront, providing an artistic lens through which passersby may view Elliott Bay and Puget Sound. Views of boats, ranging in size from personal watercraft, to commuter ferries, to cruise liners, can be seen docked at various piers on the waterfront or on the water. The panoramic water and mountain landscape provides a vivid backdrop to the Seattle Waterfront area.

Within the Central Waterfront Visual Character Unit, the viaduct is a key visual element that contrasts with the views of Elliott Bay, Puget Sound, and the Olympic mountains to the west. The greatest visual impacts of the viaduct are to pedestrians on the waterfront promenade on the west side of the Alaskan Way surface street. The Viaduct functions as a semi-permeable visual barrier between the waterfront and downtown. The shadows cast by the viaduct and the overlap of vertical supports obscure the view under the Viaduct of the ground floors of buildings directly behind it. The encroachment of the Viaduct structure for views from the west is softened somewhat by the line of street trees and the visual interest provided by the waterfront streetcar, which is located just west of the Viaduct. Views of Elliott Bay, Puget Sound and the Olympic Mountains are also key visual components as described for the North Waterfront Character Unit.

A pedestrian moving between the waterfront and downtown along any of the perpendicular streets is presented at the Viaduct with a radical change in the visual environment, which is reinforced by the intrusive noise levels of engine and exhaust noise, with the irregular thumps of tires crossing expansion joints and the occasional noise peaks of heavy trucks moving at high speeds. The visual environment opens suddenly when one passes under the Viaduct; the space above is open, and street trees frame one side of the sidewalk and buildings the other. On a clear day, one may see the Olympic Mountains in the distance and the expanse of

Elliott Bay and Puget Sound. The intrusion of traffic noise recedes gradually. Visual impacts from the waterfront are blocked largely by existing development north of Pine Street. As described for the North Waterfront Character Unit, views towards the west of Elliott Bay, Puget Sound, and the Olympic Mountains are key visual elements from portions of the Commercial Core and Pioneer Square Historic District when not obstructed by the Viaduct, buildings, or other features of the built environment.

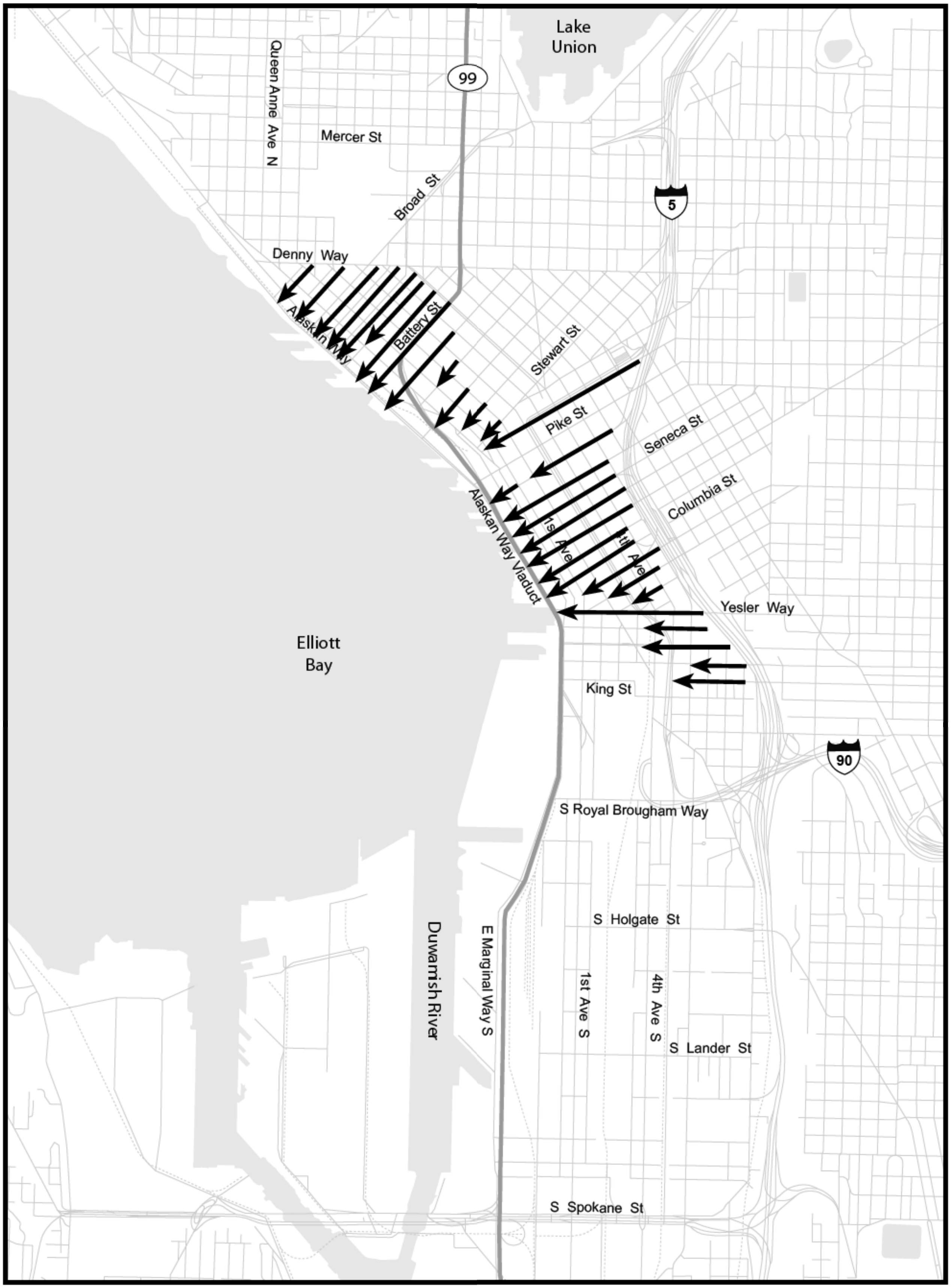
The existing Viaduct is the most prominent feature in street-level views of the Pioneer Square Historic District from the Alaskan Way surface street to the east. The Viaduct dominates near views and obstructs views of historic structures. From viewpoints to the south, there are some distant views of downtown high-rise buildings farther to the north; however, they are minor elements compared to the scale of the Viaduct. The visual dominance of the structure is reinforced by the visual distraction of vehicles flashing by and the associated noise of vehicles, especially the thump as they cross expansion joints.

Views Toward the Project

Views toward the project were identified and evaluated after review of photographs of various viewpoints in various areas and in accordance with the FHWA DEIS (FHWA 2004).

Within the waterfront visual character units, the Seawall is not a large visual element, since much of the wall is hidden from view below Alaskan Way. The typical view of the Seawall is the roadway surface itself and portions of the railing along the outer edge of the Seawall. From the seaward side, such as near the ends of piers and from ferries and other vessels in Elliott Bay, the Seawall appears intermittently between piers and structures as the homogenous horizontal base of the visual environment. More vivid visual components, such as the waterfront structures or downtown skyline, appear above and beyond the Seawall (Figure 2.10-4, photos 3 and 4). The Seawall itself is not particularly aesthetic in its existing condition, as it is often multicolored due to weathering and staining. Various utility features such as conduit boxes and wire housings are also built onto the Seawall.

All perpendicular streets that intersect with Alaskan Way in the Commercial Core are designated view corridors in the Seattle Comprehensive Plan (DTUDP 8 and 9, BP-19, LG 92 and 93), Land Use Regulations (SMC 23.49.024), and street vacation policies (Resolution 30297) as indicated in Figure 2.10-11. View corridors are designed to preserve views to the west of the waterfront and natural amenities such as Elliott Bay and landforms to the west. Upper level setbacks are required on Marion, Madison, Spring, and Seneca Streets west of Third Avenue to limit the encroachment of buildings on the view corridors. Views from private property include employees and residents in buildings that face the viaduct and from buildings along perpendicular street corridors. There are many high-rise buildings, generally east of First Avenue, which allow views down to the waterfront through gaps between buildings. Individual structures or buildings within the waterfront become an increasingly smaller element of the visual environment from higher floors. Buildings east of Western Avenue generally have views of the waterfront blocked by intervening buildings, except down street corridors or where intervening buildings are absent and parking lots are located.



Sources: SR99 AWVSRP DEIS (2004, 2006); Jones & Stokes (2006)

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Extent of View Corridor
Direction of View

Figure 2.10-11
City of Seattle
View Corridors

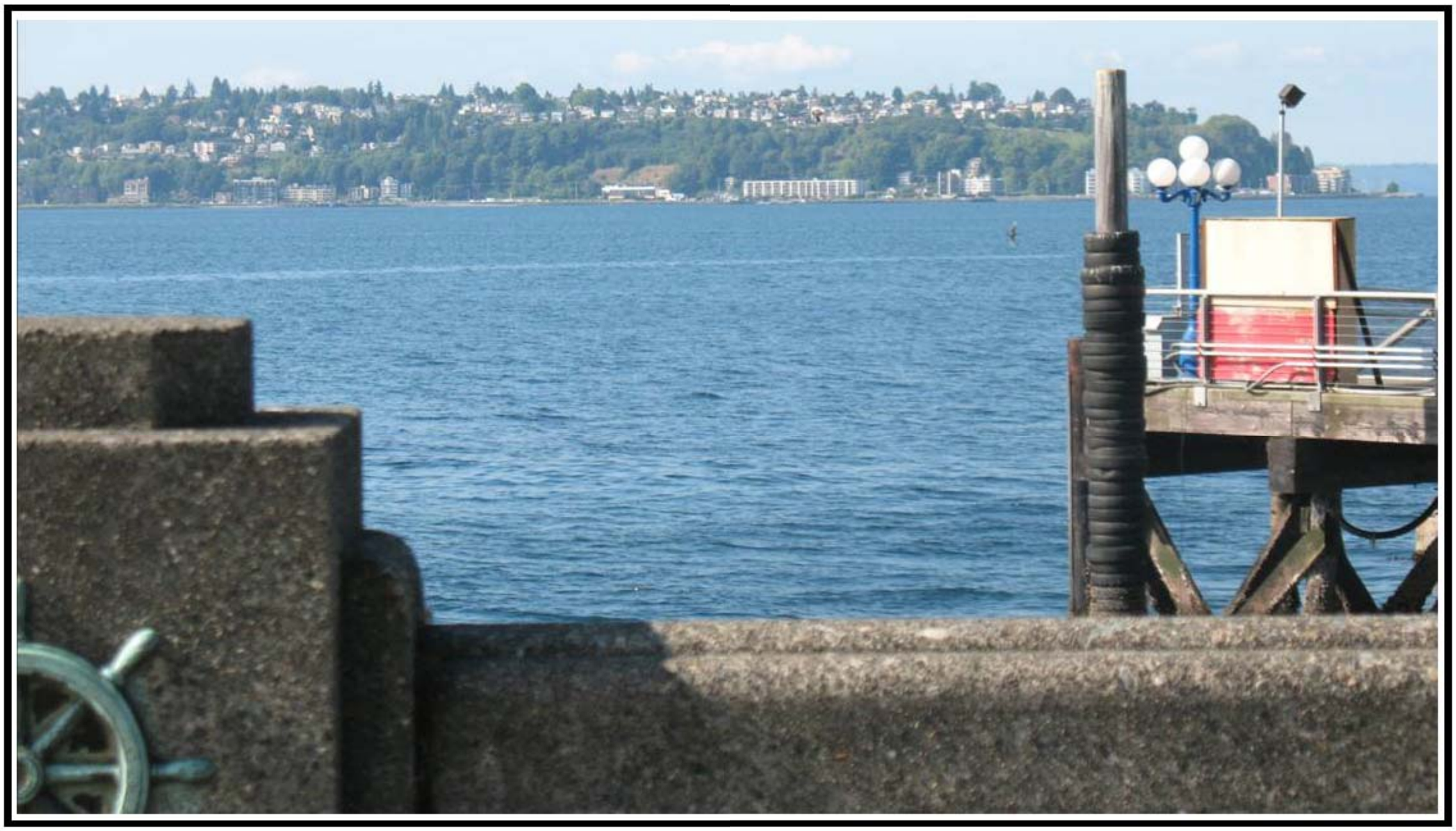


Photo 15. View westward from atop the Elliot Bay Seawall between Pier 69 & 70.

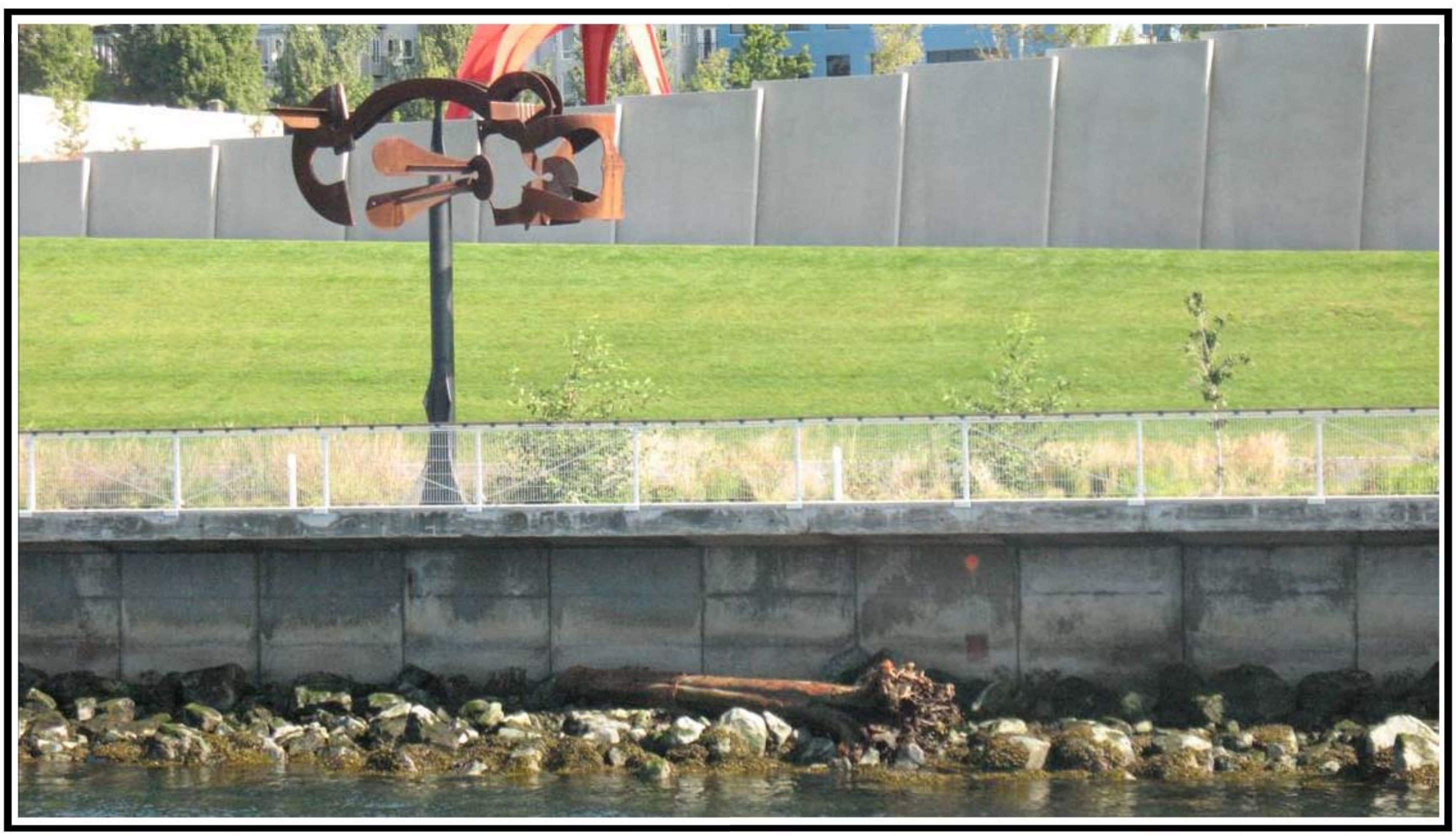


Photo 16. Olympic Sculpture Park and seawall as seen from Pier 70.

Figure 2.10-12
Photos 15 and 16

Photo 17. View westward, toward Bainbridge Island, from Pier 70. A commuter ferry is visible on the left.

Photo 18. Olympic Sculpture Park as viewed from the PACCAR Pavillion.

Photo 19. View south from Myrtle Edwards Park. The habitat area, sculpture park, Pier 70, and downtown are visible.

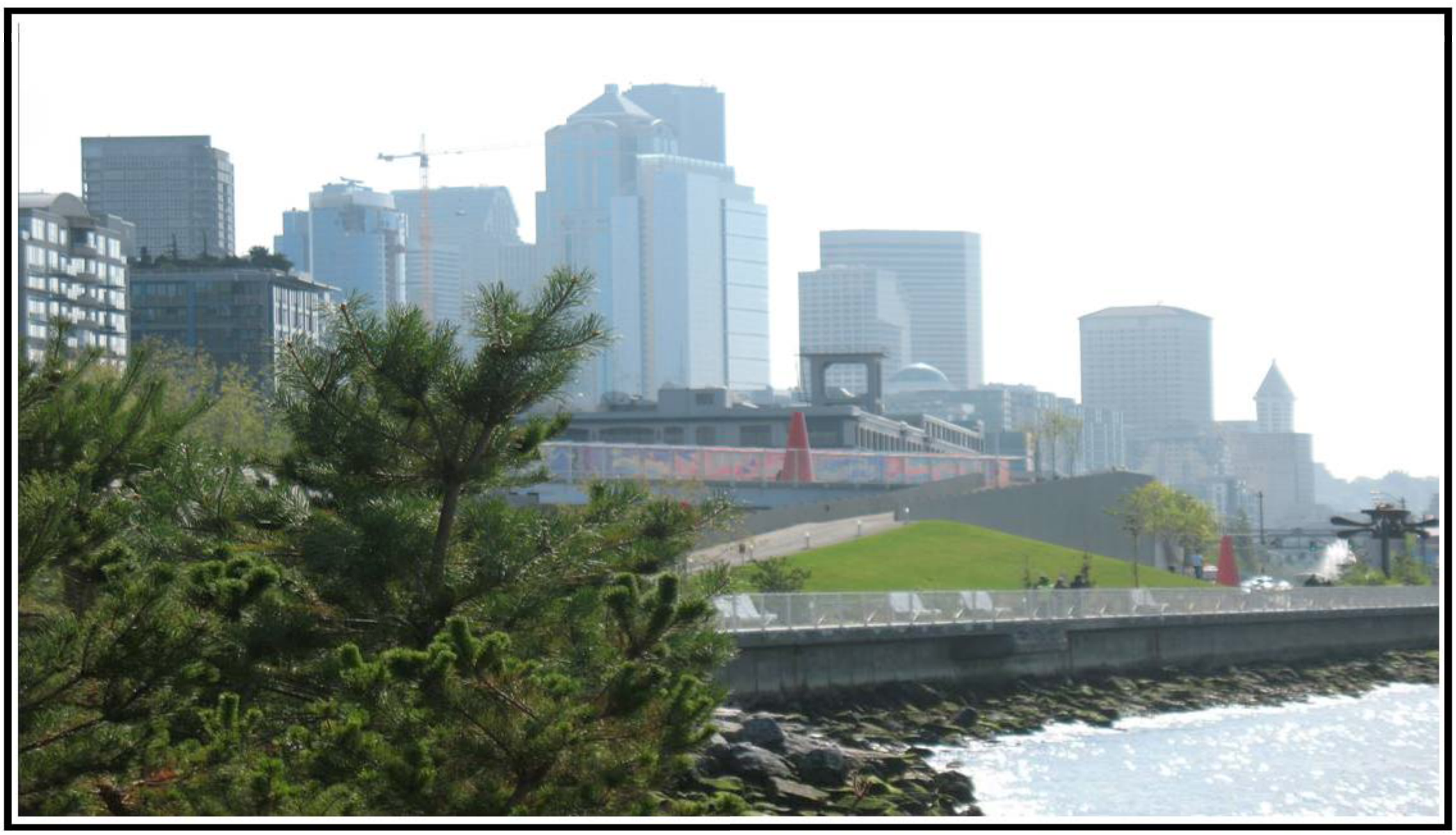


Photo 20. The completed Olympic Sculpture Park and downtown Seattle in juxtaposition.

Figure 2.10-14
Photos 19 and 20

Photo 21. Facing North. Myrtle Edwards Park as viewed from the new habitat area north of Olympic Sculpture Park.

TetraTech SWG 2008

Figure 2.10-15
Photo 20

In these cases, ground floors are likely to be similar to the street-level pedestrian views, second to fourth floors (at the level of the decks of the Viaduct) likely experience blockage of views down the street corridor, and upper floors enjoy views down street corridors that look over the viaduct and allow unobstructed distant views.

Views of the waterfront within Pioneer Square are available from east–west streets that are perpendicular to Alaskan Way and from adjacent to the viaduct, where a number of buildings directly access the surface street and parking beneath the aerial structure. Views toward the waterfront from the Pioneer Square Historic District are most significant from the five perpendicular streets stretching from South King Street to Yesler Way. The visual context of the streets is similar in that three- to eight-story brick buildings tightly frame all. The complexity of the framing tends to increase on the northerly streets because the building scale tends to be smaller and more complex. All the streets have buildings at the sidewalk line, street trees, and no overhead utilities. The streets provide a unified and consistent corridor of urban development of a historic character. Views from private property include employees and residents in buildings that face the waterfront, and from buildings along perpendicular street corridors.

Buildings east of First Avenue are unlikely to have views of the waterfront, except down street corridors. Some buildings fronting the west side of First Avenue have views of the viaduct from rear windows facing west, where intervening buildings facing the Alaskan Way surface street are lower than the viaduct. For buildings adjacent to the Viaduct, the Viaduct structure is likely to dominate ground floor views. Views from second to fourth floors adjacent to the viaduct are likely to look out upon traffic decks. These views may be blocked or exhibit the presence of high-speed traffic flashing past windows. There are several buildings adjacent to the viaduct with floors above the viaduct level. In these cases, there are views of the waterfront, Elliott Bay, Puget Sound, West Seattle, and the Olympic Mountains that are not blocked or intruded upon by the viaduct. Yesler Way and Jackson Street are both designated City of Seattle Scenic View Routes. Both streets are oriented east-west.

From higher elevations east of the Pioneer Square area, building occupants enjoy panoramic views to the west. The views west down Jackson Street east of Fifth Avenue are framed somewhat more closely by buildings than the Yesler Way views. Both streets have a moderate slope down to about Third Avenue, where the topography is almost flat. The existing Alaskan Way Viaduct is visible in distant views to the west down both streets as a horizontal band that contrasts with the water of Elliott Bay. The viaduct also provides a contrast to the linear nature of the street corridor. It is not a dominant element of distant views because of the vivid focus provided by water and mountain views. In the vicinity of Third or Fourth Avenues, the position of the Viaduct relative to an observer moves above the line of sight and is silhouetted against the sky. As one moves closer, it increases in relative scale and blocks elements of the distant views.

All views of the project area from the Belltown, Pike Place Market, Commercial Core, and Pioneer Square visual character units are similar in that these are not seaward views of the Seawall project area as shown in photo 14 of Figure 2.10-10. When visible, the Seawall normally appears only as the roadway surface of Alaskan Way and the intermittent railing along the Seawall edge. At greater distances, the more vivid elements of Elliott Bay and the waterfront structures dominate the long-distance views of the Seawall.

Historic Landmarks

The City of Seattle Municipal Code allows for the protection of views of historic landmarks as designated by the Landmark Preservation Board. Table 2.9-3 presents a list of historic landmarks in the study area. The landmarks identified in the study area were all historic buildings. Any future development within the area must consider the effects on protected views of landmarks in addition to the protection of views of natural features, as discussed in previous sections. The owner, present use, and address are presented in the table.

Table 2.9-3. Historic Landmarks in the Study Area

#	Owner	Present Use	Address
1.	Winant, Anais	Retail	1923 1ST AVE
2.	Champion Building	Retail	1926 PIKE PL
3.	Pike Place Market Preservation and Development Authority	Retail	1918 PIKE PL
4.	Pike Place Market Preservation and Development Authority	Retail	1912 PIKE PL
5.	Seattle Department of Transportation	Retail	1901 PIKE PL
6.	Pike Place Market Preservation and Development Authority	Retail	1423 1ST AV 98101
7.	Inter Co-op USA No 7	Office	1501 WESTERN AV
8.	Integrus Architecture P.S.	Office	1426 ALASKAN WY
9.	Pacific Trustee, Ltd.	Office	1414 ALASKAN WY
10.	Harbor Properties, Inc.	Misc	1400 WESTERN AV
11.	Bradely Holdings, Ltd.	Loft/Warehse	1400 ALASKAN WY
12.	State of Washington	Loft/Warehse	90 S DEARBORN ST

Viewer Groups and Responses

Viewer groups and responses were identified and evaluated after review of photographs of various viewpoints in various areas and in accordance with the FHWA DEIS (FHWA 2004).

North and Central Waterfronts

Viewer populations in the waterfront vary considerably. However, the nature of the Seawall is such that views of it are limited to those people who are on the waterfront at ground level. As such, this report considers pedestrians near the waterfront to be the persons most likely to view the Seawall. Viewers in residences and office buildings near the waterfront are important viewer groups when considering the viaduct, but are unlikely to view the Seawall from those structures.

The Seattle-King County Convention and Visitors Bureau list the waterfront as the second most visited attraction in the Seattle area, with approximately 4.2 million visits in 1999. In the vicinity of Yesler Way and Columbia and Marion Streets, there are a large number of pedestrian viewers who are likely to be ferry commuters. Tourists are likely to be a component of this group, as well as other individuals walking between the waterfront and Pioneer Square.

The area between piers 54 and 63 is likely to have the highest pedestrian volumes of elective and tourist viewers along the waterfront. These piers contain retail stores and restaurants; Waterfront Park; the Seattle Aquarium; and views, activities, and other amenities. They are also connected with the Pike Place Market via the Pike Street Hillclimb and with the Seattle Art Museum and Benaroya Hall along University Street and Harbor Steps.

Pedestrian volumes are highest during the summer. Pedestrian counts at Pier 56 in late May 1997 were about 5,000 people in a 4-hour midday period. September 2001 lunch hour volumes were about 1,580 people, with daily volumes of about 3,750 people. Estimated pedestrian volumes accessing the Seattle Aquarium are about 4,000 for a peak summer day. Pedestrian volumes fall off to the north of Pier 59 due to the lower level of pedestrian attractions.

Viewer sensitivity is likely to be lower among commuters accessing the Colman Dock Ferry Terminal and highest among tourists and others at Piers 54 through 59 and the Seattle Aquarium. Pier 66 incorporates a pedestrian bridge connection to Elliott Avenue, but average daily pedestrian volumes in the areas are believed to be relatively low. Pier 66 experiences very high pedestrian levels when cruise ships dock; however, the distribution of cruise ship patrons from the site is unknown.

Belltown

Within the Belltown Visual Character Unit, pedestrian counts in September 2001 at Second Avenue and Lenora Street were about 1,000 people during the lunch hour and about 2,800 people for the weekday total. Elliott and Western Avenues have relatively few destinations for pedestrians.

Residences in the area north of the existing viaduct are likely to be the most sensitive viewer population, and most are likely affected by the barrier effect of the present viaduct. Residents and others to the east can avoid crossing the Viaduct by circulating on First Avenue and streets to the east.

Pike Place Market

The Pike Place Public Market is rated as the most popular tourist destination in Seattle, with about 5.6 million visitors in 1999. The Pike Place Market Public Development Authority estimates 9 million visitors per year, including local residents. This represents a very large potential viewing population. It is likely that Victor Steinbrueck Park (a Seattle designated viewpoint) is the primary viewing location because of its accessibility and the attractiveness of the panoramic views of Elliott Bay and the downtown skyline.

The Pike Street Hillclimb carries high pedestrian volumes. At both locations, viewer sensitivity is likely to be high, with impacts relatively higher on the Pike Street Hillclimb because of the location of the viaduct as a barrier to views and the necessity to walk under the structure.

Commercial Core

Viewer populations in the Commercial Core Visual Character Unit are high due to its status as an employment center. The number of pedestrians at University Street and First Avenue was about 2,500 during the noon hour and about 7,700 daily, according to counts taken in September 2001. These pedestrian volumes are similar to the Pioneer Square area and the center of the shopping and hotel district in the vicinity of Westlake Park at Pine Street and Fourth Avenue.

The sensitivity of viewers is likely to be high for downtown employees engaged in elective activities when using open spaces and is likely to be similar to tourists or shoppers. The less homogenous and distinct visual quality of buildings in the area, as well as their greater scale, is likely to reduce sensitivity to the existing viaduct compared to the smaller building scale in the Pioneer Square area

The highest pedestrian populations are likely along Marion Street, where a grade-separated pedestrian connection to the Colman Dock Ferry Terminal is located. Washington State Ferries reports an average of 10,000 walk-on passengers per day, with the majority on car ferries at the Colman Dock Ferry Terminal. High pedestrian levels are also likely on University Street, where the Seattle Art

Museum and Benaroya Hall attract tourists and the regional community and are adjacent to the Harbor Steps pedestrian connection between First and Western avenues. This corridor is likely to carry significant pedestrian volumes between the downtown core and the waterfront. The sensitivity of viewers is likely to be highest for persons attracted to the cultural resources of the museum and the pedestrian and open spaces along University Street. Sensitivity is likely to be higher on designated Green Streets, which include Marion Street from Third Avenue to the Alaskan Way surface street and Spring and University Streets from First Avenue to the Alaskan Way surface street.

Pioneer Square

Current pedestrian volumes at Pioneer Square are 2,500 during weekday lunch hours, with weekday totals of around 6,500 pedestrians. Volumes near Occidental Avenue and Main Street are about 1,800 pedestrians for the lunch hour and about 4,300 pedestrians daily. The viewing population is typically highest along First Avenue where the largest concentration of businesses exists. Pedestrian volumes drop off to the south, except on days when events are scheduled in the sports complexes to the south. There is also a large component of commuter traffic from the passenger ferry at the foot of Yesler Way that walks up Yesler to First Avenue on their way to places of employment.

The population of viewers in the Pioneer Square Historic District is high and is likely to be among the most sensitive to visual quality. The area has among the greatest concentrations of small shops, restaurants, and entertainment in the downtown area. The visual qualities of the historic area are also one of the prime attractions. The Pioneer Square area is estimated to receive about 2.5 million tourist visitors a year. The area also attracts shoppers and restaurant patrons. A high proportion of viewers are likely to be involved in elective activities, which makes them highly sensitive to the features of the environment.

Light and Glare

Lighting along Alaskan Way and the Seawall is typical of urban arterials. The Alaskan Way corridor is little different from other downtown arterials in light and glare impacts to the surroundings.

2.11. Parks and Recreation

2.11.1. Overview

This section provides information on park and recreational facilities, and public art along the Alaskan Way Seawall structure. In general, park facilities along or abutting the Alaskan Way right-of-way between S. Washington Street on the south and Broad Street on the north are identified as being within the study area (or potential impact area of construction/operational impacts). Recreational facilities include those on private land in which the public has a proprietary interest, such as an access easement or other access rights.

2.11.2. Methodology

This chapter includes information on the condition of parks and recreational facilities within the study area. Existing conditions were identified through use of existing written resources; no field surveys or assessments were completed for this report. Data was obtained primarily from discipline reports and technical memoranda completed for the Alaskan Way Viaduct and Seawall Replacement Project Draft Environmental Impact Statement (DEIS) and Supplemental DEIS (SDEIS) (Federal Highway Administration (FHWA 2004; 2006 respectively).

2.11.3. Existing Parks, Recreation and Public Shoreline Access Facilities

Seattle's Parks and Recreation 2006 Development Plan describes the City's park and recreational system as follows:

> Comprised of open space, parks, boulevards and trails, beaches, lakes and creeks, recreational, cultural, environmental, and educational facilities, a broad variety of programs, and people. The system is diverse and woven into the fabric of Seattle's neighborhoods. It is an integral part of everyday life within the city. The system contributes significantly to the city's identity, stability, urban design, and network of public services. It promotes the physical, mental, social and spiritual well being of our citizens. The condition of the park and recreational system reflects the city's health and is essential to our quality of life.

The Park and Recreation Development Plan emphasizes that planning for parks and recreation in Seattle must be sensitive to the stresses and complexities of urban life, flexible to the changing urban conditions, and be a part of the City's overall growth strategy. It must be focused on conservation of the natural environment and meld recreation programs with human and family services. Above all, planning for parks and recreation must reflect a vision consistent with the goals and aspirations of the community (City of Seattle 2006).

The City's park and recreation development policies include pursuing boulevard-type improvements and the greening of Seattle's streets to link neighborhoods to parks and other activity centers, as well as improving selected street ends for shoreline access (City of Seattle 2006).

Shoreline access is also recognized as providing open space functions: "A variety of shoreline access facilities have been required by conditions of Shoreline Management Substantial Development Permits, and other city permits and approvals. In addition, many of the piers along the shoreline are located within publicly owned aquatic lands between the Inner and Outer Harbor Lines. The Washington Department of Natural Resources, as trustee for those lands, encourages public use and access in management decisions, consistent with Revised Code of Washington (RCW) 79.90.450 and 455 and has included public access requirements in some aquatic land leases (FHWA 2004).

The Seawall stretches along the Seattle waterfront from S. Washington Street on the south to Broad Street on the north. Between Broad and Bay streets, the Seawall has been repaired as part of the recently constructed Olympic Sculpture Park and is not included within the study area. The park, recreational facilities, and public art described below are located primarily within the Alaskan Way right-of-way or on abutting property. Table 2.11-1 and Figures 2.11-1 and 2.11-2 describe and illustrate locations of parks and recreational and public access facilities found along Alaskan Way.

The park and recreation system is described in the Seattle Parks and Recreation Development Plan as consisting of open space; parks; boulevards and trail; beaches; lakes and creeks; recreational, cultural, environmental, and educational facilities; and a wide variety of programs and people (City of Seattle 2006).

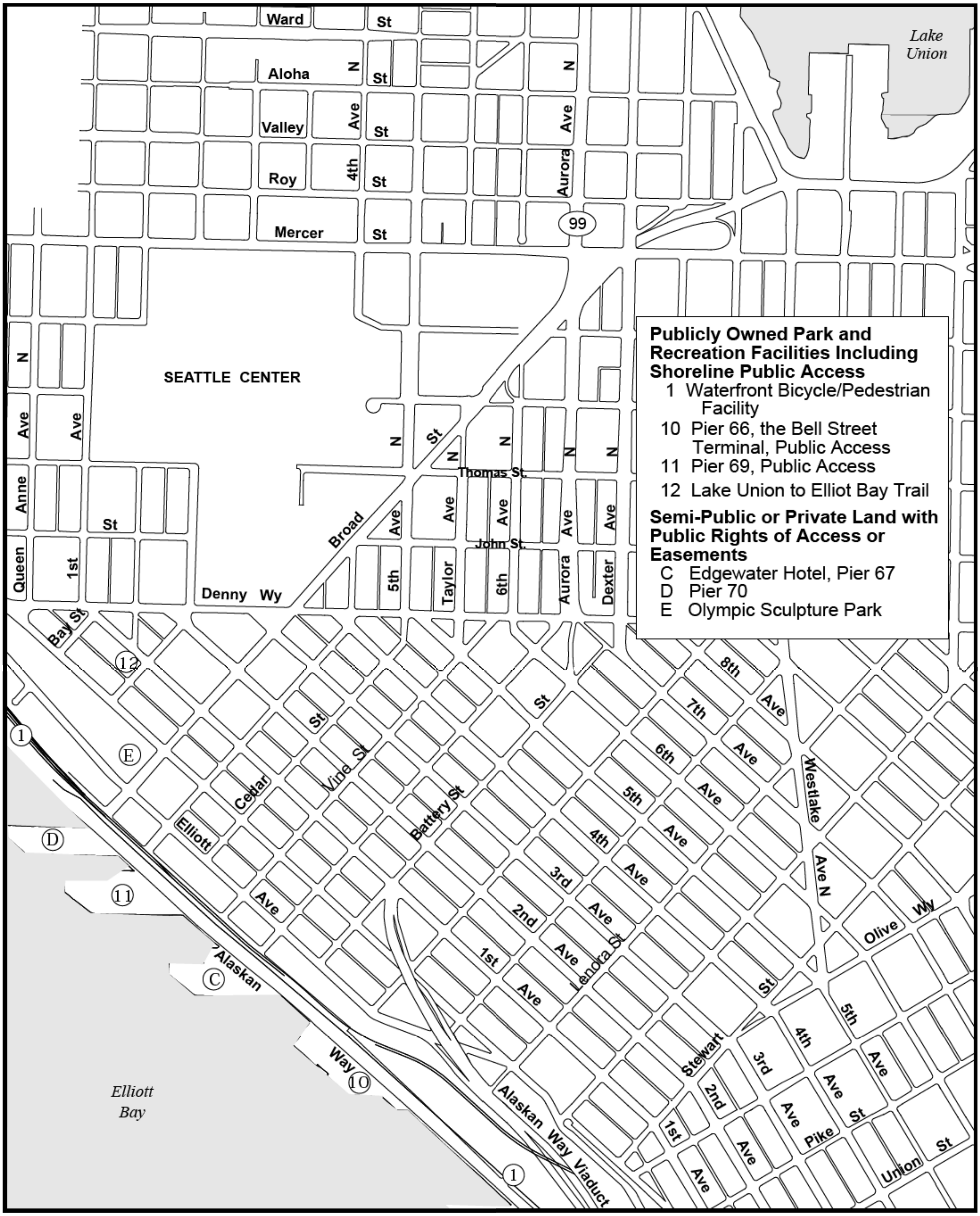
The Seattle Parks Department and Port of Seattle own most park and/or public access sites. In some instances, however, facilities consist of public access rights over private property. A variety of shoreline access facilities have been required by conditions of Shoreline Management Substantial Development Permits and other City permits and approvals, as well as aquatic lands leases.

Table 2.11-1. Parks, Recreation, and Public Access Facilities

Facility Name	Location	Owner	Primary Facilities	Primary Uses
Publicly Owned Park and Recreation Facilities, Including Shoreline Public Access				
1. Pier 48: Alaskan Square	Pier 48 S. Washington Street at Alaskan Way	Port of Seattle	Totem poles Hard Surfaces Seating	View Enjoyment Relaxation Picnicking People Watching Fishing
2. S. Washington Street Public Dock and Pergola	S. Washington Street at Alaskan Way	City of Seattle	Hard Surfaces	View Enjoyment Relaxation Fishing
3. Public Access at Washington State Ferry Terminal	Piers 50 and 52 Alaskan Way between Yesler Way and Madison Street	Washington State Department of Transportation	Public Viewing Areas Hard Surfaces Seating Water Feature	View Enjoyment Relaxation
4. Access to Blake Island/Tillicum Village	Pier 55 Alaskan Way and Seneca Street	Private	NA	Provides boat access to Blake Island State Park
5. Waterfront Park	Alaskan Way between University and Pike Streets	City of Seattle	Hard Surfaces Seating Picnic Tables Restrooms	View Enjoyment Relaxation Picnicking People Watching Fishing
6. Seattle Aquarium	Pier 59 and 60 Alaskan Way	City of Seattle	Interpretive Displays Research Facilities	Interpretive Displays Education Research
7. Pier 62/63 (Currently closed)	Alaskan Way at Pine Street	City Seattle	Hard Surfaces Performance Facilities	View Enjoyment Relaxation Picnicking Summer Concert Series
8. Pier 66, the Bell Street Terminal, Public Access	Alaskan Way at Bell Street	Port of Seattle	Hard Surfaces Seating Restrooms	View Enjoyment Relaxation People Watching Boat Access to Central Waterfront
9. Pier 69, Public Access	Alaskan Way at Bell Street	Port of Seattle	Hard Surfaces Seating	View Enjoyment Relaxation Picnicking Fishing
10. Lake Union to Elliott Bay Trail (formerly Potlatch Trail)	Between Lake Union and the Waterfront at Broad Street	City of Seattle	Trail	View Enjoyment People Watching Walking Jogging Bicycling Skating

Facility Name	Location	Owner	Primary Facilities	Primary Uses
Semi-Public or Private Land with Public Rights of Access or Easements				
A. Pier 54	Alaskan Way at Madison Street	Private	Hard Surfaces Seating	View Enjoyment Relaxation
B. Piers 55 and 56	Alaskan Way at Seneca Street	Private	Hard Surfaces Seating Picnic Tables	View Enjoyment Relaxation Picnicking People Watching
C. Edgewater Hotel Pier 67	Alaskan Way at Wall Street	Private	Hard Surfaces Seating	View Enjoyment Relaxation People Watching
D. Pier 70	Alaskan Way at Broad Street	Private	Hard Surfaces Seating	View Enjoyment Relaxation People Watching
E. Olympic Sculpture Park	Between Western Avenue and Alaskan Way at Broad Street	Non-Profit Corporation Municipal Development Authority	Hard Surfaces Soft Surfaces Seating Picnic Tables Art Display Restrooms Parking	View Enjoyment Relaxation Picnicking People Watching Cultural Activities

Source: FHWA 2004



Sources: SR99 AWVSRP DEIS (2004, 2006); Jones & Stokes (2006)

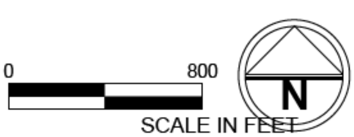
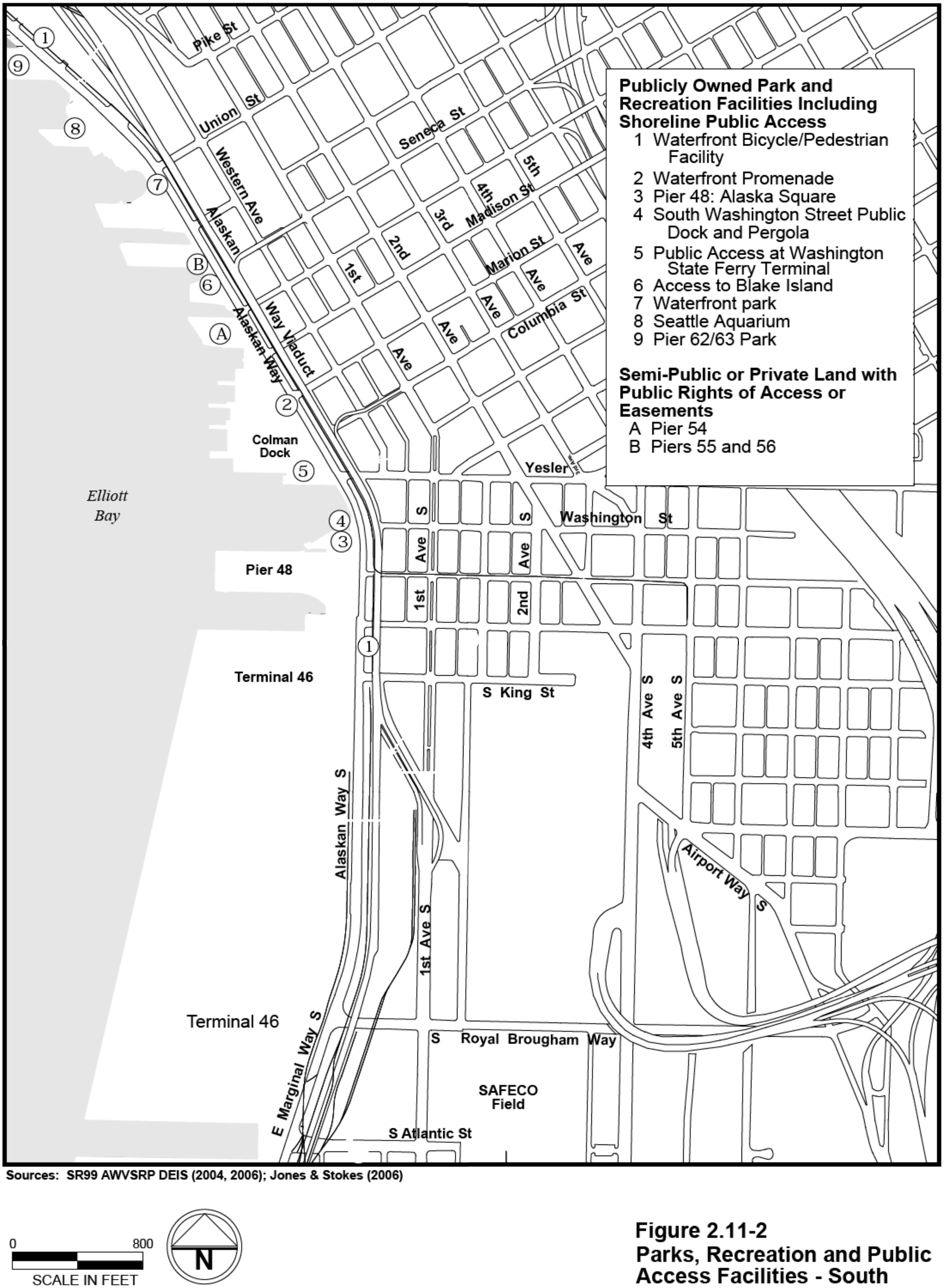


Figure 2.11-1
Parks, Recreation and Public Access Facilities - North



Sources: SR99 AWVSRP DEIS (2004, 2006); Jones & Stokes (2006)

Figure 2.11-2
Parks, Recreation and Public Access Facilities - South

A description of specific parks and recreation facilities follows, starting from facilities located at the south end of the study area and proceeding to the north end.

Waterfront Bicycle/Pedestrian Facility

This multipurpose asphalt pathway extends from S. Royal Brougham Way on the south to Broad Street on the north where it connects to the Elliott Bay Trail. The Waterfront Bicycle/Pedestrian Facility is part of the Seattle Urban Trails System designated in the City's Comprehensive Plan. The Urban Trails System is designated to facilitate walking and bicycling as viable transportation choices, provide recreational opportunities, and link major parks and open spaces with Seattle neighborhoods. These trails provide an off-road path or sidewalk (separated from motor vehicles) for pedestrians and bicyclists, as well as off-road trails, special bicycle lanes, and signed routes in the street right-of-way. The City considers the Waterfront Bicycle/Pedestrian Facility to be primarily a transportation facility rather than a recreational facility.

The Waterfront Bicycle Pedestrian Facility is planned to connect with the future Mountains to Sound Greenway Trail at S. Atlantic Street. The portion of the Waterfront Bicycle/Pedestrian Facility between S. Washington and Pike streets has a landscaped berm and street trees on the east side adjacent to the viaduct and a wood rail fence on the west side adjacent to the waterfront streetcar tracks that are located between the route and the street. This portion of the Waterfront Bicycle Pedestrian Facility corridor fills with pedestrians during midday, making it unworkable for heavy bicycle use. Commuter bicyclists generally use the vehicular lanes in this area. The asphalt trail carries considerably lower pedestrian volumes than the promenade on the west side of the Alaskan Way surface street. In addition to its transportation function, this section of the multiuse route probably attracts greater active recreational use by exercise seekers (such as walkers and joggers) than by sightseers, given its location farther from the high-interest waterfront uses.

Between Pike and Blanchard Streets, a concrete sidewalk is provided adjacent to the Alaskan Way surface street west of the streetcar tracks, with an asphalt path on the east side of the right-of-way adjacent to apartment buildings, a hotel, and an office building. The waterfront streetcar tracks are located between the sidewalk and the asphalt pathway. The asphalt pathway extends to Bell Street, where it is routed onto an 18- to 24-foot-wide concrete sidewalk west of the streetcar tracks and BNSF railway that terminates at Clay Street (FHWA 2006).

Waterfront Promenade

The Waterfront Promenade is the sidewalk between the face of the Seawall and the west side of the Alaskan Way surface street that extends from S. Washington Street to Myrtle Edwards Park. The promenade is the one element that ties the City's central waterfront into a linear corridor where a variety of uses are accommodated. The promenade provides space for the interaction of private and public activities that make the waterfront an attractive destination. Of particular interest to many promenade users are the near and distant views of Puget Sound and water-related uses, including ferries, shipping, and recreational watercraft. The interrelated functions of the promenade including pedestrian movement, access to private uses such as retail and restaurants, access to public open space, and enjoyment of activities such as walking and viewing occur simultaneously for each user. The high density of pedestrians and a variety of activities such as retail and restaurant uses provides opportunity for people watching and enjoyment of the general ambience and setting along the busy waterfront.

In most places, the promenade is 20 feet wide. Between S. Washington Street and Yesler Way, open water areas and views of Elliott Bay and distant natural features such as the Olympic Mountains are readily visible on clear days, but the uses adjacent to the promenade attract less visual interest. From Yesler Way to Madison Street, the Washington State Ferries (WSF) Colman Dock Terminal blocks near views of the water and distant views are blocked by ferry loading facilities and the Colman Dock building. Between Piers 54 and 59, the waterside is bounded by a variety of historic piers, many of which contain public access areas. Design continuity is provided on the waterside (west side) of the promenade by a concrete railing (where not abutted by piers), which must be maintained or reconstructed as part of any development pursuant to the City's Municipal Code (SMC 23.60.704) requirements to ensure the historic character of the area. (FHWA 2004)

Pier 48 Alaska Square, Shoreline Public Access

Alaska Square is a Port of Seattle facility located on the north side of Pier 48 at the southern limit of the Seawall. This 15,000-square-foot park opened in 1990 and provides public access to the shoreline and a viewing area including seating and a totem pole focal point. Alaska Square is currently closed to public access because its concrete bulkhead has collapsed in places. (FHWA 2004)

South Washington Street Public Dock and Pergola (Washington Street Boat Landing)

The Washington Street Boat Landing is located on public right-of way at the end of S. Washington Street on the west side of Alaskan Way. The pergola was constructed in the 1920s as the headquarters for the now defunct Seattle Harbor Department. The pergola is a City-designated historic structure and is on the National Register of Historic Places. This facility is located within the City's Pioneer Square Preservation District. Over the years, this building has fulfilled a number of other uses, including: a landing for ferries and oceangoing ships, and as the U.S. Navy's official shore-leave landing and departure point. The pergola is approximately 86 feet long and 30 feet wide. The facility provides some seating and views of the water and mountains to the west. The Pioneer Square Neighborhood Plan calls for the rehabilitation and reuse of the Washington Street Boat Landing, either as an entry for new "mosquito fleet" passenger ferries or as part of a new public space (FHWA 2006).

A historic plaque is located at the pergola commemorating the wreckage of the steamer Idaho, which served between 1900 and 1909 as a mission hospital where Dr. Alexander De Soto ministered to the needs of seafarers and the destitute.

Colman Dock Ferry Terminal (Piers 50 and 52), Shoreline Public Access

Currently, the Colman Dock Ferry Terminal provides public access and shoreline viewing areas that are shared by pedestrians accessing the ferries. Existing designated public access areas include the south side of Pier 52 passenger ferry terminal walkway, an open space area along the promenade near Yesler Way, and Alaskan Way along the upper level deck of the terminal. The area along the street near Yesler Way provides benches and a fountain. It is bounded by Alaskan Way on one side and a large expanse designated for auto queuing on the other side, creating little or no view of the water, mountains, or other areas of interest. The south side of Pier 50 provides no seating or other amenities.

The area of Colman Dock accessible without paying a ferry fare has limited visual interest and limited views of the waterfront. These areas also provide pedestrian access to ferries and therefore provide limited opportunities for lingering to enjoy views during peak commuter hours. An interior public information area is provided in the ferry waiting room. (FHWA 2004) Some facts on the Ferry Terminal include:

- The Seattle Ferry Terminal at Colman Dock is WSF's busiest terminal:
- Over 25,000 people commute daily through the Seattle Ferry Terminal.
- During peak commute periods, walk-on passengers exceed vehicle passengers by a factor of 8 to 1.
- More than 9 million people travel through the terminal on an annual basis. Of these, 7.2 million people walk onto the ferries or are passengers in cars (as opposed to drivers in single-occupancy vehicles).

The terminal serves the Bainbridge Island and Bremerton passenger-vehicle routes and the Vashon Island passenger-only ferry route. In coming years, the number of daily commuters and visitors is expected to grow, with the majority of the growth coming from walk-on passengers. Walk-on passengers are expected to triple by 2030, and on the Bainbridge and Bremerton routes overall ridership is projected to double over the next 25 years. These ferries are a critical part of the state highway system, and the terminals serve as the transportation hub between the east and west sides of Puget Sound.

Washington State Department of Transportation (WSDOT) has determined that the Colman Dock structures are deteriorating and need to be replaced soon. The north portion of Colman Dock was built in 1936, and the timber decking and pilings under the dock are being eaten away by shipworms and other marine borers. The creosote-coated timber is eroding and needs to be replaced. The terminal building is undersized and needs seismic, electrical, and energy upgrades. In addition, the building is too small to accommodate the projected growth in walk-on passengers. Other marine structures need to be replaced, such as trestles, transfer spans, and overhead loading.

The City of Seattle has started planning for a new waterfront with public spaces, activity zones, and improved marine habitat. Through this planning effort, Colman Dock has been identified as a prime location for increased activity, density and public access to the waterfront. WSF would like to take advantage of this opportunity to generate non-fare box revenues to offset rising operating costs. WSF is exploring the possibility of including privately funded transit-oriented development at Colman Dock. Redevelopment of Colman Dock could provide neighborhood and passenger amenities and an opportunity to improve the nearshore environment (WSDOT 2006).

Fire Station No. 5, Shoreline Public Access

Fire Station No. 5 includes a dock for the City's fireboats. The fire station is located on right-of-way at the foot of Madison Street on the west side of Alaskan Way, and it provides a small public access area for harbor viewing located just north of the station building. The primary elements of visual interest are the fireboats moored at the fire station and ferries leaving the Colman Dock ferry terminal to the south (FHWA 2004).

Pier 54, Shoreline Public Access

Pier 54 is a private pier at the foot of Madison Street that provides a small public plaza area immediately north of Fire Station No. 5. The public plaza features a public art installation called *Ivar Feeding the Gulls*. There is also a public access area along the south side of the pier transit shed within the Madison Street right-of-way. This public access area is required as a condition of a right-of-way use permit (Seattle Street Use Permit 04.25.83) (FHWA 2004).

Pier 55, Access to Blake Island/Tillicum Village

Access to Blake Island State Park is provided by regular boat services from Pier 55. Blake Island is located in Puget Sound about 5 miles from the Seattle waterfront. Blake Island State Park is 475 acres in size, with 5 miles of saltwater beach shoreline. It provides 15 miles of day use trails, 51 individual campsites, and a group camping area in addition to Tillicum Village. The park is reachable only by tour boat or private boat. Most members of the public access the island by regular boat service from Pier 55 to Tillicum Village provided by Argosy Cruise Line. Tillicum Village has been located on the island since the establishment of the park in 1974 and is a concessionaire of Washington State Parks. Tillicum Village provides a Pacific Northwest Native American style dinner and interpretive program based on legends of various Northwest Coast tribes. The recreational and interpretive services provided by the concessionaire are considered by State Parks to constitute public services necessary or appropriate for the public use and enjoyment of the park.

More than 90% of the Tillicum Village visitors use Argosy Cruise Line for access. Argosy carried 52,700 persons to Blake Island in 2005 and estimates that 99% of the persons it carries are attending events at Tillicum Village. Tillicum Village served about 57,000 visitors in 2005. Blake Island State Park has an estimated 148,500 visitors per year. Overnight boaters total 14,200, and overnight campers total 4,200. Of the estimated balance of 73,000 day users not associated with Tillicum Village, the park staff estimates that about half are short-term users of moorage and spend a limited amount of time on the island to use the rest rooms, purchase items at the store, or stretch their legs. Other day users spend more time using hiking trails and other amenities (FHWA 2006).

Piers 55 and 56, Shoreline Public Access

Pier 55 and 56 are privately owned piers at the foot of Seneca Street that provide 29,259 square feet of public access on a deck area between the two piers and along the south and west sides of the transit shed on Pier 56. These public access areas are required as a condition of shoreline permit approval and the Washington State Department of Natural Resources (DNR) outer harbor aquatic lease (Seattle Department of Design, Construction and Land Use [DCLU], Permit 9703373). Benches for public seating are provided adjacent to the promenade along Alaskan Way and at the end of Pier 56. In 2001, pedestrian counts on Alaskan Way at Pier 56 totaled 1,580 for the lunch hour average and 3,741 for the daily average (FHWA 2004).

Pier 57, Shoreline Public Access

Pier 57 is a privately owned pier located just north of University Street housing restaurants, retail and recreational uses in the transit shed called the Bay Pavilion. There is a deck area on the south side of the transit shed that provides outdoor restaurant seating and public access. A portion of the walkway on the north side of the transit shed is part of the City of Seattle Waterfront Park. A public access area is provided at the end of the pier in accordance with the provisions of the DNR outer harbor aquatic lease (FHWA 2004).

Waterfront Park

The City of Seattle Waterfront Park is located on an overwater deck area north of Pier 57; it includes all of Pier 59, a public deck area between the two piers, and the Seattle Aquarium, which also encompasses piers 59 and 60. The deck area between piers 57 and 59 provides an overwater plaza with shoreline viewing and congregating areas, fishing areas, seating, and picnicking areas. Two public art installations are located in the park, a Christopher Columbus statue and a Waterfront Fountain.

Three plaques in Waterfront Park commemorate historic events:

1. The ‘S.S. Portland’ plaque describes the July 1897 arrival of the S.S. Portland at Schwabacher’s Wharf carrying the “ton of gold” that started the stampede to the Klondike.
2. The ‘Miike Maru’ plaque noting the arrival of the Miike Maru in 1896 with a cargo of tea heralding the first regular shipping service from the Far East and the birth of Seattle as an international port.
3. The ‘Joshua Green Memorial Plaque’ noting the establishment of the Puget Sound Navigation Company, which operated steamboats and automobile ferries by Joshua Green.

Public use of the park is primarily from foot traffic, as well as being tied to the surrounding attractions like the Aquarium. In September 2001, pedestrian volumes on the Alaskan Way surface street at Union Street adjacent to the park totaled 1,917 pedestrians during the noon hour and 5,856 daily (FHWA 2006). Seattle Parks and Recreation has been working on plans for the waterfront park in the context of larger redevelopment plans on the waterfront such as the viaduct and seawall. The 2006 Final EIS of the Central Waterfront Master Parks Plan suggests removal of the park to allow for the expansion of the Seattle Aquarium.

Pier 59

Public access on Pier 59 is provided along a portion of the south and north sides of the Seattle Aquarium. The public deck area provides shoreline viewing and congregating areas. Pier 59 originally served as a terminal for the Northwestern Steamship Dock Company, and later for Dodwell & Co. First referred to as Pier 8, the structure was renumbered to Pier 59 in the 1940s. The building was purchased by the City, and, with the adjacent concrete exhibit building (Pier 60), was renovated to house the Seattle Aquarium, which opened in 1977.

Pier 59 is the oldest structure still standing on the Seattle Central Waterfront. Pier 59 was designated as a City Landmark in 2001. When first constructed in 1872, the pier served as a terminal for loading and shipping coal. The original pier structure succumbed to shipworms (a marine boring organism) late in the decade, and was replaced in 1896 with a new pier on the standardized east-west alignment. The pier shed on Pier 59 was erected in 1905. It is a heavy timber superstructure, sheathed in ship lap wood siding on wood deck and originally supported by wood piles. Much of the piling system was replaced by new concrete and steel piles in 2005 and 2006. It is similar to other pier sheds built at the time and still existing on the waterfront, although its roof support system is unique. The east and west end walls of the wharf include distinctive and original curvilinear parapets, and the exterior retains much of its original siding and some of its original windows. (FHWA 2006)

Seattle Aquarium

The Seattle Aquarium fronts directly on the Alaskan Way surface street with a new main entrance at Pier 59. Remodeling of the Seattle Aquarium at Pier 59 began in June 2005. Seattle Parks and Recreation restored structural integrity to the majority of the facility by installing new driven and posted piles and new concrete aprons (to replace existing wooden ones). The pier pile and deck replacement project was completed on schedule. Another part of the restoration was the rebuilding and painting of the shell of Pier 59, which is also complete. New concrete aprons and reinstallation of the historic façade of Pier 59 completed the project in June 2007.

The purpose of the Seattle Aquarium program is “inspiring conservation of our marine environment.” The Aquarium is open daily and serves more than 700,000 visitors annually, of which more than 40,000 are school children. The Seattle Parks and Recreation Department and the Aquarium Society were in the process of long-term planning that addressed a number of options, including an new, expanded aquarium that would require removal of the existing Waterfront Park (south of Pier 59 and Pier 60). One option called for a new waterfront park in place of Piers 62/63. However, a more modest remodel plan involving two new exhibits and a new Alaskan Way entrance was adopted. Since the completion of the remodel in June 2007, previous plans to build a new aquarium has been postponed. However, plans to rebuild the Seawall have renewed interest in a new aquarium.

Major factors influencing the success of the Seattle Aquarium in attracting visitors include the following:

- Visibility to the public, supportive land uses, and strong connections to the water, provided by the location on the waterfront.
- Physical accessibility, especially with respect to the proximity of visitor parking. This is an especially important factor for the Seattle Aquarium, since it is separated from the Pike Place Market, retail core, and other upland areas by a steep hillside.
- A critical mass of attractions in the area, which is provided by proximity to major pedestrian attractions such as the Pike Place Market and nearby Pioneer Square, as well as the Colman Dock Ferry Terminal and waterfront commercial attractions.

- A strong thematic focus and the depth of visitor experience. The aquarium is a vital facility that provides an involving visit or experience with a solid thematic focus. The Seattle Aquarium, at 68,000 square feet, is smaller than other major aquariums, and this restricts to some degree the extent of the visitor experience. This may be more significant in attracting tourist visitors than local visitors (FHWA 2006).

Pier 62/63 Park

Pier 62/63 Park is owned by Seattle Parks and Recreation and consists of a large unobstructed deck with views of the water, Olympic Mountains, and downtown skyline.

Piers 62/63 comprise a flat, 77,000-square-foot wooden deck on creosote-treated timber pilings. The piers were constructed in the 1920s as two separate general cargo piers with large warehouses covering the central portion of the piers, leaving a 16-foot-wide apron around the perimeter for rail service and warehouse access. The warehouse structures were demolished in the 1980s. The piers' long history of commerce, labor, and trade changed in 1989 when they were purchased by the City of Seattle for a new waterfront public open space.

From 1991 through 2004, Pier 62/63 Park was used for a series of 18 to 20 concerts during summer evenings. In 2005, the summer concert series was relocated to South Lake Union Park due to structural problems with the pier. Future plans include relocation of some or all of the functions of the Waterfront Park at Pier 57/59 to this area when the Seattle Aquarium expands to the south of Pier 59. Passive public uses like walking, fishing, and picnicking are still permitted on portions of the piers despite their condition. In general, casual use is not encouraged due to the deck's expansiveness and lack of amenities. Portions of the piers were also being used for construction staging in conjunction with the Seattle Aquarium pile replacement and renovation project (City of Seattle 2006).

Seattle Parks and Recreation has been considering options for replacement of Piers 62/63 and upgrades and improvements to Waterfront Park. Structural concerns at both Piers 62/63 and Waterfront Park have prompted this analysis. These plans would be integrated with plans for the expansion of the Seattle Aquarium, rebuilding of the Seawall, and replacement of the Viaduct. The staff-preferred alternative presented in the Final EIS involves the removal of Waterfront Park and relocation of pier 62/63 to complement a new aquarium. Proposed intertidal habitat restoration ranges from replacing the existing riprap to placing nearshore fill material to convert the vertical seawall to a sloping intertidal surface seawall.

Pier 66, the Bell Street Terminal, Shoreline Public Access

The Port of Seattle, Pier 66 Bell Street Terminal is an 11-acre facility containing outdoor plazas, restaurants, 57,000-square-foot conference center, pleasure craft marina, cruise terminal, and the Odyssey Maritime Discovery Center. The Port of Seattle has recently chosen not to renew the lease of the struggling Odyssey Maritime Discovery Center and will begin taking bids soon for a new tenant. Bell Street Pier Cruise Terminal is the homeport for Norwegian Cruise Line and Celebrity Cruises. In 2005, the cruise terminal had 79 vessel calls. Guest moorage is available year-round for up to 80 recreational vessels in slips ranging from 25 to 120 feet.

Public access facilities include a roof deck and street level plaza area. The roof deck provides panoramic views and seating facilities. A bridge connection across the Alaskan Way surface street to Elliott Avenue is provided at the roof level on the alignment of Bell Street. On the street level, public plaza areas are provided between the conference center and the marina. Public facilities include view areas, seating and art features required by shoreline permits (Seattle DCLU, Application 9203932). Pedestrian volumes are very high when cruise ships load and unload at the pier and are moderate at other times. Two public art installations are located at Pier 66: the Light Tower by Ron Fisher is located on the tip of the breakwater at the entrance to the marina, and a mosaic wall entitled Danza del Cerchio was created in 1996 by Ann Gardner on commission from the Port of Seattle (FHWA 2004).

Edgewater Hotel, Pier 67, Shoreline Public Access

Constructed in 1962, the Edgewater Hotel located on Pier 67 is a four-story structure containing 223 guestrooms, a restaurant, and 10,000 square feet of meeting and conference space. A public waterfront viewing area is located along the north side of the parking area as a condition of its shoreline permit (Seattle DCLU, Application 8802084) (FHWA 2004)

Pier 69, Shoreline Public Access

The Port of Seattle headquarters are located on Pier 69. The historic three-story building was refurbished in 1993 and houses the Port Commission, Commission Chambers, Executive, Legal, Seaport, and other Port support services. First-floor tenants include a café; the Victoria Clipper Terminal, a high-speed Seattle–Victoria, B.C. passenger-only ferry; and Seafloor Surveys.

Public access areas are located along the north and west sides for views and public fishing. Public access is a condition of the shoreline permits (Seattle DCLU, Applications 9007326, 8301578) and DNR lease conditions for public aquatic land (FHWA 2004)).

Pier 70

Built in 1902, Pier 70 is a privately owned pier housing a variety of businesses and providing public access areas along the south, north, and west sides required as a condition of the shoreline permit and DNR lease conditions for public aquatic lands (FHWA 2004).

Olympic Sculpture Park

The Seattle Art Museum's Olympic Sculpture Park opened in January 2007. This new park transformed a former industrial property into a 9-acre green space for art at the north end of the Seawall. The Olympic Sculpture Park was developed by the Seattle Art Museum in partnership with the City of Seattle. Approximately one-third of the site is made up of City-owned parcels and rights-of-way. The Sculpture Park is open to the public free of charge.

The park is bounded by the Alaskan Way Seawall on the west, Western Avenue on the east, Broad Street on the south, and Bay Street on the north. It encompasses approximately four city blocks and a portion of the Alaskan Way right-of-way between the BNSF railroad and the Seawall. The design of the park is based on its location along and above the waterfront. It has views of Puget Sound and the Olympic Mountains to the west and of the waterfront and downtown Seattle to the south. The design provides features and areas for people to sit and enjoy views. At the east side of the park is a 7,000-square-foot glass and steel pavilion that houses special events, temporary exhibitions, public programs, and a café. In addition to classic, modern, and contemporary permanent sculptures, the park hosts temporary installations and draws people together for art-related musical and theater performances, as well as year-round educational programs.

As part of this project, the northern end of the Seawall was stabilized with the placement of new rock riprap in front of the Seawall face between Bay and Broad streets. The Olympic Sculpture Park created 1.5 acres of salmon habitat in Elliott Bay on the southern end of Myrtle Edwards Park by removing fill and creating a shallow water bench and kelp forest along 990 feet of waterfront. The shoreline habitat created by the park will benefit species including juvenile Chinook and chum salmon emerging from the Green/Duwamish river system.

Lake Union to Elliott Bay Trail (formerly Potlatch Trail)

This trail facility has not been developed, but a concept plan has been completed showing the intended route extending 1.5 miles from Lake Union at Westlake Avenue to Elliott Bay at Broad Street. The planned trail is designed to link South Lake Union to Elliott Bay using both public and private sidewalks and other corridors. It is being developed with funds from the Pro Parks levy approved by Seattle voters in November 2000. The number of persons who currently use the route on city sidewalks is unknown. The planned trail will connect with the newly named Cheslahud Lake Union Loop, which connects on the north end to the popular Burke-Gilman Trail.

2.11.4. Green Streets

Green Streets are one of the open space resources located within street rights-of-way. Green Streets are sections of streets that are designated for pedestrian circulation to provide pedestrian and bicycle trails and connect open spaces within activity centers. Green Streets are designed to serve as gathering places or corridors connecting activity areas and open spaces in an attractive urban setting. Elements of Green Street design include enhancing the separation of pedestrian and vehicular areas through street trees, landscaping, street furniture, bollards, and parking; providing weather protection for pedestrians; maximizing light and air reaching public spaces; and providing arcades, landscaping, and outdoor cafes to provide a harmonious relationship and graceful transition between private and public spaces. City plans and policies recognized the open space functions of boulevard trails and Green Streets in meeting open space needs in the City (FHWA 2004).

The City of Seattle Comprehensive Plan Transportation Element defines Green Streets as follows:

> Green Streets are designated on a number of non-arterial streets within Downtown Seattle. Landscaping, historic character elements, traffic calming, and other unique features distinguish Green Streets from other street types. Green Streets are designed to emphasize pedestrian amenities and landscaping in areas that have dense, residential land uses. Each Green Street has its own unique character and design. The street right-of-way dimensions can vary significantly from street to street and from segment to segment.

The purpose of a Green Streets is to enhance and expand public open space, and to reinforce desired land use and transportation patterns on appropriate City street rights-of-way. There are three designated Green Streets that intersect with the Alaskan Way right-of-way with in the study area, which are described and illustrated below (see Figure 2.10-9).

Marion Street Green Street

Marion Street is designated as a Green Street with block-to-block traffic permitted between Second Avenue and Alaskan Way. An elevated walkway provides ferry access along the south side of Marion Street from First Avenue to the Colman Dock Ferry Terminal. No private development has occurred adjacent to the portion of Marion Street designated as a Green Street corridor since 1993 when the Green Street guidelines were developed. A specific design for Marion Street has not been prepared (FHWA 2004).

Vine Street Green Street

Vine Street is designated as a Green Street with block-to-block traffic prohibited between Denny Way and Alaskan Way. Currently, the street is open to traffic, as a specific design has not yet been prepared or implemented. An art installation by Buster Simpson is located on the sidewalk next to the adjacent rail lines on either side of Vine Street. These art installations were developed as part of a public art project, Vine Street Grows, under the City's 1% for Art Program. The pieces are intended to evoke the industrial heritage of the waterfront (FHWA 2004).

Clay Street Green Street

Clay Street is designated as a Green Street in the *Seattle Right-of-Way Improvements Manual*. A specific design has not yet been prepared or implemented.

2.11.5. Public Art Installation Locations

A description of specific public art installations found in the study area is provided below proceeding from south to north along the Alaskan Way right-of-way. A list and a location diagram are provided in Table 2.11-2 and Figure 2.11-4, respectively.

Table 2.11-2. Public Art Installations

Title	Artist	Owner
1. *Joshua Green Fountain*	George Tsutakawa	unknown
2. *Marion Street Overpass Mural*	José Orante	City of Seattle Engineering Department
3. *Ivar Feeding the Gulls*	Richard Beyer	Seattle Arts Commission
4. *Christopher Columbus*	Bennet Douglas	Seattle Arts Commission
5. *Waterfront Fountain*	James Fitzgerald and Margaret Tomkins	Seattle Arts Commission
6. *Piers 62/63*	Barbara Kruger and others	Seattle Arts Commission
7. *Welcoming Spirit*	Melvin Schuler	Waterfront Landing Condominiums
8. *Light Tower*	Ron Fisher	Port of Seattle
9. *Danza Del Cerchio*	Ann Gardner	Port of Seattle
10. *Growing Vine Street 1*	Buster Simpson	Seattle Arts Commission
11. *Growing Vine Street 2*	Buster Simpson	Seattle Arts Commission
12, Olympic Sculpture Park	Various	Seattle Art Museum
12a. Eye Benches I/II/III	Louise Bourgeois	Seattle Art Museum
12b. Father and Son	Louise Bourgeois	Seattle Art Museum
12c. Eagle	Alexander Calder	Seattle Art Museum
12d. Riviera	Anthony Caro	Seattle Art Museum

Title	Artist	Owner
12e. Schulbert Sonata	Mark di Suvero	Seattle Art Museum
12f. Bunyon's Chess	Mark di Suvero	Seattle Art Museum
12g. Neukom Vivarium	Mark Dion	Seattle Art Museum
12h. Seattle Cloud Cover	Teresita Fernández	Seattle Art Museum
12i. Curve XXIV	*Ellsworth Kelly*	Seattle Art Museum
12j. Untitled	Roy McMakin	Seattle Art Museum
12k. Love & Loss	Roy McMakin	Seattle Art Museum
12l. Sky Landscape I	Louise Nevelson	Seattle Art Museum
12m. Typewriter Eraser	Claes Oldenburg and Coosje van Bruggen	Seattle Art Museum
12n. Split	Roxy Paine	Seattle Art Museum
12o. Perre's Ventaglio III	Beverly Pepper	Seattle Art Museum
12p. Persephone Unbound	Beverly Pepper	Seattle Art Museum
12q. Wake	Richard Serra	Seattle Art Museum
12r. Stinger	Tony Smith	Seattle Art Museum
12s. Wandering Rocks	Tony Smith	Seattle Art Museum

Source: FHWA 2004

Joshua Green Fountain

Joshua Green Fountain is a bronze fountain created by artist George Tsutakawa. It is located at the Colman Dock Ferry Terminal (Pier 52) at Columbia Street and Alaska Way.

Marion Street Overpass Mural

Artist José Orantes created the Orca Mural (360 feet long by 7 feet tall) on the Marion Street Overpass to the Colman Ferry Dock (Pier 50). The mural was created in 1990 with the Orca School in Seattle as part of the Washington State Art Commission's Artist in Residence program.

Ivar Feeding the Gulls

Richard Beyer's bronze and aluminum cast sculpture of Ivar Haglund (1905–1985) feeding seagulls is located at Pier 51.

Christopher Columbus

Located at the south end of Waterfront Park is a larger-than-life bronze statue of Christopher Columbus by D. Bennett

Waterfront Fountain

Located in the northern end of Waterfront Park, *Waterfront Fountain* is a cast and welded bronze cubical structure fountain, surrounded by a series of stairs and walls that break up the space and provide interesting places to linger. The sculpture was begun by James FitzGerald and, in collaboration with the sculptor's widow, Margaret Tompkins, was completed by Terry Copple.

Piers 62/63

Located on piers 62/63 is a 1991 public arts project titled *Piers 62/63*. This project is a wire mesh fence located around the piers' perimeter painted with a series of questions which, when seen against the backdrop of the city, quietly urge the viewer to examine the complex social and political relationship that make up a city. The questions, painted in red on a dense chain-link perimeter handrail fence, appear and disappear depending on the viewer's position and the conditions of light, sky, and water. However, this artwork has deteriorated and is now barely visible.

Welcoming Spirit

A sculpture by Melvin Schuler titled *Welcoming Spirit* is located on the east side of the Waterfront Bicycle/Pedestrian Facility in front of the Waterfront Landing Condominiums at 1950 Alaskan Way.

Light Tower

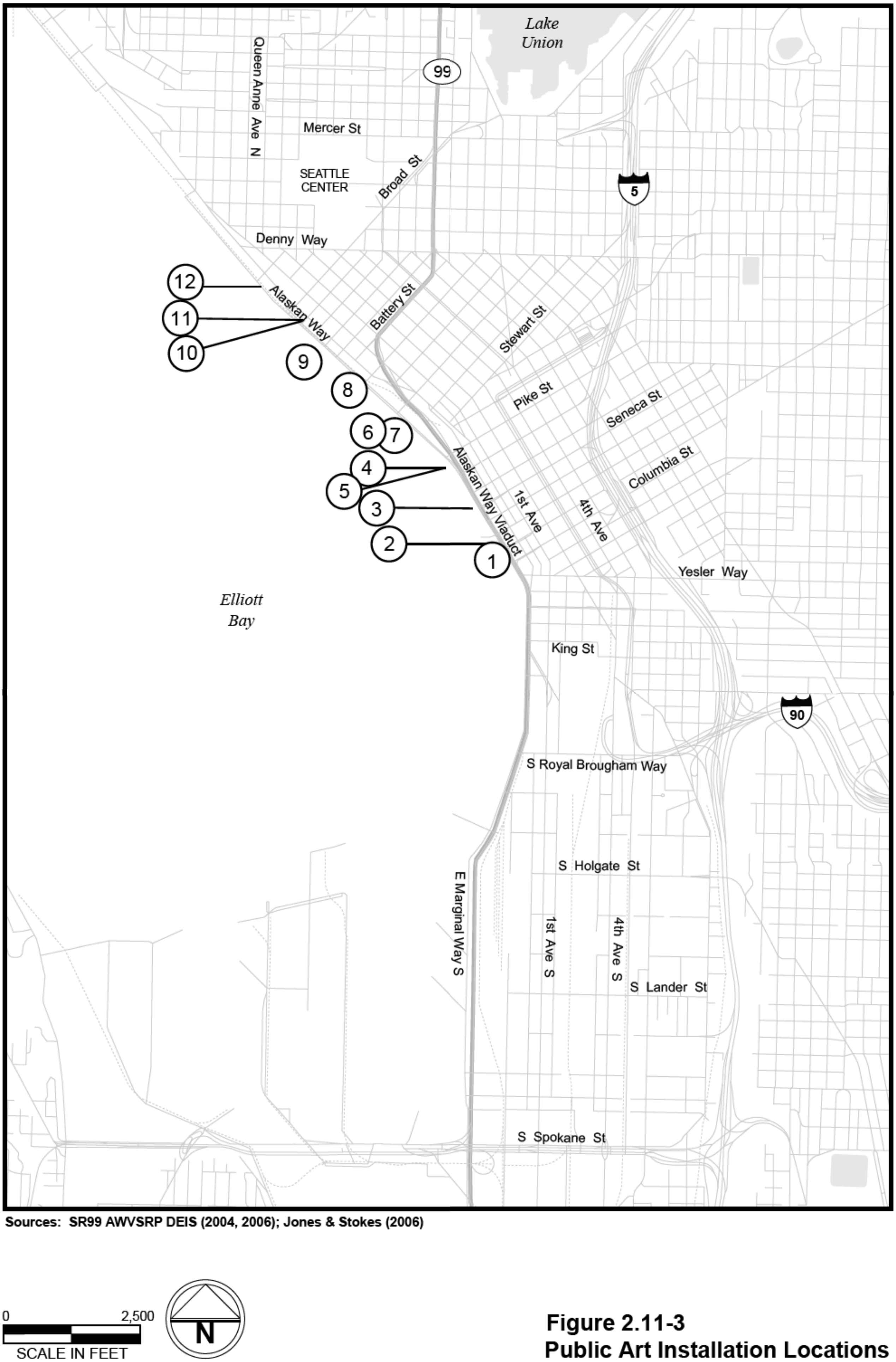
This piece created by Ron Fisher is located at Pier 66 at the end of the breakwater protecting the marina. The 138-foot-tall *Light Tower* also referred to as the Bell Street Pier Beacon.

Danza Del Cerchio

A glass mosaic wall installation entitled *Danza Del Cerchio* was created in 1996 by Ann Gardner. It is located on an exterior wall of the Bell Harbor Conference Center on Pier 66.

Growing Vine Street 1 and Growing Vine Street 2

Two public art work projects by artist Buster Simpson, *Growing Vine Street 1 and Growing Vine Street 2* are located at either side of Vine Street on the east side of Alaskan Way adjacent to the railroad line. These are two installations consisting of 55-gallon steel barrels strapped to fabricated steel pallets and galvanize-dipped as a single unit. The barrels are intended to remind passersby of the industrial activity of what was once a working waterfront adjacent to a salmon cannery in the vicinity of Vine Street.



Sources: SR99 AWVSRP DEIS (2004, 2006); Jones & Stokes (2006)

Figure 2.11-3
Public Art Installation Locations

2.12. Economics

2.12.1. Overview

This section provides information on the economic context of the study area. Activities associated with the replacement of the Alaskan Way Seawall will be located largely within the Alaskan Way right-of-way. In general, the economic environment along or adjacent to the Alaskan Way right-of-way between S. Washington Street on the south and Broad Street on the north is identified as being within the study area and the potential construction impact area. Some aspects of the affected economic environment are described for the broader geographical area, including King County and the King-Pierce-Snohomish counties region. Future iterations of this document may include more detailed economic analysis as data becomes available from the USACE economic impact analysis currently underway.

2.12.2. Methodology

General descriptions of the City of Seattle and Puget Sound region economies are provided for context. Existing economic conditions were identified exclusively through the examination of existing resources and telecommunications; no field surveys or assessments were undertaken. Economic data and information focusing on the Alaskan Way right-of-way and Seawall was obtained primarily from information gathered from discipline reports and technical memoranda completed for the Alaskan Way Viaduct and Seawall Replacement Project (AWVSRP) Draft Environmental Impact Statement (DEIS) and Supplemental DEIS (SDEIS), along with information contained in the Alaskan Way Seawall Without Project Conditions Feasibility Study (Jones & Stokes 2006).

2.12.3. General Role of the Local Economy

The greater Seattle area and King County host a large and diverse economy. King County and its 39 cities are the center of the Puget Sound economy—home to 50% of the region's population, 60% of its workforce, and 70% of its economic output. King County plays a critical role in the future economic well being of both the region and the State of Washington as the business and population center of the Pacific Northwest. King County is the epicenter for industry sectors that provide stability and improve job growth, such as Information Technology, Clean Technology, Biotechnology (Life Sciences), Logistics and International Trade, Services and Tourism (Enterprise Seattle 2006).

In, 2005, King County not only had the largest county population in the state (roughly 1.8 million residents), but it also had the largest number of businesses, with a total of 76,677. King County's population is increasing at a steady rate; its residents represent nearly 31% of Washington State's total population (Enterprise Seattle 2006). The population of King County has increased substantially since 1990, especially in the mid-late 1990s. Despite the increasing cost of living in King County, especially in housing, the high-tech job boom has attracted a particularly well-educated workforce into the area. Seattle has a higher percentage of residents with bachelor's degrees than anywhere else in the nation (Enterprise Seattle 2006).

While the County's economy thrived in the late 1990s, the start of the new decade saw significant job losses. The 2001 national recession affected King County more drastically than other regions of the country; the local economy lost jobs steadily from 2001 through 2003. The job market in King County began creating jobs again in 2004 but did not reach prerecession employment levels until mid-2006. The County's average annual wage in 2005 was $50,139, well above the state average of $40,704. Of the state's 39 counties, King County' wages were the highest in 2005. Although the 2005 average wage was 4.8% lower than the 2000 average wage (at the height of the economic boom), the 2005 wage exceeded the 1990 average wage by about 40% (WSESD 2006).

In the year 2000, the largest employers in King County included Boeing, University of Washington, Metro-King County Government, US Postal Service, Microsoft, Group Health Cooperative, City of Seattle, Swedish Health Services, Providence Health System, Starbucks, Seattle School District #1, and Washington Mutual.

The Downtown Seattle Association highlights the following economic indicators for Seattle (2006):

- Almost 50% of the employees in the City of Seattle and 21.4% in King County work in downtown Seattle.
- 45% of the office market for the Puget Sound region is located downtown.
- Most of the region's largest public facilities are located in the city center area: Qwest Field, Safeco Field, Key Arena, Seattle Art Museum, Experience Music Project, Benaroya Hall, Fifth Avenue Theatre, Paramount Theatre, McCaw Hall, Washington State Convention & Trade Center, and the new Seattle Central Public Library.
- The cruise industry, based in downtown Seattle, was responsible for more than 1,732 jobs in the region, $208 million in business revenue, and $5.8 million in state and local taxes in 2005.
- According to an AAA survey from 2004, Seattle was the second-most popular domestic summer destination in the country for air travel; second only to Orlando. Downtown Seattle had over 11.1 million tourists, entertainment seekers, conventioneers, and sports events attendees, making it the most active, visible, and heavily used part of the city.

- The Port of Seattle is the 20th-largest container port in the world.
- The Port of Seattle saw 170 vessel calls and a total of 686,357 passengers during the 2005 cruise season, which runs from late April to early October. That number is up from only six vessel calls and 6,600 passengers in 1999.

2.12.4. Established Urban Villages

Seattle's Comprehensive Plan is unique in having an Urban Village element. The City's urban village strategy is intended to maximize the benefit of public investment in infrastructure and services and promote collaboration between private interests and the community, to achieve mutual benefits. The urban village strategy tries to match growth to the existing and intended character of the city's neighborhoods. The Seawall is located within the Seattle Downtown Urban Center, which is further divided into five urban center villages, three of which are at least partly within the Seawall project area: Pioneer Square Urban Center Village, Commercial Core Urban Center Village, and Belltown Urban Center Village.

Pioneer Square Urban Center Village

The southernmost portion of the project areas is located within the Pioneer Square Urban Center Village. Pioneer Square is Seattle's oldest neighborhood district located just south of the Commercial Core Urban Center Village. The area is characterized by tree-lined streets and avenues, cobblestone parks, diverse street-level retail establishments and restaurants, late nineteenth-century brick and stone buildings, and one of the nation's best surviving collections of Romanesque Revival style urban architecture, all of which contribute to the neighborhood's warm and intimate feel. Established as both a National Historic District and a local preservation district in 1970, Pioneer Square is protected by City ordinance and design guidelines focused on preserving its unique historic and architectural character, assuring the sensitive rehabilitation of buildings, promoting development of residential uses for all income levels, and enhancing the district's economic climate for residents, employers, workers, and visitors. Today, property and business owners benefit from the tourists and shoppers attracted to Pioneer Square by the neighborhood's historic and architectural character. Its close proximity to Safeco Field (major league baseball stadium) and Qwest Field (professional football stadium) has helped the area to develop as an entertainment district with one of the City's liveliest collections of nightspots, from sports bars to hard rock taverns to small eateries.

Commercial Core Urban Center Village

The majority of the study area runs through the Commercial Core Urban Center Village along the waterfront from Bell Street on the north to Yesler Way on the south. The Commercial Core is downtown's largest and most developed neighborhood. The Commercial Core is divided into several smaller districts, including Seattle's Retail Core, Financial Center/Office Core, City and County government centers, Central Waterfront, and Pike Place Market Historic District (COS 1999). The study area is located entirely in the Central Waterfront district, in the area of downtown Seattle that fronts Elliott Bay. Water-related tourist activities characterize the area. Attractions include, but are not limited to, a series of piers, restaurants, the Seattle Aquarium, parks, and ferry and cruise ship terminals.

Belltown Urban Center Village

The northernmost portion of the project area runs through Belltown (Denny Regrade). Belltown is a neighborhood in the northern portion of downtown Seattle bounded by Denny Way to the north, Elliott Bay to the west, Sixth Avenue to the east, and Virginia Street to the south (historically and decades ago, the southern border was Stewart Street). Belltown, Seattle's densest residential community, is an eclectic and diverse neighborhood. It is an arts center, a shopping and dining destination, and home to a wide variety of businesses, all of which shape the neighborhood's diverse social and cultural fabric. Belltown's character is also reflected in the built environment through its architecture, public art, and other street amenities.

2.12.5. Employment

Employment by Industry

To characterize employment in the project area requires an examination of recent economic data (PSRC, 2004 & 2006) from the project region (King, Pierce, and Snohomish counties), King County, the City of Seattle and the Seattle Commercial Core[3] within which the study area is located.

The regional economy is diverse with an emphasis on service industries, although employment derived from retail trade and government/education sectors also plays a major role (FHWA 2004). Relevant regional/local employment data from 1970 to 2020 (forecast) is presented below in Table 2.12-1.

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[3] The Seattle Commercial Core is the downtown area bound by Elliott Bay to the west, Denny Way to the north, I-5 to the east and S. Dearborn Street to the south. The boundary of this geographic area was selected based on forecast analysis zone (FAZ) groups that the project area crosses. A FAZ is composed of one or more census tracts, and a FAZ group is an aggregation of FAZs. A FAZ is the basic geographic unit for demographic data and forecasts. Local agencies, such as the Puget Sound Regional Council, use these FAZ and census tract areas to characterize historic, existing and projected population, housing and employment trends, and land use.

Table 2.12-1. Employment Data for Each Region and Job Type (Number/Percent of Jobs)

Area/Industry Sector	1970	1980	1990	2000	2010 (Forecast)	2020 (Forecast)
Region (King-Pierce-Snohomish counties)	702,522	976,706	1,365,976	1,680,411	1,915,328	2,169,504
Manufacturing	19.8%	20.8%	18.2%	13.6%	11.3%	10.2%
Trade/Transport/Utilities*	13.0%	13.2%	12.6%	12.6%	12.0%	12.6%
Retail Trade	16.3%	18.1%	18.1%	18.1%	17.4%	17.6%
Services	26.2%	27.9%	34.0%	39.3%	43.1%	44.5%
Government/Education	24.7%	20.0%	17.1%	16.2%	16.1%	15.15%
King County	466,592	697,401	972,567	1,196,043	1,351,220	1,516,898
Manufacturing	19.9%	20.9%	17.4%	12.4%	10.0%	8.6%
Trade/Transport/Utilities*	15.4%	15.1%	14.4%	14.4%	13.5%	13.9%
Retail Trade	17.2%	18.2%	14.0%	17.6%	16.5%	16.4%
Services	30.0%	29.7%	36.3%	42.3%	46.3%	48.2%
Government/Education	17.5%	16.1%	17.8%	13.4%	13.7%	12.8%
City of Seattle	310,288	386,684	469,802	540,419	603,027	658,409
Manufacturing	13.5%	13.1%	10.2%	7.4%	5.4%	4.8%
Trade/Transport/Utilities*	16.0%	15.6%	14.7%	12.6%	11.8%	12.4%
Retail Trade	15.7%	15.8%	13.8%	14.9%	13.8%	13.6%
Services	34.2%	35.5%	43.5%	47.5%	51.2%	52.2%
Government/Education	20.6%	20.0%	17.8%	17.6%	17.8%	17.1%
FAZ Group (Seattle Commercial Core)	100,546	112,248	161,834	183,234	210,315	224,564
Manufacturing	5.2%	4.9%	3.0%	2.1%	1.2%	1.0%
Trade/Transport/Utilities*	13.4%	13.0%	12.7%	10.0%	8.6%	9.2%
Retail Trade	14.6%	14.8%	12.3%	11.6%	10.5%	10.6%
Services	44.0%	44.1%	53.5%	60.0%	64.1%	63.8%
Government/Education	22.8%	23.2%	18.5%	16.3%	15.6%	15.4%

* Trade/Transport/Utilities = Wholesale trade, transportation, communication, and utilities; Total Employment does not include workers in resources (agriculture, forestry, fishing and mining) and construction).

Sources: Puget Sound Regional Council 2004, 2006.

The number of jobs in the region has more than doubled over the last three decades, with an increasing percentage of jobs gained in the services industries. In 2000, the region had 39.3% of its jobs in service industries; however, the City of Seattle has a higher proportion in the services (47.5%) and manufacturing industries (13.6%). Seattle's second-highest employment sector is slightly less diverse, with government/education providing 17.6% of the jobs.

Employment within the study area has several variations from the regional to the city-level distribution of jobs across industry sectors. The majority of employment in the Seattle CBD is in the service sector (61%), which is substantially higher than the regional, King County, and Seattle averages. Government/education sectors are the second leading job sectors in the CBD (15%) (FHWA 2004).

Unemployment

Unemployment rates within the region have historically been lower than the statewide average rate, as shown in Table 2.12-2. In 2006, the average civilian labor force in King County numbered 1,044,300. Approximately 43,700 (4.2 percent) were unemployed (LMEA 2006, 2007). That compares with the average statewide civilian labor force of 3,326,600 with 166,200 (5.0 percent) unemployed for 2006 (LMEA 2007).

Over the next decade, nonagricultural employment in the state is forecast to continually increase, although at a slower rate (1.3 percent) compared to growth in the previous decade (1.8 percent) (LMEA 2002). An increasing proportion of jobs are expected in the services sector, and jobs in the government/education sector are expected to continue as the second highest sector; however, the percentage of jobs overall in this sector will be flat across the state (LMEA 2002).

Table 2.12-2. Unemployment Rates in the Counties in or Surrounding the Study Area (Average Annual Percent)

Area	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Washington State	**4.9**	**4.8**	**4.8**	**5.0**	**6.2**	**7.3**	**7.4**	**6.3**	**5.5**	**5.0**	**4.5**	**5.2**
King County	**4.1**	**4.0**	**3.8**	**4.1**	**5.1**	**6.1**	**6.2**	**5.2**	**4.8**	**4.2**	**3.7**	**3.7**
Kitsap County	**5.1**	**4.5**	**4.6**	**5.0**	**6.0**	**6.8**	**6.8**	**5.8**	**5.2**	**4.7**	**4.4**	**4.9**
Pierce County	**4.2**	**3.9**	**4.3**	**5.0**	**6.5**	**8.1**	**8.2**	**7.1**	**5.9**	**5.2**	**4.7**	**5.5**
Snohomish County	**4.2**	**4.1**	**4.7**	**4.5**	**5.3**	**7.0**	**7.1**	**5.7**	**5.1**	**4.6**	**4.0**	**4.3**

Note Unemployment rate for 2008 is rate for January 2008 (not seasonally adjusted)
Source: WSESD 2008

2.12.6. Local Government Revenues

Washington State and the City of Seattle rely on a variety of taxes to fund state and local government programs. These taxes include a combined state and local sales and use tax; a business and occupation tax; public utility tax; property tax; and several other excise, real estate, and estate taxes.

Following are the four main sources of revenue supporting the services and programs provided by the City of Seattle:

1. Taxes, license fees, and fines support activities typically associated with City government, such as police and fire services, parks, and libraries;
2. Fees for services, regulatory fees, or dedicated property tax levies partially or completely support certain City operations, including the Seattle Center, several parks and recreational facilities, and building inspections;
3. Grant revenues from private, state, or federal agencies support a variety of City services, including social services, street and bridge repair, and targeted police services; and
4. Charges to customers for services that fund City utilities (e.g. electricity, water, drainage and wastewater, and solid waste).

Sales and Use Tax

A combined state and local retail sales tax is collected on the selling price of tangible personal property. A use tax is assessed on the market value of using tangible personal property and services for which the sales tax does not apply. The retail sales and use tax applies to most items purchased by consumers but does not apply to food items or prescription drugs. Utility services and most personal services (e.g., medical, dental, legal, barber) and real estate are not subject to these taxes. However, construction services and building materials are subject to the retail sales tax.

The amount of retail sales and use tax varies by locality. The state tax base is 6.5%, but each locality can assess additional taxes. The combined state and local tax rate for the project area is 8.8%, which also includes a Regional Transit Authority tax.

The City of Seattle's 2007 proposed budget forecasts retail sales tax revenues at $162 million, or 21% of the General Fund Revenue Forecast (King County 2007). The City of Seattle's retail sales tax revenue was forecasted to increase by 7% in 2006. However, the forecast is for slower growth in 2007 and 2008 (COS 2006d).

Within King County, taxes account for the bulk of general fund revenues, supporting 64% of general fund services. Sales tax is the second largest source of general fund tax revenue (behind property taxes) and is expected to total $99.2 million in 2007. King County collects a 1% general local option sales tax in the unincorporated areas and a tax of 0.15% inside cities. The 0.10% criminal justice sales tax (expended only for criminal justice purposes as defined by Ch. 4.28.017 of KC Code) is also part of the General Fund. This revenue is shared with cities, allocated on the basis of population. The County also receives revenue from the cable franchise fee and gambling and liquor taxes. The King County Food and Beverage tax is collected in addition to the state and local retail sales tax at restaurants, taverns and bars. This adds 0.5% to the 8.8% sales tax levied at these types of establishments. King County sales tax revenue is forecast to grow on average 5.5% annually from 2006 to 2009 (King County 2006).

Business and Occupation Tax and Public Utility Tax Revenues

Most businesses operating in Washington State are subject to the business and occupation (B&O) tax. The B&O tax is typically assessed on the gross income, proceeds of sales, or value of doing business. Contractors for federal agencies are classified as government contractors for B&O tax purposes and are subject to B&O taxes. Typically, the measure of tax is the gross contract price (WAC 458-20-17001).

According to the City of Seattle's proposed 2007 budget, B&O taxes will account for $150 million (19%) of the 2007 General Fund Revenue Forecast (COS-DOPD 2006). In addition, the City levies a tax on the gross income derived from sales of utility services by privately owned utilities within Seattle, including telephone, steam, cable communications, natural gas, and refuse collections. These business tax revenues on utilities account for $130 million (17%) of the forecasted 2007 General Fund Revenue.

Property Tax Revenues

Real and personal property is subject to property tax. Real property includes land and any improvements, such as buildings, attached to the land. The primary characteristic of personal property is mobility. Examples of personal property are machinery, equipment, supplies, and furniture. Personal property tax typically applies to personal property used when conducting business (WSDOT 2007).

Property tax is a combined state and local tax. The 2005 property taxes in the study area range from $12.53 to $14.50 per thousand dollars of assessed value (King County Department of Assessments 2006). The state portion of these property taxes is $2.32 per thousand dollars of assessed value with the rest apportioned to many taxing districts (WSDOR 2006). Within King County, property taxes are projected to account for 52 percent of the total taxes collected as revenue in 2006 (KCBO 2006). According to the 2005 adopted budget, King County had a proposed levy of $406.8 million in property taxes for the 2004 fiscal year (KCBO 2006). Property tax revenues in the City of Seattle's endorsed 2004 budget account for $207.5 million, which is slightly more than one-third of the General Subfund Revenue (COS 2006b). This includes general property tax and an Emergency Management System levy. The total revenue accrued from King County property taxes during the calendar year of 2004 was $434,953,972 (King County 2008).

Other Taxes and User Fees

Various other taxes are assessed at the state and local levels, including excise tax on hotels and motels, admission to entertainment and recreation events, food and beverages, fuel, cigarettes, tobacco products, liquor, timber, rental cars, and other products and services. In Seattle, a Convention and Trade Center tax (7%) is levied on all lodging establishments with 60 or more rooms/spaces. This tax is also levied in Bellevue and elsewhere in King County with various tax rates.

Other local excise taxes include municipal business taxes and licenses. The sale of most real property is subject to a real estate tax that is paid by the seller. Other taxes levied by the state or local municipalities include an estate and transfer tax, vehicle licensing fee, and watercraft excise tax. No personal income tax is levied in the State of Washington.

Revenues from On-Street Parking and Public Garages

Revenues from on-street parking are deposited into the City of Seattle’s General Fund. These revenues are designated as “fees to cover the cost of installation, inspection, supervision, regulation, and maintenance involved in the control of traffic and parking upon the streets” (SMC 11.16.480). Seattle Municipal Code (SMC 11.16.300) also grants authority to the City’s Traffic Engineer to “Establish areas where parking is regulated by parking payment devices, and the time limit for parking therein; order installation or removal of parking payment devices where it is determined upon the basis of an engineering and traffic investigation that the installation or removal of such devices is necessary to aid in the regulation, control, and inspection of the parking of vehicles; and designate the parking space or spaces for which a parking payment device is to be used by signs or appropriate markings upon the pavement and/or the curb.” The code was updated in January 2004 to accommodate parking pay stations and to allow for their installation and maintenance.

Beginning in April 2004, City of Seattle began replacing it’s approximately 9,000 single-space parking meters with multi-space parking pay stations. By the end of 2007, approximately 1,900 pay stations controlling 13,500 paid parking spaces were installed (COS 2005, 2006c). One or two pay stations are intended to replace a block’s worth of single-space parking meters. The pay stations allow users to pay with currency, credit card, or debit card. In addition, as part of the City’s 2004 budget, the City Council approved a meter rate increase from $1.00 to $1.50 per hour for pay stations and electronic meters. This was the first increase in on-street parking rates in more than 10 years (WSDOT 2007). The City expects to have converted the majority of single-space parking meters throughout the city to pay stations by the end of 2008.

The City evaluated the revenue associated with 525 parking spaces controlled by pay stations in the area along the waterfront between Yesler Way and the Pike Place Market. These pay stations have been in operation since May 2005. Because of the increase in hourly rates, as well as changes in the behavior of motorists who use such parking, the City has realized a substantial increase in revenue per parking space per year versus the use of single-space parking meters. Based on the pay stations currently in operation along the waterfront, each parking space generates approximately $2,574 per year ($8.58 per day; estimated 300 days per year) in revenue for the City's general fund.

Paid parking within the Seattle Commercial Core accounts for 30 percent of the City's total annual revenue. Paid parking in the Center City (downtown, Uptown, South Lake Union, Capitol Hill, and First Hill) represents 48 percent of the City's total parking revenue (COS 2008). The percentages have dropped over the years as the City has added paid parking in neighborhoods outside of downtown, including South Lake Union and the University District.

The City of Seattle collects an annual license fee from operators of public garages. Public garages include both buildings and uncovered lots (SMC 6.48). The annual license fee is $90 per 1,000 square feet of floor or ground space contained in a parking garage or lot and used for parking or storage purposes (COS 2006). However, per recently passed City Ordinance #122192 (see below), the annual license fee has become $6 per 1,000 square feet of floor or ground space contained in a parking garage or lot and used for parking or storage purposes, effective July 1, 2007.

In August 2006, the City of Seattle passed an ordinance that amended the city's Municipal Code (SMC 5.35.030) to impose "a tax for the act or privilege of parking a motor vehicle in a commercial lot within the City that is operated by a commercial parking business" (COS 2006). The purpose of this tax is to "provide an equitable means of generating revenue to support the City's transportation system, and to reduce the existing Public Garage and Parking Lot License Fee (see above) that is currently imposed by SMC Chapter 6.48" (COS 2006). Effective July 1, 2007 through June 30, 2008, the tax rate will be 5% (0.05). Effective July 1, 2008 through June 30, 2009, the tax rate will be 7.5% (0.075). Effective July 1, 2009, the tax rate will be 10% (0.10) (SMC 5.35.030). These taxes will be collected by commercial parking businesses from the parking customer at the time payment is made.

The City of Seattle also receives sales and B&O tax revenue from short-term and long-term off-street parking (less than 30 days). The sales tax rate is 8.8% and the B&O rate for parking is 0.215%.

2.12.7. Parking Inventory

Off-Street Parking

The available inventory of off-street parking is provided by private property owners and operators of private parking lots. There are 7,047 off-street parking stalls within the study area and an additional 33,967 off-street parking stalls within ¼ mile of the study area (Nelson/Nygaard Consulting Associates 2006).

On-Street Parking

In April, 2004 City of Seattle began to replace most of the 9,000 aging, single-space parking meters. One or two pay stations replace single-space parking meters for one block. Parking pay stations offer customer service benefits of multiple payment options (e.g., credit and debit card).

There are a total of 1,646 on-street parking spaces (626 long-term and 1,020 short-term) within the study area (Nelson/Nygaard Consulting Associates 2006). Of these, 525 parking spaces are controlled by pay stations in the waterfront area between Yesler Way and the Pike Place Market. These pay stations have been in operation since May 2005. The City expects to have converted the majority of single-space parking meters throughout the city to pay stations by the end of 2008.

2.12.8. Ferry and Cruise Ship Facilities

Ferry and cruise ship activity at the Port of Seattle contributes to the regional economy by generating business revenue to companies providing vessel and passenger services. These companies, in turn, provide employment and income to individuals and pay taxes to state and local governments. Port-of-call passengers support the local Seattle economy by visiting local attractions.

Three different locations within the project area are used for ferry and cruise ship operations:

1. Pier 52 Colman Dock Ferry Terminal (801 Alaskan Way). These terminals are owned by the Washington State Department of Transportation and are located in the southern portion of the project area. They provide ferry service to and from the Seattle CBD to communities on Bainbridge and Vashon islands and the city of Bremerton. Vehicles queue up for ferries, load on, and disembark on Pier 52. There is no public parking available at the terminal, but parking for Washington State Ferries employees is available at the terminal.
2. Pier 66/Bell Street Cruise Terminal (2225 Alaskan Way). This facility is owned by the Port of Seattle and operated by Cruise Terminals of America. It provides berths for Norwegian Cruise Line and Celebrity Cruises. On-pier parking is not available for users of the facility; parking currently occurs across from the

terminal at the Bell Street Pier Garage, between Alaskan Way and Western Avenue. At the Bell Street Cruise Terminal, the covered parking garage is located directly across the street from the cruise terminal. The garage offers 1700 secure spaces linked to the terminal by a covered pedestrian bridge. In 2005, the Port of Seattle hosted a total of 686,357 cruise ship passengers and 170 cruise ship vessel calls (79 of which were at Pier 66) and estimate hosting approximately 800,000 passengers and 211 vessels in 2008 (Port of Seattle 2008).

3. Pier 69 (2700 Alaskan Way). This facility, located at the north end of the study area, is owned by the Port of Seattle and is home to the Victoria Clipper, a high-speed, passenger-only ferry operating between Seattle and Victoria, B.C. The facility also provides berthing to several small cruise vessels specializing in local sightseeing and expeditions to Alaska. Pier 69 is also the headquarters for the Port of Seattle.

2.12.9. Inventory of Existing Businesses

A business inventory was conducted as part of the SR 99: Alaskan Way Viaduct and Seawall Replacement Project Draft EIS (2004) and Supplemental Draft EIS (2006). The area of direct effects from a SR 99 Viaduct/Seawall replacement project includes businesses within one block of proposed changes to existing facilities or proposed new facilities (WSDOT 2006). The inventory, initially conducted in 2004, was updated in 2006. Primary detour routes where parking and access were likely to be affected, such as First Avenue, were not updated in the 2006 inventory.

Data Parameters Collected

The businesses were assigned a business type based upon observed use. The business types included:

- Commercial Office
- Commercial Retail
- Industrial Marine Dependent
- Industrial Non-Marine Dependent
- Government Service
- Other Service
- Residential Multi-family (included to account for % of non-business structures in area)

- Other

Other Service includes restaurants, bars, hotels, hair salons, and other types of walk-in service providers that were not specifically retail. Residential Multi-Family was included as a category to account for the residential structures in the study area, and includes both condominiums and apartments. Other was the catch-all category that includes uses such as parking lots, religious institutions, union meeting halls, etc.

The general size of the businesses was also characterized based upon an estimate of the number of employees. The business sizes include:

- Vacant
- Small (less than 20 employees)
- Medium (between 20 and 100 employees)
- Large (over 100 employees)

Each business is assumed to need some minimum number of parking spaces to accommodate all potential customers. In order to estimate the number of spaces vital for each business, types of parking/access requirements for each business were identified and the parking data was used to assess the potential disruptions to business operations. These might include impaired deliveries, lost employee parking, and less customer access. The estimated ‘minimum spaces required’ for each business to operate normally is called the ‘Primary Parking Requirement’. This does not refer to a legal requirement, but to the number of spaces/access a business needs to function. The primary parking requirement may be calculated at multiple levels of disaggregation (per-business, per-block, etc.). The parking and access requirements evaluated included:

- On-Site Parking (primary parking requirement contributor)
- Off-Street Parking (primary parking requirement contributor)
- On-Street Parking (primary parking requirement contributor)
- On-Street Freight Loading (secondary parking requirement)
- Driveway Access to Surface Street Directly Affected (secondary parking requirement)

‘On-site parking’ is parking that is directly associated with the business or multi-family residence that is adjacent to the building and is off the street. ‘Off-street parking’ is parking that is near a business and that is off the street but not exclusively used by any particular business. ‘On-street parking’ is where there is either no on-site or nearby off-street parking. ‘On-street freight loading’ is where a vendor or delivery truck has to utilize on-street parking in order to make deliveries or load goods.

‘Driveway Access to Surface Street Directly Affected’ refers to areas that could be directly affected by potential disruptions; including driveways for on-site parking as well as alleys at the midpoint of blocks.

Because businesses may have multiple types of parking and access requirements, only the primary parking requirement (on-site, off-street, or on-street) is presented here (WSDOT 2006).

Project-wide Findings

Within the area of direct effects, 1,398 businesses were identified (Geiger 2006). The breakdown of type of businesses totaled across all geographic areas is presented in Figure 2.12-1. Businesses operating in Commercial Office space accounted for over half (53.9%) of the type of businesses. Other Service accounted for 13.4% of businesses; almost half (44%) of the Other Service businesses were involved in food service as opposed to retail grocery. Commercial retail accounted for 11.2% of the type of businesses. Other represented about one-tenth of the type of businesses; the majority of other businesses identified was parking (39%). Residential Multi-Family use represented 7.1% of the structure use in the study area. The sum of Industrial (both Marine and Non-Marine Dependent) and Government Service represented 4% of the type of business.

The breakdown of size of businesses totaled across all geographic areas in the area of direct effect is presented in Figure 2.12-2. The vast majority (79.9%) of the businesses was estimated to be small (less than 20 employees). Medium-sized businesses (20 to 100 employees) accounted for 13.8% of the businesses. Remaining businesses are split between large businesses (greater than 100 employees) at 2% and vacant businesses (no discernable business activity) at 4.3%.

The breakdown of primary parking requirement totaled across all geographic areas in the area of direct effect is presented in Figure 2.12-3. The majority of businesses (57.8%) rely primarily upon street parking for their employees and customers. A bit more than a third of all businesses (36.2%) provide on-site parking for employees and customers. The remaining businesses had identifiable off-street parking (6%).

Figure 2.12-1. Number of Each Type of Business for the Study Area, 2006

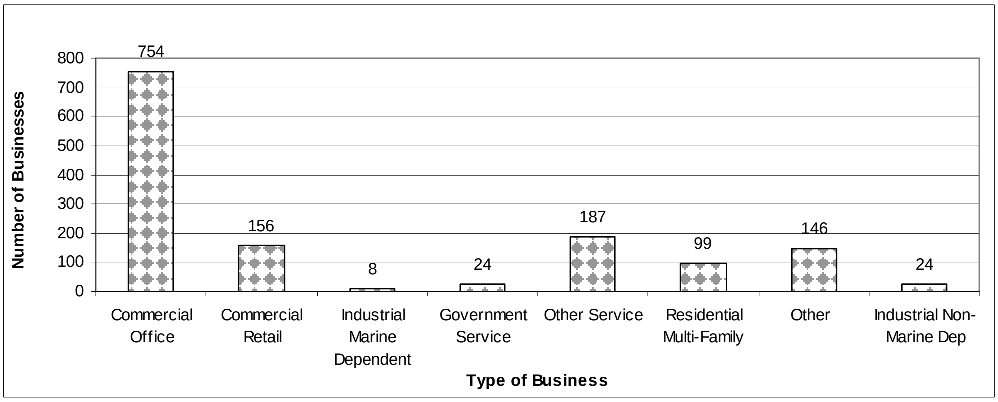


Figure 2.12-2. Number of Employees per Size of Business in the Study Area, 2006

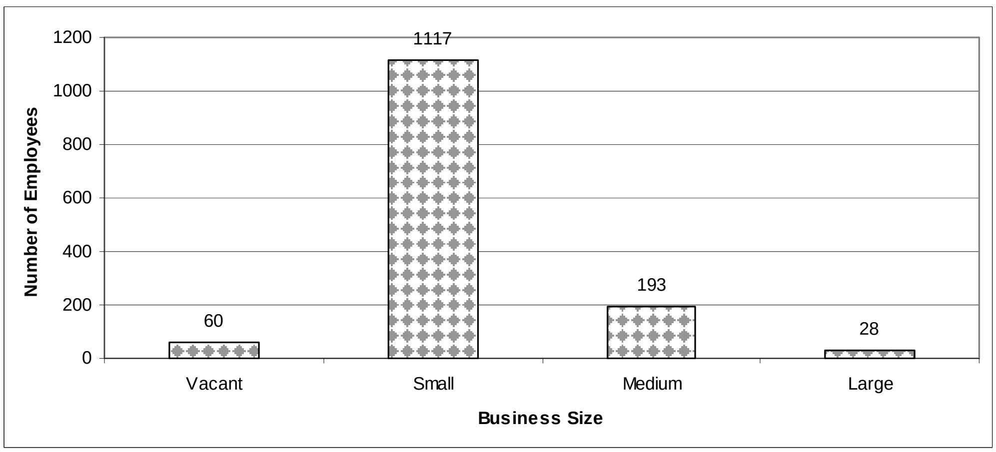
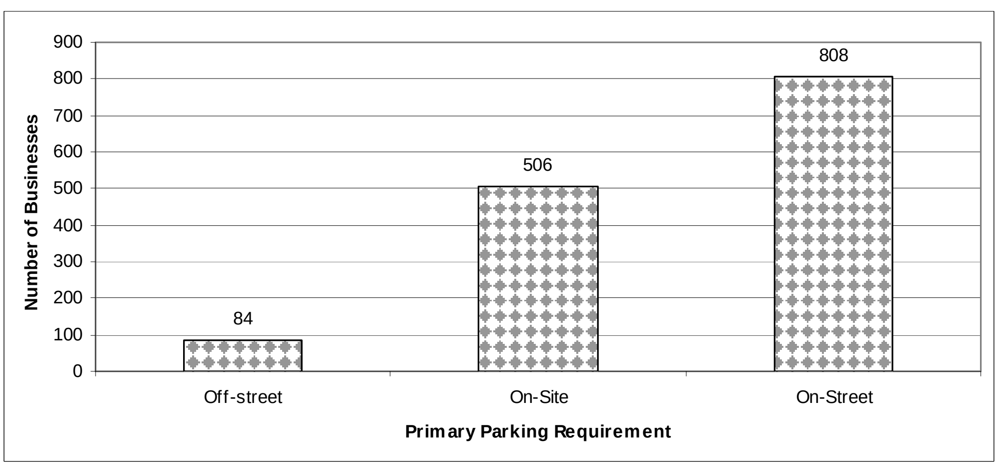


Figure 2.12-3. Primary Parking Requirement per Business in the Study Area, 2006



According to the Downtown Seattle Association (2006), during the time period between January 2004 and October 2006, the vacancy rate for commercial property in downtown Seattle fell from 16 to 12.6 percent and from January 2004 through December 2005 the market added 200,000 square feet of additional leasable space. With the exception of the waterfront, all areas have showed a decrease in vacancy rates since the end of 2003 (Geiger 2006).

Turnover within the study area ranged between 24 percent in the waterfront and Seawall segment (almost entirely attributable to the businesses abutting Alaskan Way surface street, east side north of Pier 59) to 51 percent in the south segment (Table 2.12-3).

Table 2.12-3: Number of Businesses, Percent Increase in Number of Businesses, and Percent Turnover in Existing Businesses Present for Each Geographic Area

Date / %	Pioneer Square	Central	Waterfront Seawall
January 2004	194	382	91[a]
October 2006	205	461	116
% Increase	6	21	27
% Turnover	48	29	24

[a] Includes 8 businesses from the January 2004 Broad Street Detour inventory
[b] Data from both January 2004 and August 2005 addendum survey
[c] Decrease of 8 businesses attributable to the north seawall
[d] Not re-surveyed in October 2006

The types of businesses that turned over were dominated by the commercial office business type in each geographic area inventoried, although less so for the north segment (Table 2.12-4).

Table 2.12-4: Percent Turnover by Business Types for Each Geographic Area

Business Type	South	Pioneer Square	Central	Waterfront Seawall	North
Commercial Office	72%	69%	79%	86%	43%
Commercial Retail	1%	15%	8%	4%	17%
Government Service	0%	1%	0%	4%	1%
Industrial (Both Types)	16%	0%	0%	0%	0%
Other Service	3%	10%	1%	0%	6%
Other	9%	2%	10%	7%	18%
Multi-Family Residential	0%	3%	1%	0%	15%

The high percent turnover figures implies that businesses in most of these geographic segments are very dynamic whose business models do not rely upon the physical location of the office for operation. The exceptions are the waterfront businesses (retail and other service, primarily non-retail food service) on the central piers that rely upon customers visiting the place of business (Geiger 2006).

It was noted that several (less than 10) businesses moved out of the south and Pioneer Square segments into the central segment; this was determined by tracking registered business names. It appears that during good economic times, these businesses are moving from the commercial office fringe to more central locations.

Breakdown of Findings per Geographic Area

The inventory area was generally broken down into the same geographic areas as presented in the Technical Memoranda for the 2004 Draft EIS (FHWA 2004). However, not all areas that were pertinent to the viaduct need to be considered with regard to future seawall development projects. As such, only two main areas were chosen from the 2004 EIS. The third area presented below, Pioneer Square, is a subset of the central segment. As a result of this survey, the distribution of businesses per geographic area is as follows (numbers of businesses are in parentheses):

- Pioneer Square –South King Street to Yesler Way (205).
- Central – Yesler Way to Battery Street Tunnel South Portal (461).
- North Waterfront and Seawall – Pier 46 to Pier 70 (116)

2.12.10. Pioneer Square

Within Pioneer Square, a portion of the central segment of the project, 205 existing businesses were identified along the east side of the Alaskan Way viaduct. Existing businesses along the west side of the Viaduct were included in the Waterfront grouping. This historic area is considered by the City of Seattle to be an area of special economic concern due to its heavy reliance upon on-street parking. The mix of business types is dominated by commercial office (61 percent) followed by other service (primarily non-retail food service) at 19 percent and commercial retail at 12 percent (Table 2.12-8). No industrial (marine dependent and non-marine dependent) businesses were surveyed within this segment. There were 11 multi-family residential buildings in the survey area along with three government service and three other business types.

Virtually all of the businesses were characterized as small businesses (89 percent) and less than 5 percent were characterized as medium-sized (Table 2.12-9). No businesses appeared to be large, while vacant businesses accounted for over 6 percent. The parking requirements for businesses within Pioneer Square are reliant upon on street parking with only 11 businesses (5 percent) identified as having either on-site or off-street parking (Table 2.12-10).

Table 2.12-8. Business Type (Pioneer Square)

Business Type	Pioneer Square	% Total
Commercial Office	124	60.5%
Commercial Retail	25	12.2%
Industrial Marine Dependent	0	0.0%
Government Service	3	1.5%
Other Service	39	19.0%
Residential Multi-Family	11	5.4%
Other	3	1.5%
Industrial Non-Marine Dependent	0	0.0%
Total	**205**	**100.0%**

Table 2.12-9. Business Size (Pioneer Square)

Business Size By Employees	Pioneer Square	% Total
Vacant	13	6.3%
Small	183	89.3%
Medium	9	4.4%
Large	0	0.0%
Total	**205**	**100.0%**

Table 2.12-10. Primary Parking Requirement (Pioneer Square)

Primary Parking Requirement	Pioneer Square	% Total
Off-Street	7	3.4%
On-Site	4	2.0%
On-Street	194	94.6%
Total	**205**	**100.0%**

2.12.11. Central

Within this portion of the central segment of the project 461 existing businesses were identified along the east side of the Alaskan Way viaduct. Existing businesses along the west side of the Viaduct were included in the Waterfront grouping. This area is in the heart of Seattle's Commercial Core as demonstrated by the density of businesses encountered. The mix of business types is dominated by commercial office (over 70 percent) followed by commercial retail at 10.8 percent and other service (primarily non-retail food service) at 7.4 percent (Table 2.12-11). One industrial (non-marine dependent) business was surveyed within this segment. There were 18 multi-family residential buildings in the survey area along with 30 other and three government service business types.

Virtually all of the businesses were characterized as small businesses (88.5 percent) and about 9 percent were characterized as medium-sized (Table 2.12-12). Two businesses appeared to be large and 11 were vacant. The parking requirements for businesses within the Central geographic area are reliant upon on street parking for 67 percent of the businesses; 30 percent of businesses provide on-site parking and 14 businesses relying on off-street parking (Table 2.12-13).

Table 2.12-11. Business Type (Central Segment)

Business Type	Central	% Total
Commercial Office	325	70.5%
Commercial Retail	50	10.8%
Industrial Marine Dependent	0	0.0%
Government Service	3	0.7%
Other Service	34	7.4%
Residential Multi-Family	18	3.9%
Other	30	6.5%
Industrial Non-Marine Dependent	1	0.2%
Total	**461**	**100.0%**

Table 2.12-12. Business Size (Central Segment)

Business Size By Employees	Central	% Total
Vacant	11	2.4%
Small	408	88.5%
Medium	40	8.7%
Large	2	0.4%
Total	**461**	**100.0%**

Table 2.12-13. Primary Parking Requirement (Central Segment)

Primary Parking Requirement	Central	% Total
Off-Street	14	3.0%
On-Site	138	29.9%
On-Street	309	67.0%
Total	**461**	**100.0%**

2.12.12. North Waterfront and Seawall

Within this portion of the study area, 116 existing businesses were identified along the west side of the Alaskan Way viaduct and along the east side of the Alaskan Way surface street north of the Pier 59 (where the viaduct begins to shift eastward towards the west portal of the Battery Street Tunnel) to Broad Street. Existing businesses along the east side of the viaduct between Yesler Street and Pier 59 were included in the Central. The waterfront and seawall area is considered by the City of Seattle to be an area of special economic concern due to its heavy reliance upon tourist visitors as well as on-street parking. The mix of business types is distributed between commercial office (36.2 percent) (primarily north of Pier 59), other service (27.6 percent) (primarily non-retail food service), and commercial retail (19.8 percent) (Table 2.12-14). No industrial (marine dependent and non-marine dependent) businesses or residential multi-family buildings were identified. There were 11 other business types and eight government service business types.

More than 75 percent of the businesses were characterized as small businesses and almost the rest being characterized as medium-sized (just over 20 percent) (Table 2.12-15). Four businesses appeared to be large and there were no vacant businesses. The parking requirements for businesses along the waterfront and north seawall are reliant upon on street parking (65 percent) with off-site and on-site parking sharing the remaining parking requirement (Table 2.12-16).

Table 2.12-14. Business Type (Waterfront/Seawall Segment)

Business Type	Waterfront/Seawall	% Total
Commercial Office	42	36.2%
Commercial Retail	23	19.8%
Industrial Marine Dependent	0	0.0%
Government Service	8	6.9%
Other Service	32	27.6%
Residential Multi-Family	0	0.0%
Other	11	9.5%
Industrial Non-Marine Dependent	0	0.0%
Total	**116**	**100.0%**

Table 2.12-15. Business Size (Waterfront/Seawall Segment)

Business Size By Employees	Waterfront/Seawall	% Total
Vacant	0	0.0%
Small	88	75.9%
Medium	24	20.7%
Large	4	3.4%
Total	**116**	**100.0%**

Table 2.12-16. Primary Parking Requirement (Waterfront/Seawall Segment)

Primary Parking Requirement	Waterfront/Seawall	% Total
Off-Street	19	16.4%
On-Site	22	19.0%
On-Street	75	64.7%
Total	**116**	**100.0%**

2.13. Noise and Vibration

2.13.1. Overview

The study area is a densely-populated and high traffic urban area. Noise-sensitive receivers consist of apartments, hotels, restaurants with outdoor dining areas, and outdoor parks. The urban environment results in existing noise levels that are relatively high during both daytime and nighttime.

2.13.2. Noise Terminology

Sound is mechanical energy transmitted by pressure waves moving through the air. Noise can be defined as unwanted sound. Sound is characterized by various parameters that include the rate of oscillation of sound waves (frequency or pitch), and the pressure level or energy content (amplitude or sound volume). The sound pressure level is the most common descriptor used to characterize the loudness of an ambient sound level. The decibel (dB) scale is used to quantify sound pressure levels. Because sound pressure can vary enormously within the range of human hearing, a logarithmic loudness scale is used. The human ear is not equally sensitive to all frequencies in the entire spectrum, so community noise measurements are typically weighted more heavily for frequencies to which humans are sensitive in a process called A-weighting (dBA). Typical dBA noise levels for various types of sound sources are summarized in Table 2.13-1.

Table 2.13-1. Typical A-Weighted Sound Levels

Sound Source	dBA	Typical Response
Carrier deck jet operation	140	Painfully loud
Limit of amplified speech	130	
Jet takeoff (200 feet) Auto horn (3 feet)	120	Threshold of feeling and pain
Riveting machine Jet takeoff (2,000 feet)	110	
Shout (0.5 foot) New York subway station	100	Very annoying
Heavy truck (50 feet) Pneumatic drill (50 feet)	90	Hearing damage (8-hour exposure)
Passenger train (100 feet) Helicopter (in flight, 500 feet) Freight train (50 feet)	80	Annoying
Freeway traffic (50 feet)	70	Intrusive
Air conditioning unit (20 feet) Light auto traffic (50 feet)	60	

Sound Source	dBA	Typical Response
Normal speech (15 feet)	50	Quiet
Living room, Bedroom, Library	40	
Soft whisper (15 feet)	30	Very quiet
Broadcasting studio	20	
Total silence	0	Threshold of hearing

Source: Federal Transit Administration 2006
Note: Blank cells in the 'Typical Response' column are transitional between cells that are indicated.

The perceptibility of a new noise source intruding onto background conditions depends on the nature of the intruding sound and the background sound. For situations where the nature of the new sound is similar to the background sound (e.g., new traffic noise added to background traffic noise) a noise of 3 dB is just noticeable, a change of 5 dB is clearly noticeable, and a change of 10 dB is perceived as doubling the sound level. For situations where the nature of the new intruding sound is different or much louder than background (e.g., construction noise in an otherwise quiet setting), the new sound (including sporadic clanks from construction equipment) can be discernible even if it raises the overall noise level by less than 1 dBA.

Different types of measurements are used to characterize the time-varying nature of sound.

- The "equivalent sound level" or Leq is the equivalent steady state sound level that during a stated time period contains the same acoustical energy as a time-varying sound level during that same period.
- The "maximum sound level" or Lmax is the loudest 1-second period during a noise measurement.
- The "percentile exceeded level" or Lnn is the percentage of time the measured noise level exceeds the specified Lnn level. For example, the L90 is a relatively quiet noise level that is exceeded 90% of the time, while the L10 is a relatively loud noise level that is exceeded only 10% of the time.
- The "day-night average noise level" or Ldn is the 24-hour average Leq, with a 10 dBA factor added to measured nighttime noise levels (10:00 p.m. to 7:00 a.m.) to account for increased sensitivity to nighttime noise.

2.13.3. Land Use and Noise-Sensitive Receivers

The Seattle waterfront is a densely populated urban area. For this project, the noise study area is defined as the area within 500 feet of anticipated construction operations at the Seawall. Land use in the noise study area consists of commercial businesses, restaurants, the Washington State Ferries Colman Dock, urban parks, condominiums, apartments, and hotels.

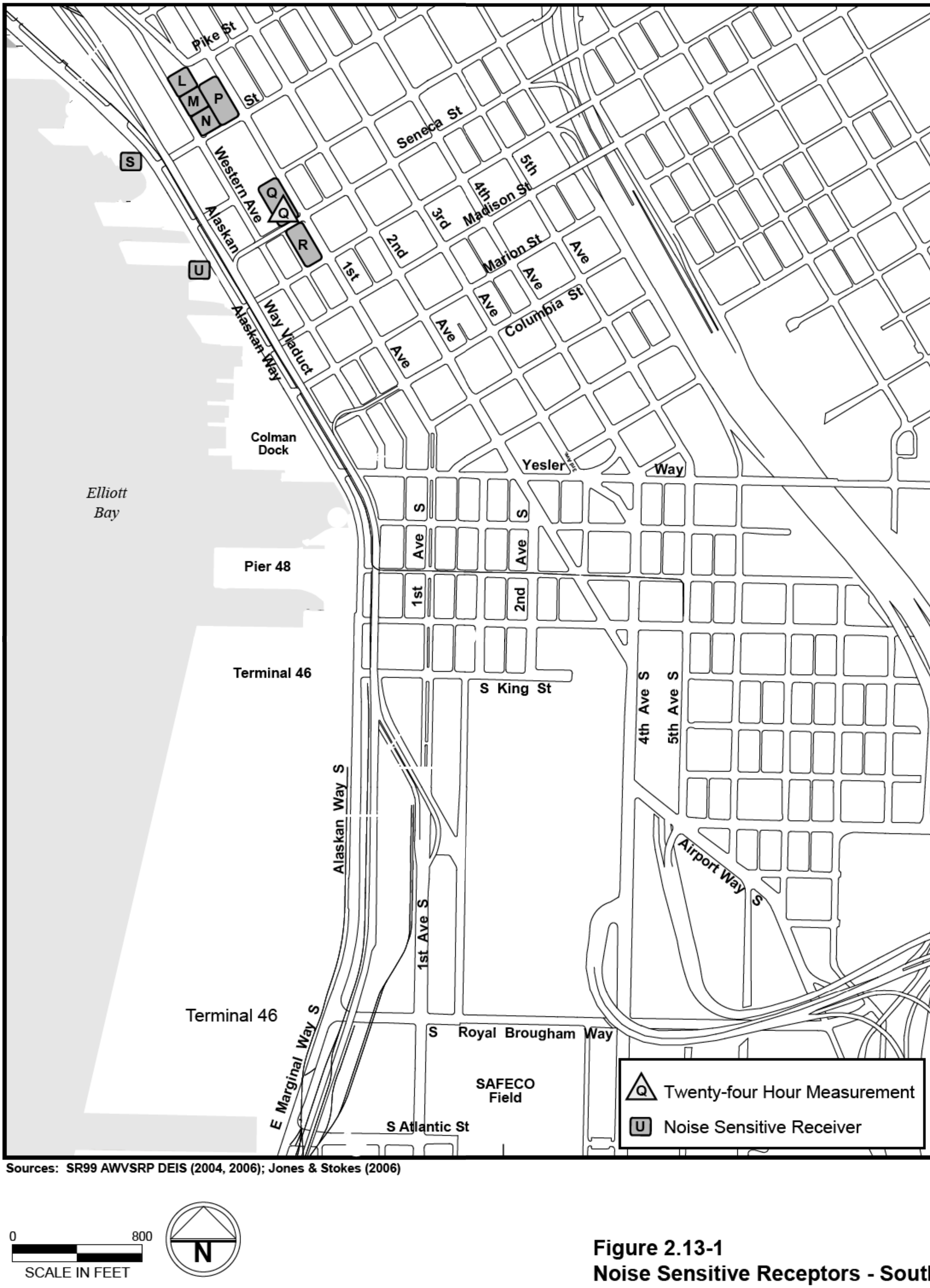
For this analysis, noise-sensitive receivers are evaluated and are defined as the following:

- Commercial businesses with dedicated outdoor use areas;
- Parks and dedicated gathering places where quiet conditions are essential to the park's function; and
- Condominium, apartment, and hotel units with dedicated outdoor use areas, including outdoor balconies.

Locations of noise-sensitive receivers within the study area were based on site reconnaissance conducted in September 2006. Figures 2.13-1 and 2.13-2 show the locations of noise-sensitive receivers, and Table 2.13-2 summarizes each noise-sensitive receiver.

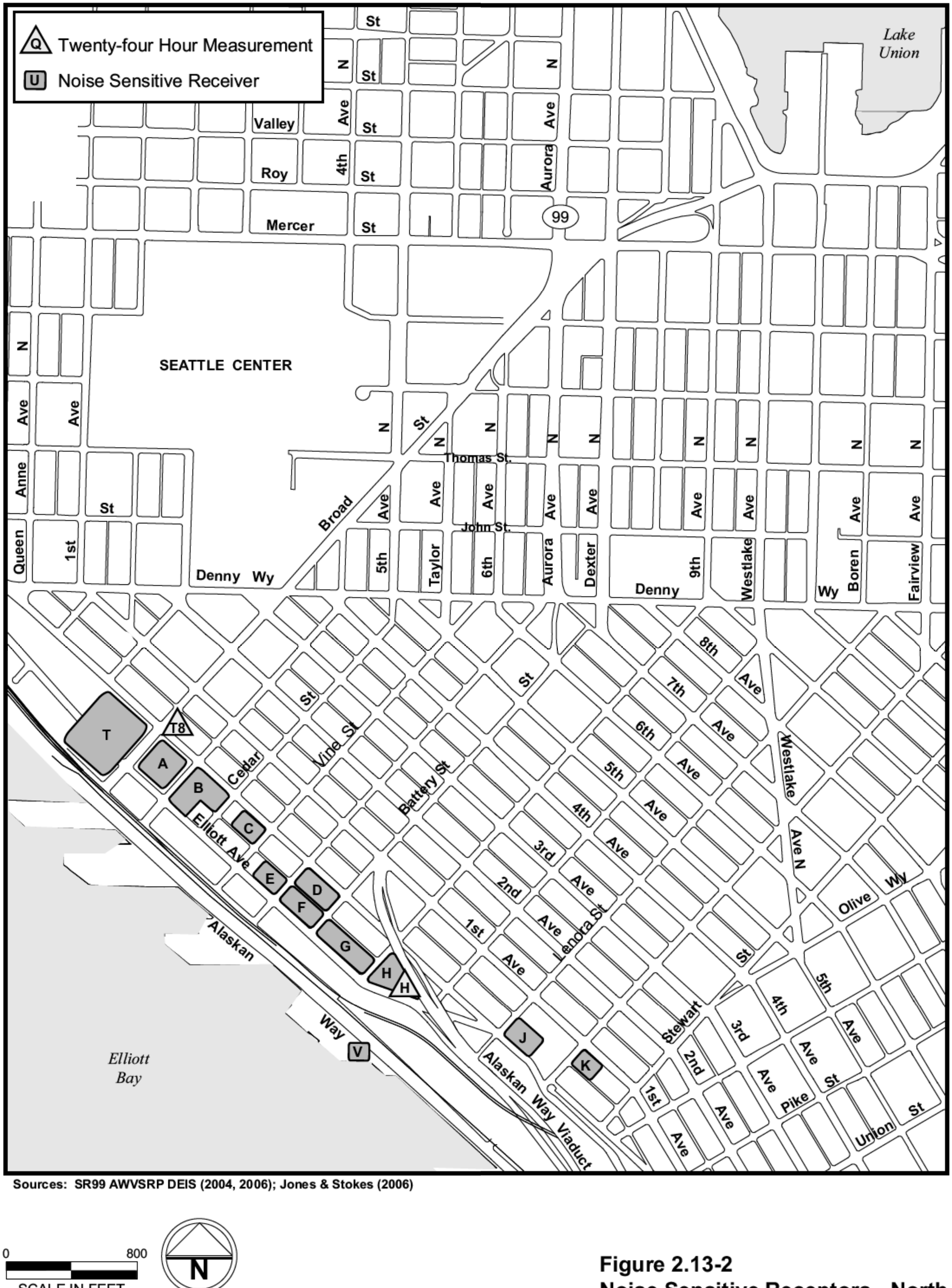
Table 2.13-2. Noise-Sensitive Receivers in the Study Area

Receiver	Description
A	Olympus Apartments
B	Bellora Apartments
C	Kleg Lofts Apartments
D	Vine Apartments
E	Unnamed Apartments
F	Elliott Bay Plaza Apartments
G	2300 Elliott Apartments
H	Elliott Pointe Apartments
J	Market Court Apartments
K	87 Virginia Apartments
L	Ross Manor (Seattle Housing Authority)
M	Post Alley Court Apartments
N	Hostelling International Hotel (closed in March 2007)
P	South Arcade Apartments
Q	Harbor Steps Condominium Complex
R	Watermark Tower
S	Seattle Aquarium Outdoor Area
T	Olympic Sculpture Park/Myrtle Edwards Park
U	Elliott's Restaurant (Outdoor dining area)
V	Anthony's Pier 66 (Outdoor dining area)



Sources: SR99 AWVSRP DEIS (2004, 2006); Jones & Stokes (2006)

Figure 2.13-1
Noise Sensitive Receptors - South



Sources: SR99 AWVSRP DEIS (2004, 2006); Jones & Stokes (2006)

Figure 2.13-2
Noise Sensitive Receptors - North

In addition to the noise-sensitive receivers listed in the above table, there are numerous commercial buildings within 500 feet of the Seawall that have no dedicated outdoor use areas. As described later in this section, the City of Seattle noise regulation specifies allowable indoor noise levels at commercial buildings for construction operations during normal business hours (8:00 a.m. to 5:00 p.m.).

2.13.4. Existing Noise Levels

In 2002, 24-hour continuous baseline noise measurements in the study area were taken to support the DEIS for the Alaskan Way Viaduct and Seawall Replacement Project (FHWA 2004). Figures 2.12-1 and 2.12-2 show the locations for the 24-hour measurement locations relevant to this analysis. Figure 2.12-3 shows the trend in hourly-average Leq noise levels measured over the 24-hour period.

The study area is a densely populated urban area, so measured noise levels were high even during the relatively quiet periods late at night. Noise levels measured at four locations of interest (Avalon Belltown Apartments, Harbor Steps Apartments, Port of Seattle, and Waterfront Landing Condominiums) are shown in Table 2.13-3.

Table 2.13-3. Existing Noise Levels at Selected Locations in the Study Area

Location	Average Level (Ldn)	Energy Equivalent Level (Leq)	Max Level (Lmax)	Min Level (Lmin)	Level Range (Leq)
Avalon Belltown Apartments	71	76	102.8	36.3	59.8-75.6
Harbor Steps Apartments	78	84	105.6	50.9	61.6-83.5
Port of Seattle	75	76	100.9	47.7	62.8-75.5
Waterfront Landing Condominiums	80	80	92.7	46.8	65.9-79.6

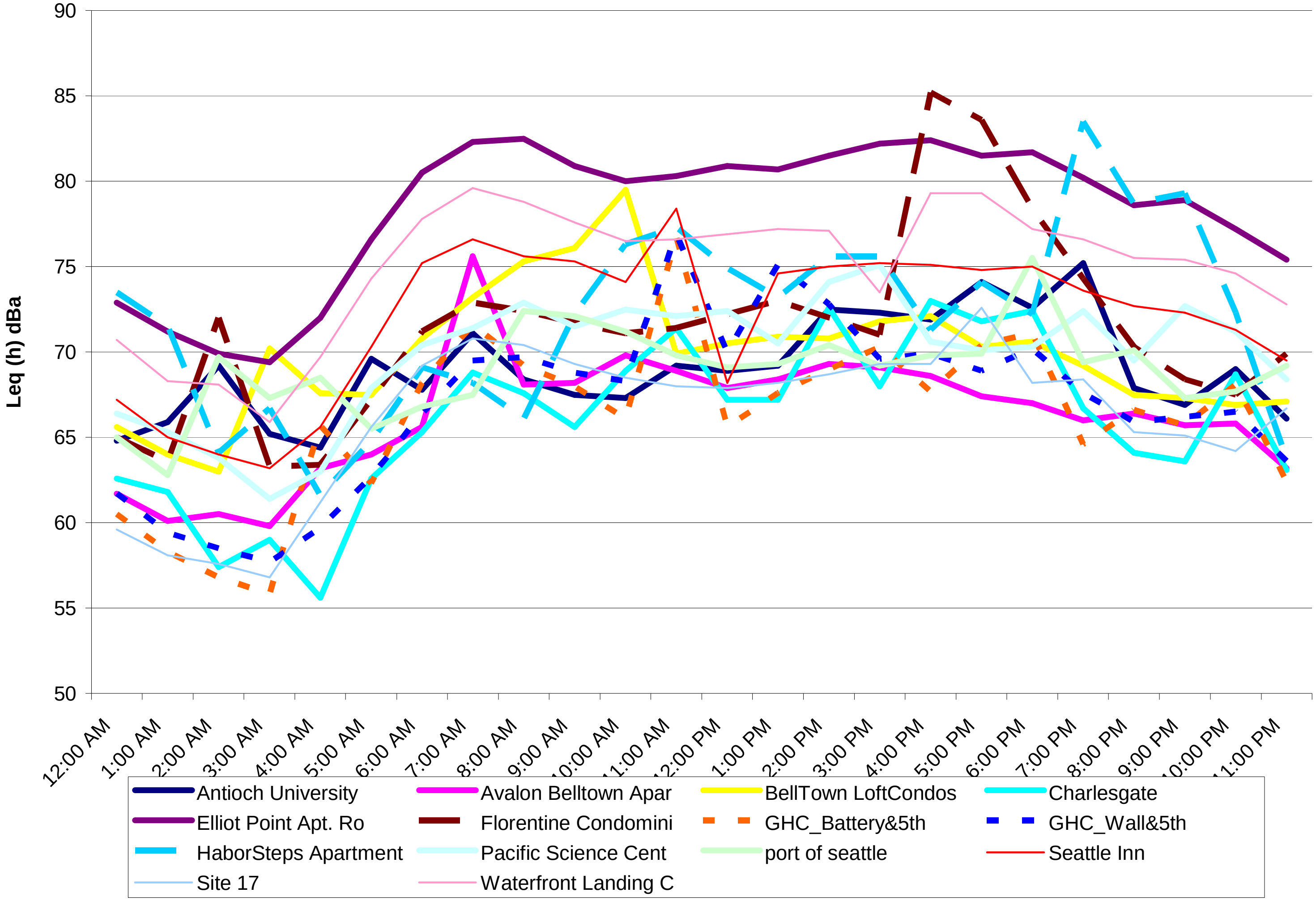
Source: Parsons Brinckerhoff Quade and Douglas data 2002

2.13.5. City of Seattle Construction Noise Regulation

Noise in Seattle is regulated by the Seattle Municipal Code, Chapter 25.08 Noise Control. Allowable indoor and outdoor noise levels caused by construction activity are regulated by Section 25.08.425, Construction and Equipment Operations. The allowable construction noise limits are listed in Table 2.13-4. The allowable limits depend on the zoning for the source and receiver. For this analysis, it is assumed the Seawall construction would be considered a commercial noise source. The City's regulation specifies allowable outdoor construction noise levels at residentially zoned buildings and specifies limits for both indoor and outdoor noise levels at commercially zoned buildings. The regulation specifies allowable noise levels for daytime periods (7:00 a.m. to 10:00 p.m. on weekdays and 9:00 a.m. to 10:00 p.m. on weekends) and nighttime periods (10:00 p.m. to 7:00 a.m. on weekdays, and 10:00 p.m. to 9:00 a.m. on weekends).

The City noise regulation includes Subchapter VII Variances. At the discretion of the City, a variance can be granted if the applicant demonstrates that it is infeasible to achieve the noise limits based on technical and/or economic considerations.

Baseline noise levels in the study area generally exceed the nighttime allowable construction noise levels for residential buildings except during the period from 1:00 a.m. to 5:00 a.m. (Figure 2.13-3).



Source: Parsons Brinckerhoff Quade and Douglas Data from 2002

Figure 2.13-3. Baseline Noise Measurements

Table 2.13-4. City of Seattle Construction Noise Limits

Type of Noise	Daytime Construction (Outdoor Noise Levels) Mobile Equipment	Daytime Construction (Outdoor Noise Levels) Handheld Equipment	Daytime Construction (Outdoor Noise Levels) Impact Equipment	Nighttime Construction (Outdoor Noise Levels) All Equipment	Daytime Construction (Indoor Noise at Commercial Buildings, 8:00 a.m. to 5:00 p.m.) All Equipment
Seawall Construction Impacting Residentially Zoned Buildings					
Continuous Noise	82	72	–	47	–
15 minutes in any hour (L25)	87	77	–	52	–
5 minutes in any hour (L8)	92	82	–	57	–
1.5 minutes in any hour (L2)	97	87	–	62	–
1-hour Leq	–	–	90	–	–
Seawall Construction Impacting Commercially Zoned Buildings					
Continuous Noise	85	80	–	50	60
15 minutes in any hour (L25)	90	85	–	55	65
5 minutes in any hour (L8)	95	90	–	60	70
1.5 minutes in any hour (L2)	100	95	–	65	75
1-hour Leq	–	–	90	–	–

Note: "–" indicates no limit is set by the regulation

Source: Seattle Municipal Code 25.08.425

2.13.6. Construction Equipment Noise

The use of construction equipment will cause increased noise levels above the baseline existing noise in the Seawall study area. Table 2.13-5 shows typical noise levels for various types of construction equipment that could be used for various elements of the Seawall construction.

Table 2.13-5. Noise Levels (Lmax) of Various Equipment Types.

Equipment	Size	Noise Level L max (dBA)
Asphalt Roller	125 hp	80
Compressor	250 cfm (50 hp)	85
Compressor	1000 cfm (350 hp)	85
Concrete Pump	85 hp	81
Concrete Trucks	300 hp	79
Crawler Crane	125 ton (332 hp)	81
Crawler Crane	150 ton (340 hp)	81
Dozer D6R	175 hp	82
Drill Rig		84
Dump Trucks	330 hp	76
Excavator	100k lb (316 hp)	81
Grader	165 hp	85
Grout Pump	20 hp	81
Hydraulic Crane	50 ton (215 hp)	81
Light Plants	14 hp	81
Loader	200 hp	79
Loader	300 hp	79
Off-Highway Trucks	30 cy (100 tons, 1016 hp)	76
Pile Driver (vib)	150 hp	101
T&T Trucks	220 hp	75
Track Excavator	75k lb (268 hp)	81
Truck	220 hp	75
Truck & Trailer	220 hp	75
Vibration Roller	145 hp	80
Vibratory Loader	200 hp	79
Wheel Loader	200 hp	79

Source: FHWA 2006.

2.13.7. Underwater Noise Levels

Percussive pile driving and other impulsive sounds (explosions, etc.) can cause damage to fish and other aquatic species by damaging auditory organs and the gas-filled swim bladder as a result of pressure waves (Popper, *et al*. 2006). Percussive pile driving includes the use of a hammer or other hard surface to pound pilings into the substrate. The sounds that result from pile driving are typically short, but very sharp and high in amplitude. Monitoring of construction projects in California has provided data on noise/pressure levels from pile driving. The terms used in describing underwater sound pressures include:

- Peak Sound Pressure Level – Maximum excursion of pressure within a sound.
- RMS – Root mean square of a continuous sound signal.
- SEL – Sound exposure level defined as the level lasting for 1 second that has the same acoustic energy as the transient and is expressed as dB re: $1\mu Pa^2$ * sec.

Tables 2.13-6 and 2.13-7 show sound pressures from various types of piles driven using an impact hammer and vibratory driver, respectively. NOAA has proposed a threshold of 187 dB sound exposure level for pile driving (NOAA 2007).

Table 2.13-6. Unattenuated Sound Pressures (dB) of Pile Driving Using an Impact Hammer (water less than 5 meters deep).

Pile Type and Size	Peak Sound Pressure	RMS	SEL
12-inch Steel H-Type Thin	190	175	160
12-inch Steel H-Type Thick	195	183	170
24-inch AZ Steel Sheet	205	190	180
24-inch Concrete Pile	185	170	160
12-inch Steel Pipe Pile	192	177	--
24-inch Steel Pipe Pile	203	190	177
36-inch Steel Pipe Pile	208	190	180
60-inch Steel CISS	210	195	185

Source: California Department of Transportation 2007.

Table 2.13-7. Unattenuated Sound Pressures (dB) of Pile Driving Using a Vibratory Driver (water less than 5 meters deep).

Pile Type and Size	Peak Sound Pressure	RMS	SEL
12-inch Steel H-Type	165	150	150
24-inch AZ Steel Sheet (Typical)	175	160	160
12-inch Steel Pipe Pile	171	155	155
36-inch Steel Pipe Pile (Typical)	180	170	170
72-inch Steel Pipe Pile (Typical)	183	170	170

Source: California Department of Transportation 2007.

2.13.8. Concepts of Vibration

Ground-borne vibration can be a serious concern for neighbors near a construction site that uses impact equipment (e.g., pile drivers). The effects of ground-borne vibration include perceptible movement of the building floors and walls, rattling of windows, and rumbling sounds. The overall effect of vibration caused by construction projects is generally an annoyance to people living nearby. In some cases, building damage can also occur, but only at exceptionally high vibration levels that are not commonly encountered. In addition, older utilities infrastructure such as cast iron water manes with lead joints can also be damaged by high levels of vibration.

Ground vibration is usually quantified as the average ground velocity of the vibratory motion, commonly described as vibration decibel levels (VdB) (Federal Transit Administration [FTA] 2006). Vibration levels in the United States are commonly measured as VdB relative to a reference velocity of 1 microinch per second. Typical vibration levels are listed in Table 2.13-8.

Table 2.13-8. Typical Levels of Ground-Borne Vibration

Velocity Vibration Level	Typical Sources	Human or Structural Response
50 VdB	Typical background vibration	None, below typical threshold of perception
65 VdB	Bus or truck on public road, 50 feet away	Approximate threshold of human perception
80 VdB	Railroad train, 50 feet away	Residential annoyance for occasional events
90 VdB	Bulldozer, 50 feet away	Difficulty in reading computer screen
100 VdB	Blasting from construction project, 50 feet away	Cosmetic damage to fragile buildings

VdB = vibration decibel levels

VdB relative to reference velocity of 1 microinch per second

Source: Federal Transit Administration 2006

In some cases, long-term, steady vibration of the ground below a building can cause the walls of the building to vibrate and generate low-frequency sound waves inside the building. These sounds are called ground-borne noise, to distinguish them from sounds that propagate from noise sources through the atmosphere. The frequency of ground-borne noise is generally 16 to 64 hertz, which is near the lower end of the average person's perceptible hearing range. Therefore, ground-borne noise is perceived as a low rumble.

2.13.9. Vibration Impact Criteria

No Federal, State, or local vibration regulations or guidelines are directly applicable to the proposed Seawall. Regardless, construction of the proposed project has the potential to cause discernible vibration at buildings nearby. For this analysis, vibration impact criteria established by the FTA were used to establish NEPA significance criteria. The proposed project is not subject to FTA regulations, but the FTA guidelines serve as a useful tool to evaluate vibration impacts and to define appropriate mitigation. Table 2.13-9 lists the FTA impact criteria for ground vibration and ground-borne noise.

Table 2.13-9. FTA Impact Criteria for Vibration and Ground-Borne Noise

Impact Type	Land Use	Vibration Impact Criterion	Ground-Borne Noise Impact Criterion
Perceptible vibration or rumbling noise causing potential annoyance	Institutional and commercial buildings with primarily daytime usage	83 VdB	48 dBA
	Residences (homes and apartments)	80 VdB	43 dBA
	Auditorium (North Coast Repertory Theater)	80 VdB	38 dBA
Cosmetic damage to plaster	Plaster walls on fragile historic buildings near the vibration source	90–100 VdB	Not applicable

VdB = vibration decibel levels; dBA = A-weighted decibel

Source: FTA 2006

2.13.10. Existing Vibration Levels

The Washington State Department of Transportation measured vibration levels in the Project area to support the EIS for replacement of the Alaskan Way Viaduct (FHWA 2004). Measurements were taken at buildings closest to the existing Viaduct structure. The measured vibration levels are listed in Table 2.13-10.

Table 2.13-10. Measured Vibration Levels near Alaskan Way Viaduct

Measurement Location	Vibration Level
Viaduct at Jackson Street	79 VdB
Viaduct at S. Main Street	66 VdB
Viaduct at Union Street	77 VdB

VdB = vibration decibel levels
Source: FHWA 2004

2.13.11. Vibration Levels of Construction Equipment

Typical vibration levels are known for some types of construction equipment. Types of equipment that could be used for seawall replacement construction that would be expected to result in elevated vibration levels in the study area include dump trucks, pile drivers, and dozers. Dump truck vibration levels are approximately 86 VdB, vibration roller levels are approximately 94 VdB, vibratory pile driver approximately 93 VdB, and a 175 hp dozer vibration levels are approximately 58 Vdb (FHWA 2006; HMMH 1995).

2.14. Air Quality

2.14.1. Overview

This section provides information on existing air quality conditions within the project vicinity, federal and State air quality standards, regulations that would be applied to the project construction, and emissions for typical types of construction equipment. The study area is designated a "maintenance area" for carbon monoxide (CO) and an "attainment area" for all other pollutants. The air pollutant concentrations in the project vicinity have been below the National Ambient Air Quality Standards (NAAQS).

2.14.2. Local Meteorology

The study area is located along the eastern shore of Elliott Bay (Puget Sound) with the Olympic Mountains to the west and the Cascade Range to the east. The climate is strongly influenced by these mountains and the proximity of the area to Puget Sound and the Pacific Ocean. The relatively cool summers, mild winters, and wet weather characteristic of a marine climate are enhanced by Puget Sound.

Two meteorological patterns dominate local weather. Winds are relatively light and are frequently from the north and northwest during the summer. During the winter, a relatively stationary low-pressure region often develops in the Aleutian Islands, regularly sending Pacific storms through British Columbia and Puget Sound. This pattern is responsible for the cloudy, rainy winters for which Puget Sound is noted. Winds are generally from the southwest in inclement weather and from northwest during fair weather, but are strongly influenced by local terrain.

The annual average temperature in the project area is approximately 52 degrees Fahrenheit (ºF). The project area experiences an average winter temperature of approximately 41ºF and an average summer temperature of 63 ºF. Total precipitation in the project area averages approximately 38 inches annually. Precipitation occurs mostly during the winter and relatively infrequently during the summer (Western Regional Climate Center 2007).

Due to the low solar heating of the land in winter, nighttime inversions often last until late in the day and occasionally last for several days. It is during these very stable atmospheric conditions that monitoring instruments measure high concentrations of those air pollutants emitted at ground level, because little vertical dispersion occurs. Such ground-level-emitted pollutants include carbon monoxide (CO) from motor vehicles. This meteorological stability and resulting pollutant concentrations may be worse in areas of uneven terrain, such as river valleys, because of the additional restriction on air flow by valley walls.

2.14.3. Air Pollutants Considered

This section focuses on five pollutants that are most commonly measured and regulated (i.e., criteria pollutants): CO, ozone (O_3), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), particulate matter with a diameter less than or equal to 10 microns (PM10), and particulate matter with a diameter less than or equal to 2.5 microns (PM2.5). Since O_3, a photochemical oxidant, is not directly emitted into the air from sources, emissions of O_3 precursors, nitrogen oxides (NOX) and volatile organic compounds (VOC) are regulated with the aim of reducing O_3 formation in the lowermost region of the troposphere. The principal characteristics and environmental effects of these pollutants are presented in Table 2.14-1.

2.14.4. Air Quality Regulatory Requirements

Air Quality Regulatory Agencies

The following agencies have jurisdiction over ambient air quality in the study area: U.S. Environmental Protection Agency (EPA), Washington State Department of Ecology (Ecology), and the Puget Sound Clean Air Agency (PSCAA).

EPA regulates emission sources that are under the exclusive authority of the federal government, such as aircraft, ships, non-road construction equipment, and locomotives. EPA is responsible for establishing the NAAQS. The agency has jurisdiction over emission sources outside State waters and establishes various emissions standards, including those for vehicles sold in states other than Washington.

Ecology is responsible for establishing Washington Ambient Air Quality Standards. The agency is also responsible for setting emission standards for vehicles sold in Washington and for other emission sources, such as stationary industrial sources. Ecology oversees the functions of local air pollution control districts and air quality management districts, which in turn administer air quality activities at the regional and county levels.

PSCAA has jurisdiction over King, Kitsap, Pierce, and Snohomish counties. The agency is also responsible for monitoring air quality, as well as planning, implementing and enforcing programs designed to attain and maintain State and federal ambient air quality standards in the district. Programs that were developed include air quality rules and regulations that regulate stationary source, area source, point source and certain mobile source emissions. PSCAA is also responsible for establishing permitting requirements for stationary sources and ensuring that new, modified or relocated stationary sources do not create net emission increases and, therefore are consistent with the region’s air quality goals.

Table 2.14-1. Most Commonly Measured and Regulated Pollutants and Their Effects

Pollutant	General Characteristics	Sources	Human Effects	Environmental Effects
Carbon Monoxide (CO)	An odorless, tasteless, colorless gas that is emitted primarily from any form of combustion.	Mobile sources (autos, trucks, buses), wood stoves, open burning, industrial combustion sources.	Deprives the body of oxygen by reducing the blood's capacity to carry oxygen; causes headaches, dizziness, nausea, listlessness and in high doses, may cause death.	A non-reactive air pollutant that dissipates relatively quickly, so ambient CO concentrations generally follow the spatial and temporal distributions of vehicular traffic. CO concentrations are influenced by local meteorological conditions; primarily wind speed, topography, and atmospheric stability. CO from motor vehicle exhaust can become locally concentrated when surface-based temperature inversions are combined with calm atmospheric conditions, a typical situation at dusk in urban areas between November and February.
Ozone (O_3)	Formed when NOX and VOC react with one another in the presence of sunlight and warm temperatures. A component of smog.	Mobile sources, industry, power plants, gasoline storage and transfer, paint.	Irritates eyes, nose, throat and respiratory system; especially bad for those with chronic heart and lung disease, as well as the very young and old, and pregnant women.	Meteorology and terrain play major roles in O_3 formation. Ideal conditions occur during summer and early autumn, on days with low wind speeds or stagnant air, warm temperatures, and cloudless skies. The greatest source of smog-producing gases is the automobile.
Nitrogen Dioxide (NO_2) and Nitrogen Oxides (NOX)	A poisonous gas produced when nitrogen oxide (NO) is a by-product of sufficiently high burning temperatures.	Fossil fuel power, mobile sources, industry, explosives manufacturing, fertilizer manufacturing.	Harmful to lungs, irritates bronchial and respiratory systems; increases symptoms in asthmatic patients.	NO and NO_2 are collectively referred to as "oxides of nitrogen" or NOX and are major contributors to O_3formation. NO_2 also contributes to the formation of PM10 (see discussion of PM10 under *Suspended Particulate Matter* in this table). At atmospheric concentration, NO_2 is only potentially irritating. In high concentrations, the result is a brownish-red cast to the atmosphere and reduced visibility.
Sulfur Dioxide (SO_2)	A gas or liquid resulting from the burning of sulfur-containing fuel.	Fossil fuel power plants, non-ferrous smelters, kraft pulp production.	Increases symptoms in asthmatic patients; irritates respiratory system.	SO_2 can cause plant leaves to turn yellow, as well as erode iron and steel. In recent years, SO_2 concentrations have been reduced by the increasingly stringent controls placed on stationary source emissions of SO_2 and limits on the sulfur content of fuels. SO_2 concentrations have been reduced to levels well below the state and national standards, but further reductions in emissions are needed to attain compliance with standards for sulfates and PM10, of which SO_2 is a contributor.
Suspended Particulate Matter	Particles of soot, dust, and unburned fuel suspended in the air.	Wood stoves, Industry, dust, construction, street sand application, open burning.	Aggravates ailments such as bronchitis and emphysema; especially bad for those with chronic heart and lung disease, as well as the very young and old, and pregnant women.	Suspended particulates damage and discolor surfaces on which they settle, as well as producing haze and reducing regional visibility.

Pollutant	General Characteristics	Sources	Human Effects	Environmental Effects
DPM[1]	A complex mixture of thousands of gases and fine particles (commonly known as soot) that contains more than 40 toxic air contaminants (including many known or suspected cancer-causing substances, such as benzene, arsenic, polynuclear aromatic hydrocarbons, and formaldehyde).	Diesel exhaust is emitted by diesel-fueled internal combustion engines. It also contains other pollutants, including NOX.	Diesel exhaust and many individual substances contained in it have the potential to contribute to mutations in cells that can lead to cancer. In fact, long-term exposure to diesel exhaust particles poses the highest cancer risk of any toxic air contaminant evaluated by the OEHHA.	There are no regulatory limits on diesel exhaust as a toxic substance in Washington. However, diesel exhaust is known to contain a variety of toxic substances, and there has been considerable study regarding its health effects.

DPM = Diesel Particulate Mater

OEHHA = California Office of Environmental Health Hazard Assessment

[1]The discussion of the health effects of diesel exhaust was developed by the OEHHA (2001).

Source: Ecology 2007

Ambient Air Quality Standards

EPA and Ecology have established regulations designed to limit emissions from air pollution sources and to minimize concentrations of pollutants in the outdoor ambient air. Although their regulations are similar in stringency, each agency has established its own standards. Unless the state or local jurisdiction has adopted more stringent standards, EPA standards apply.

Table 2.14-2 lists both the national and Washington ambient air quality standards. The NAAQS consist of primary standards designed to protect public health and secondary standards designed to protect public welfare (e.g., preventing air pollution damage to vegetation). Ecology has established additional ambient standards for total suspended particulates and SO_2 standards more stringent than the federal requirements.

Table 2.14-2. National and State Ambient Air Quality Standards

Pollutant	National (EPA) Standards		Washington Standards (Ecology)
	Primary	Secondary	
Carbon Monoxide			
8 hour average[1]	9 ppm	9 ppm	9 ppm
1 hour average[1]	35 ppm	35 ppm	35 ppm
Total Suspended Particles			
Annual average	No standard	No standard	60 μg/m³
24 hour average	No standard	No standard	150 μg/m³
Particulate Matter - PM10			
24 hour average[1]	150 μg/m³	150 μg/m³	150 μg/m³
Particulate Matter - PM2.5			
Annual average[3]	15 μg/m³	15 μg/m³	No standard
24 hour average[4]	65 μg/m³	65 μg/m³	No standard
Lead			
Quarterly average	1.5 μg/m³	1.5 μg/m³	No standard
SO_2			
Annual average	0.03 ppm	No standard	0.02 ppm
24 hour average[1]	0.14 ppm	No standard	0.10 ppm
3 hour average[1]	No standard	0.50 ppm	No standard
1 hour average[6]	No standard	No standard	0.40 ppm
O_3			
8 hour average[5]	0.075 ppm	0.075 ppm	No standard
NO_2			
Annual average	0.053 ppm	0.053 ppm	0.05 ppm

Source: EPA 2008; Ecology 2007

Notes: ppm = parts per million; μg/m³ = micrograms per cubic meter

[1] Not to be exceeded more than once per year.

[2] To attain this standard, the 3-year average of the weighted annual mean PM10 concentration at each monitor within an area must not exceed 50 ug/m³.

[3] To attain this standard, the 3-year average of the weighted annual mean PM2.5 concentrations from single or multiple community-oriented monitors must not exceed 15.0 ug/m³.

[4] To attain this standard, the 3-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor within an area must not exceed 65 ug/m³.

[5] To attain this standard, the 3-year average of the fourth-highest daily maximum 8-hour average O_3 concentrations measured at each monitor within an area over each year must not exceed 0.08 ppm.

[6] 0.25 ppm not to be exceeded more than two times in any 7 consecutive days.

Air Quality Status for Puget Sound Region

Based on monitoring information collected over a period of years, state and federal agencies designate regions as being “attainment” or “nonattainment” for regulated air pollutants. Attainment status indicates that air quality in an area meets the federal, health-based ambient air quality standards, and nonattainment status indicates that air quality in an area does not meet those standards. Regions previously designated as nonattainment that have demonstrated consistent improvements in air quality have been reclassified as maintenance areas, requiring approval of maintenance plans by Ecology.

Ecology maintains a network of air quality monitoring stations throughout the State. These stations are placed in areas where there may be air quality problems, usually in or near urban areas or close to large air pollution sources. A limited number of additional stations are located in remote areas to provide an indication of regional background air pollution levels.

The Puget Sound region in which the Project area is located has been designated a maintenance area for CO and an attainment area for all other pollutants. In August 2008, the region exceeded the criteria for allowable levels of ozone and was designated as being in non-attainment for ozone. The state will be given three years to work in cooperation with the EPA to create a plan for becoming an attainment area in the future. If that plan is not completed, or not approved by the EPA, the region could be denied federal transportation funding (PSRC, 2008).

Federal Non-Road Sources Emission Limits

Federal regulations enacted in 1994 under EPA’s Non-Road Engine Rule (40 CFR Part 89) set emission standards for diesel engines used on typical construction equipment. The regulation specifies emission limits for NOX, VOC, CO and particulate matter based on the engine horsepower and the year of manufacture for the engine.

The rule (40 CFR Part 89) is also applied to the diesel marine vessels and diesel tugboats with the engines under 37 kilowatts, which would be used on typical in-water construction. The regulation specifies emission limits for NOX, VOC, CO, and particulate matter based on the engine horsepower and the year of manufacture for the engine.

Federal General Conformity Requirements

Development of a facility located in maintenance areas or nonattainment areas receiving federal funding, or requiring federal permitting or approvals, is subject to the federal General Conformity regulations (40 CFR Part 93). The King County/Puget Sound Region is a maintenance area for CO, so these regulations apply to the Project.

A General Conformity determination would be required for a federal action in a maintenance area where the total of the direct and indirect emissions resulting from the action would exceed threshold emission rates. For CO maintenance areas, the threshold emission rate is 100 tons per year. The terms federal action and indirect emissions are narrowly defined under the General Conformity regulations. In some circumstances, the federal permits required for development of a project and its alternatives may not meet the definition of a federal action, and therefore all emissions deriving from construction and operation of a project and its alternatives may not necessarily be considered in determining if a General Conformity analysis is required. The preamble to the General Conformity rule (58 FR 63214) indicates that only the portion of a project's emissions that occur from the specific segment of the project under the direct authority of the federal permitting agency contribute to the conformity determination.

The Project is considered a federal action for air quality purposes because the U.S. Army Corps of Engineers will be required to issue approvals for in-water work related to dredging and dock construction. Therefore, only the portions of the emissions related to in-water construction under the Project are subject to the federal General Conformity regulation.

2.14.5. Regional Emissions

EPA provides air pollutant emission inventory reports for each county to list aggregate annual emissions of criteria air pollutants from different categories (EPA 2007b). Emissions from both point sources (facilities) and area sources (small businesses, residences, wildfires, vehicles, etc.) are included. Table 2.14-3 lists the 2001 regional air pollutant emissions in King County. As listed in the table, mobile source emissions from on- and off-road vehicles are the dominant air pollutant emission source in King County.

2.14.6. Local Ambient Air Pollutant Concentrations

EPA and PSCAA maintain and operate a network of ambient air monitoring stations throughout the country, Puget Sound region, and King County. The purpose of the monitoring stations is to measure ambient concentrations of the pollutants and determine whether the ambient air quality meets the NAAQS.

Table 2.14-3. King County Regional Emissions by Category (Year 2001)

	Area Source and Mobile Source Emissions (Tons per Year)						Point Source Emissions (Tons per Year)					
Category	**CO**	**NOX**	**PM10**	**PM2.5**	**SO_2**	**VOC**	**CO**	**NOX**	**PM10**	**PM2.5**	**SO_2**	**VOC**
Fuel combustion, electric utilities	0	0	0	0	0	0	24.7	121	1.24	1.16	2.2	0.62
Fuel combustion, industrial	302	1,301	90.6	89	63.8	19.2	182	702	7.82	7.81	2.88	20.2
Fuel combustion, other	8,300	3,439	1,292	1,267	803	3,294	126	316	4.68	4.65	5.03	3.47
Chemical/allied product mfg.	0	0	0	0	0	44.7	0	0	0	0	0	31.1
Metals processing	0	0	0	0	0	0	1,915	163	79.8	67	63.8	41.5
Petroleum/ related industries	0	0	0	0	0	148	0	0	0	0	0	0
Other industrial processes	349	0	925	855	0	908	1,903	4,166	306	161	887	503
Solvent utilization	0	0	0	0	0	21,476	0	0	3.59	2.45	0	2,138
Storage and transport	0	0	0	0	0	4,305	0	0	3.1	1.74	0	1.85
Waste disposal and recycling	44.1	22.2	6.79	5.59	25	36.2	9.76	70.2	0	0	45.7	11.4
Highway vehicles	406,052	41,591	1,117	804	1,651	29,130	0	0	0	0	0	0
Off-highway	173,037	21,877	1,508	1,380	2,550	12,186	0	0	0	0	0	0
Miscellaneous	4,862	113	13,376	2,553	26.9	304	0	0	0	0	0	0
Grand total	592,945	68,344	18,316	6,953	5,119	71,850	4,161	5,538	407	246	1,007	2,751

Source: EPA 2007b

Three ambient monitoring stations are located in the project vicinity inside the City of Seattle, which measure ozone, particulate matter, and CO. Ambient concentrations of pollutants over the last 3 years from these monitoring stations are presented in Table 2.14-4. These data indicate that existing air pollutant concentrations in the analysis area have been below the NAAQS standards. This applies even at heavily congested intersections in downtown Seattle (e.g., Fourth Avenue at Pike Street as listed in Table 2.14-4).

Table 2.14-4. Ambient Air Pollutant Concentrations in Seattle, Washington

Pollutant Standards	2004	2005	2006
CO: 417 Pike Street			
Maximum 1-hour concentration (ppm)	3.6	3.6	2.8
Maximum 8-hour concentration (ppm)	2.5	2.7	1.6
No. Days Standard Exceeded			
NAAQS (1-hour) $\geq$ 35 ppm	0	0	0
NAAQS (8-hour) $\geq$ 9.0 ppm	0	0	0
O_3: Beacon Hill Reservoir Station at 4103 Beacon Avenue S.			
Maximum 1-hour concentration (ppm)	0.064	0.056	-
Maximum 8-hour concentration (ppm)	0.058	0.049	-
No. Days Standard Exceeded			
NAAQS (8-hour) > 0.08 ppm	0	0	-
PM10: 4401 E. Marginal Way S.			
Maximum 24-hour concentration ($\mu g/m^3$)	57	76	51
Annual average concentration ($\mu g/m^3$)	25	24	21
No. Days Standard Exceeded			
NAAQS (24-hour) > 150 $\mu g/m^3$	0	0	0
PM2.5: Beacon Hill Reservoir Station at 4103 Beacon Avenue S.			
Maximum 24-hour concentration ($\mu g/m^3$)	33	28	17
Annual average concentration ($\mu g/m^3$)	8.5	8.0	6.0
No. Days Standard Exceeded			
NAAQS (24-hour) > 65 $\mu g/m^3$	0	0	0
NAAQS (annual) > 15 $\mu g/m^3$ exceeded	No	No	No

Source: EPA 2007c

2.14.7. Typical Emissions from Construction Equipment

Construction equipment can have significant air emissions, particularly when numerous pieces of equipment are used in a relatively confined area. Table 2.13-5 shows CO emissions from typical types of construction equipment utilizing diesel fuel. Due to the potentially long construction period for the Seawall Replacement Project, equipment used for in-water construction will need to be evaluated for compliance with the General Conformity Rule. Many of the pieces of equipment shown in Table 2.14-5 will have CO emissions much greater than 100 lbs of CO per year, which is the threshold emissions level for the General Conformity Rule.

Construction method and sequencing alternatives will be evaluated in the Effects of the Alternatives chapter, but measures to reduce or mitigate for construction air emissions could include:

- Develop a construction air emission pollution prevention plan to reduce emissions of CO, particulates, ozone and other pollutants;
- Schedule road detours and closures to minimize congestion;
- Reduce the number of pieces of equipment operating at any one time;
- Use new equipment with greater emission control;
- Use alternative fuel sources (i.e. electrical power for stationary sources);
- Utilize barges to remove materials to reduce truck use;
- Timing construction to occur during seasons with more prevalent winds;

Table 2.14-5. Typical Daily and Yearly CO Emissions from Construction Equipment (Diesel Powered)

Equipment	Duration (months)	Daily Hours of Operation	Size	Size (hp)	Number of Pieces	Usage Factor	Emission Level (lbs/hp-hr CO)	Emission Level (lbs/hr CO)	Total Daily Emissions (lbs CO)	Yearly Emission (lbs CO)
Off-Highway Trucks	9	12	30 cy (100 tons)	1016	3	100%	0.0042	12.80	153.62	41477
T&T Trucks	9	11	220 hp	220	15	80%	0.0042	11.09	97.57	26345
Track Excavator	9	12	75k lb (268 hp)	268	3	75%	0.0094	5.67	51.01	13774
Compressor	9	20.5	1000 cfm (350 hp)	350	1	100%	0.0067	2.35	48.07	12980
Excavator	9	12	100k lb (316 hp)	316	1	100%	0.0094	2.97	35.64	9624
Loader	9	12	300 hp	300	2	100%	0.0033	1.98	23.76	6415
Crawler Crane	9	20.5	150 ton (340 hp)	340	1	100%	0.0026	0.88	18.12	4893
Hydraulic Crane	9	20.5	50 ton (215 hp)	215	1	100%	0.0026	0.56	11.46	3094
Wheel Loader	9	12	200 hp	200	2	75%	0.0033	0.99	8.91	2406
Truck & Trailer	9	20.5	220 hp	220	5	30%	0.0042	1.39	8.52	2301
Crawler Crane	9	12	125 ton (332 hp)	332	2	50%	0.0026	0.86	5.18	1398
Compressor	9	12	250 cfm (50 hp)	50	4	50%	0.0067	0.67	4.02	1085
Loader	9	20.5	200 hp	200	1	50%	0.0033	0.33	3.38	913
Grout Pump	9	20.5	20 hp	20	1	50%	0.02	0.20	2.05	554
Street Sweepers	9	12	100 hp	100	1	50%	0.0042	0.21	1.26	340
Dozer D6R	6	16	175 hp	175	1	30%	0.0041	0.22	1.03	186
Vibration Roller	6	12	145 hp	145	2	30%	0.0032	0.28	1.00	180
Asphalt Roller	6	9	125 hp	125	3	30%	0.0032	0.36	0.97	175
Grader	6	16	165 hp	165	1	30%	0.0038	0.19	0.90	163
Light Plants	9	12	14 hp	14	4	30%	0.0021	0.04	0.13	34

Source: Valle del Sol Energy 2005

2.15. Geology and Soils

2.15.1. Summary

This section provides information on geology and soils in the study area. The section first describes the methodology for the analysis, including a brief review of the literature consulted and then discusses the three principal issues: geology in the study area, the risk of soil liquefaction, and geologic hazards potentially affecting the study area. Because the area is fully urbanized, soils are discussed in a geotechnical rather than a biological context. Similarly, past development has truncated most geologic processes and the geology discussion is primarily focused on seismic phenomena including earthquakes, soil liquefaction, ground motion, landslides, and tsunamis. This section does not discuss groundwater or contaminated sediments. For information on sediment contamination, refer to section 2.5.

2.15.2. Methodology

The study area includes the existing Seawall, adjacent areas that would be disturbed, areas required for material and equipment staging, and immediately adjacent areas. The study area has limited vegetation; it is chiefly covered with pavement above the surface of Elliott Bay and riprap beneath the surface of the Bay, so soils in the area have limited function in a biological or ecological sense. However, they do function as geologic entities that have properties such as mass, cohesion, and susceptibility to the action of water. Thus this section focuses on geologic phenomena, which are categorized for the purposes of description as follows:

- topography and geology,
- seismicity (the frequency and distribution of earthquakes), and
- geologic hazards.

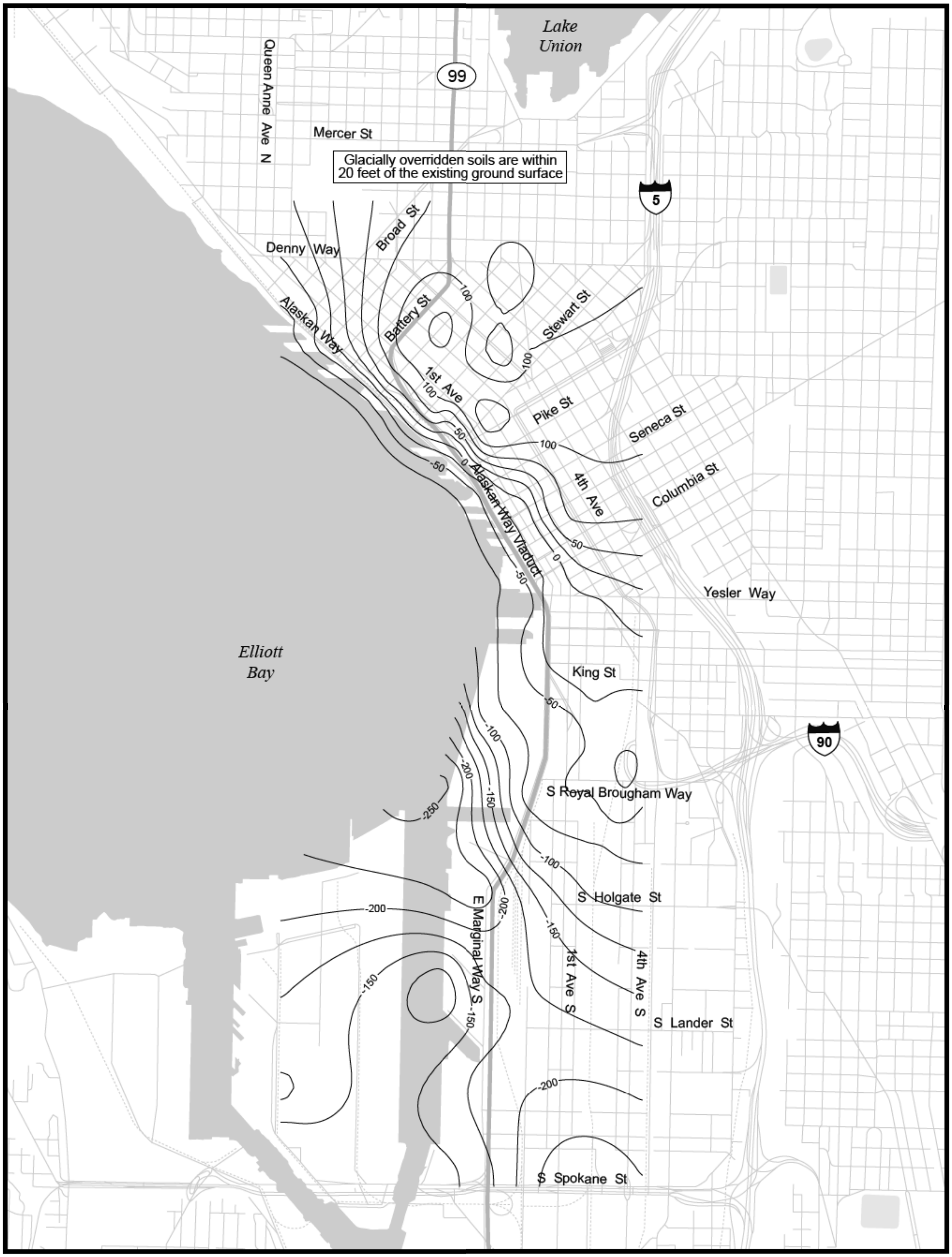
No field studies were performed in support of the analysis presented here. Instead, the analysis in this section is primarily based on review of documents prepared by Shannon & Wilson, Inc. during preparation of the Draft Environmental Impact Statement (DEIS) and Supplemental DEIS (SEIS) for the SR 99 Alaskan Way Viaduct and Seawall Replacement Project (FHWA 2004, 2006). These documents did incorporate fieldwork and collection of site-specific data. Most of this section is based on information presented in *Geology and Soils Technical Memorandum* contained within the DEIS (FHWA 2004), but other information sources are also cited below, as applicable.

2.15.3. Topography and Geology

The study area is in the central Puget Sound Basin, a north–south depression between the Olympic Mountains and the Cascade Range. The area has experienced six or more episodes of continental glaciation in the past 2 million years. The glaciers originated in what are now the Coast Mountains of British Columbia and flowed south to a terminus between modern Olympia and Centralia, Washington. During the peak of the most recent glaciation, about 18,000 years ago, the ice was approximately 3,000 feet thick in the study area. The study area was last deglaciated about 13,500 years ago (FHWA 2004).

The glaciers carried a great deal of material that was frozen to the bed of the ice; frozen within the ice; carried on top of the ice; or carried in streams flowing over, through, and beneath the ice. As a result, both the substrate and the landforms in the study area include material brought by the glaciers. This material includes both massive and stratified deposits with grain sizes from clay to boulders. It also includes deposits formed between previous glaciations and since the last glaciation by processes such as weathering, landslides, alluvial deposition, and volcanic activities. There is no bedrock exposed in the study area. The closest bedrock exposures are at Alki in West Seattle, in the Duwamish Valley near Boeing Field, and in the south Rainier Valley. These sites are all south of the Seattle Fault Zone, which runs east–west beneath southern Harbor Island. In the study area, bedrock is likely more than 1,000 feet below the ground surface (FHWA 2004).

The early postglacial topography of the study area has been determined by mapping the buried surface of glacially overridden soils in the area (Figure 2.15-1). Such soils are distinctive because they were compressed beneath 3,000 feet of glacial ice. Topography in the area was dominated by hills on the east sloping down and into Elliott Bay, with a maximum local relief of about 400 feet. A bluff rose above the bay between Pike and Battery streets, while slopes were gentle south of Columbia Street. Beneath Elliott Bay, slopes were fairly uniform but steepest in the area between Royal Brougham Way and the north end of Harbor Island. This topography was later modified somewhat by shoreline erosion, localized landslides, and alluvial and lahar deposition. Sea level has been approximately at its current elevation for the past 5,000 years, and during that time Elliott Bay developed a well-defined shoreline.



Sources: SR99 AWVSRP DEIS (2004, 2006); Jones & Stokes (2006)

0 2,500
SCALE IN FEET

N

-150 Contours Represent Elevation

Note: Elevation Datum is NAVD88

Figure 2.15-1
Elevation of Top of Glacially Overridden Soil

The greatest postglacial changes in topography, however, have been caused by human activities that began in the latter 19th century and have continued almost to the present. Within the study area, the most significant such activity was the placement of fill along the waterfront (FHWA 2004).

Most of the study area, extending from the Seawall to east of the Alaskan Way surface street, is located on fill placed along the waterfront during historical time. The fill is 10 to 40 feet thick. Much of this is non-engineered fill that includes materials such as timbers, sawdust, piles, and coal slag, and earth material. Within this matrix of fill are some remnant deposits of estuarine soils, chiefly from S. Washington Street to Union Street; and beach soils, chiefly from Union Street north. The estuarine soils consist of silty clays and fine sands, while the beach soils range from silty sand to fine gravel, with variable amounts of shells and organic material (FHWA 2004).

Some fill was also placed west of the Seawall. Most of this was placed in association with the Denny Regrade, which used hydraulic excavation to level Denny Hill, discharging most of the sediment into Elliott Bay. In the study area, this created a large volume of unconsolidated fill in Elliott Bay between Broad and Lenora streets (FHWA 2004).

2.15.4. Seismicity

The study area is located within a seismically active region. Many small to moderate and occasional strong earthquakes have occurred in recorded history, while geologic investigations have revealed evidence of very strong prehistoric earthquakes. All recorded major earthquakes have been associated with movement along two tectonic plates: the North America plate along the margin of the Pacific Ocean, and the other by the oceanic Juan de Fuca plate, which is being subducted beneath the North America plate at an average rate of about 0.35 inch per year. This activity is occurring within the Cascadia Subduction Zone, which includes most of western Washington, Oregon, and the adjacent Pacific Ocean. The forces generated during the subduction process stress rock layers in the subducted plate and in the overlying rocks. When those rock layers break or shift suddenly, an earthquake occurs. Most historic earthquakes have originated within the North America plate, at depths of 12 miles or less, but the largest historic earthquakes originated within the subducted Juan de Fuca plate at depths of 32 miles or more. These large earthquakes included a magnitude 7.1 earthquake on April 13, 1949; the magnitude 6.5 Seattle-Tacoma earthquake on April 29, 1965; and the magnitude 6.8 Nisqually earthquake on February 28, 2001 (FHWA 2004).

Although none of the historic earthquakes have been associated with observable movements along surface faults, geologic evidence indicates that such earthquakes have occurred in prehistoric time. The closest such faults to the study area are two splays (surface faults that connect to a single master fault at depth) of the Seattle Fault, shown in Figure 2.15-2. No large historical earthquakes have occurred along the Seattle Fault, but a relatively large earthquake (estimated magnitude 7) occurred on the Seattle Fault approximately 1,100 years ago, and it is assumed to remain an active fault (FHWA 2004).

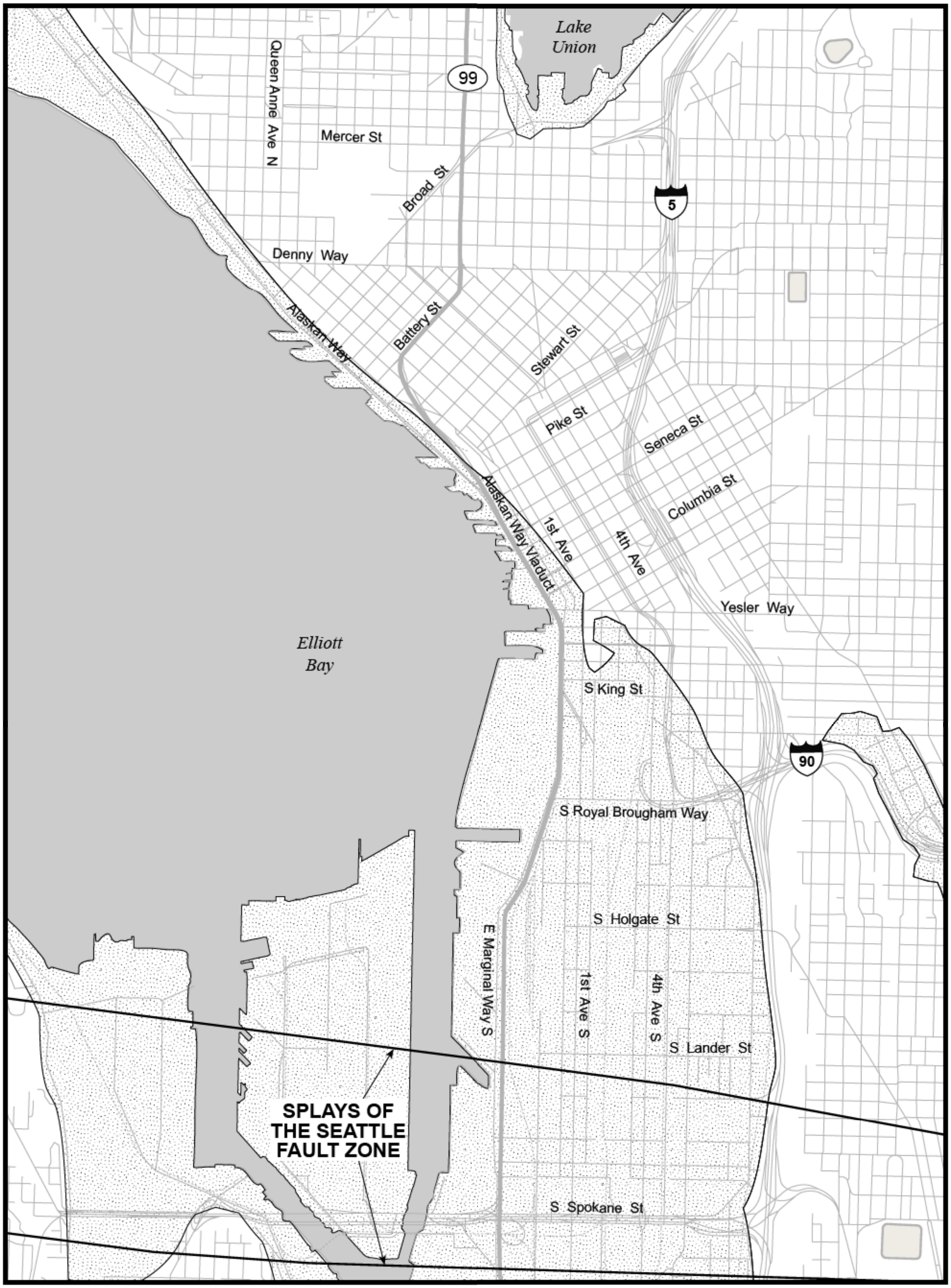
The largest earthquakes thought to have affected the Pacific Northwest within the last few thousand years have been studied through their effects on coastal estuaries and submarine landforms off the coasts of Washington, Oregon and Northern California. These earthquakes originated directly from plate movement in the contact zone between the North America plate and the subducted Juan de Fuca plate. These earthquakes have occurred repeatedly, at intervals of 400 to 1,000 years, and have had magnitudes of 8 to 9 (FHWA 2004).

2.15.5. Geologic Hazards

Geologically hazardous areas are areas that, because of their susceptibility to erosion, landslides, earthquakes or other geologic events, are not suited for development consistent with public health and safety concerns. The City of Seattle has developed maps identifying geologically hazardous areas (City of Seattle 2002), and those areas are discussed below as applicable. Five principal geologic hazards exist in the study area, of which three are primarily and all partially related to earthquakes. These hazards include: landslides, erosion, liquefaction, ground movement, and seiches and tsunamis.

Landslides

The City of Seattle has identified landslide hazard areas as areas with slopes steeper than 40%. In the study area, such slopes exist only along the Burlington Northern Santa Fe (BNSF) railroad tracks between Virginia Street and Bell Street. These slopes have in the past experienced surficial slides 1 to 3 feet deep and 10 to 30 feet wide. No deep-seated landslides are known in the study area. Landslides could occur in the study area in association with an earthquake. In an earthquake, the fill material in Elliott Bay between Broad and Lenora Streets could become unstable and subject to sliding (FHWA 2004).



Sources: SR99 AWVSRP DEIS (2004, 2006); Jones & Stokes (2006)
References: Seattle Fault Splays, Johnson (1999),
Liquefaction areas, City of Seattle (2002).

Figure 2.15-2
Mapped Liquefaction Areas and Seattle Fault Zone

Erosion

The project area is fully developed in urban land uses and therefore is not classified as an erosion hazard area. The steep slopes along the BNSF tracks mentioned above have experienced rill erosion in the past. Piping and subsurface erosion is allowing material to pass through gaps in the existing Seawall, allowing subsidence behind the Seawall. Erosion via wave action through corroded gaps in the steel sheet pile of the Seawall is also occurring (PBPower/BJT Associates 2003). Additionally, wave action along the front of the Seawall is sometimes severe enough to displace existing riprap and other fill materials, requiring periodic replenishment of the riprap protection.

Liquefaction

Soil liquefaction occurs in poorly consolidated, saturated soils when water pressure in the pore spaces is high enough to separate soil grains from each other. This causes the soil to lose shear strength and to behave like a viscous liquid. The loss of soil strength depends on the degree and extent of liquefaction. The degree of liquefaction depends primarily on soil properties and the magnitude and duration of the seismic event.

Liquefaction can result in ground settlement, lateral spreading, landslides, localized disruption due to sand boils (where liquefied soil is ejected at the surface), and reduced support for structural foundations. Structures on liquefied soils may settle, tilt, move laterally, or collapse.

Liquefaction hazard in the study area has been mapped by the City of Seattle and is shown in Figure 2.15-2. The mapped liquefaction risk has been further validated for many locations by collecting soil borings for this project and testing those soils for liquefaction vulnerability (FHWA 2004). An analysis of soil liquefaction risk for design seismic events found that almost any significant earthquake could result in sufficient liquefaction to result in the failure of portions of the existing 1916 seawall, and perhaps in failure of weakened portions of the 1934 seawall. A severe earthquake, stronger than any the region has experienced in historic time, could result in failure of any portion of the existing Seawall and could cause sliding in hillslope sediments adjacent to the filled margin of Elliott Bay (PBPower/BJT Associates 2003).

Ground Movement

Earthquake energy is primarily transmitted via bedrock, but there is no bedrock in the study area. Earthquake energy in the study area would be transmitted through the glacial sediments and fill material that underlie the study area. Soft or loose soils can cause ground motion to be either amplified or reduced in comparison to the movement in the underlying bedrock.

Soil conditions in the study area range from deep, loose, liquefiable estuarine and fill soils in the south to deep, glacially overridden silty to gravelly sediments in the north. The risk of significant ground motion amplification is substantial for the liquefiable soils, but is much less for the well-consolidated, glacially overridden sediments (FHWA 2004).

Seiches and Tsunamis

Seiches and tsunamis are large, destructive water waves. Seiches are waves that occur in relatively enclosed water bodies (such as lakes or Elliott Bay/Puget Sound) and can occur in response to any action that quickly displaces a large volume of water, such as earthquake ground motion or a large landslide. Tsunamis are earthquake-generated waves that have very low amplitude and a very long wavelength in the open ocean, but which develop a much greater amplitude and shorter wavelength in coastal waters. The extent and severity of seiches and tsunamis depend on earthquake ground motion, fault offset, and location. One study modeled the likely effects of a magnitude 7.3 to 7.6 earthquake on the Seattle Fault and determined that it would result in inundation of most of the study area with 1 to 6 feet of water (Gonzalez 2003). Koshimura and Mofjeld (2005) present more recent quantitative modeling of tsunami potential associated with a Seattle Fault earthquake, generally supporting Gonzalez’s conclusions and stating that such an event could inundate the waterfront to a depth of 3 to 6.5 feet. It is also likely that a tsunami generated by a large earthquake in the Pacific Ocean could have a measurable impact on the Seattle waterfront, but quantitative data on the likely impacts are not available.

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Appendix A

Potentially Toxic or Hazardous Substances Detected in Elliott Bay Sediments

Potentially toxic or hazardous substances detected in Elliott Bay sediments

Acenaphthene	Fluoranthene
Acenaphthylene	2,4- Fluoranthene
Anthracene	Fluorene
Arsenic	Hexachlorobenzene
Benz(a)anthracene	Hexachlorobutadiene
Benzo(a)pyrene	Ideno(1,2,3-c,d)pyrene
Benzo(b,k)fluoranthenes	Lead
Benzo(ghi)perylene	Mercury
Benzoic acid	2-Methylnaphthalene
Benzyl alcohol	4-Methylphenol
Bis(2-ethylhexyl) phthalate	Napthalene
Butylbenzyl phthalate	N-Nitrosodiphenylamine
Cadmium	Pentachlorophenol
Chromium	Phenanthrene
Chrysene	High molecular weight polynuclear aromatic hydrocarbon compounds (HPAHs)
Copper	Phenol
Dibenzo(a,h)anthracene	Low molecular weight polynuclear aromatic hydrocarbon compounds (LPAHs)
Dibenzofuran	Pyrene
1,4-Dichlorobenzene	Silver
Diethyl phthalate	Total PCBs
Dimethylphenol	1,2,4-Trichlorobenzene
2,4-Dimethylphenol	Zinc
Di-n-octyl phthalate	

Source: Ecology 2004

Table 2.5-3. Preliminary Sediment Data Table Summarizing Concentrations Exceeding Various Established Limits (Concentrations Less Than Screening Levels Not Included) (Parametrix 2007)

Sample Number	Analyte	SQS	SIZM SCSL	DMMP SL	DMMP ML	Units	Sample Result	Lab Qualifier	Reporting Limit (PQL)
AWV10-112206	1,2,4-Trichlorobenzene	0.8	1.8			mg/kg oc	1.9	U	1.9
AWV10-112206	4-Methylphenol	29.0	29.0			ug/kg dw	100.0	U	100.0
AWV10-112206	Benzoic Acid	650.0	650.0			ug/kg dw	1000.0	U	1000.0
AWV10-112206	Benzyl Alcohol	57.0	73.0			ug/kg dw	100.0	U	100.0
AWV10-112206	Mercury	0.4	0.6	0.4	2.3	mg/kg dw	2.4		0.1
AWV10-112206	Pentachlorophenol	63.0	63.0			ug/kg dw	500.0	U	500.0
AWV10-112206	Silver	6.1	6.1	6.1	8.4	mg/kg dw	8.3		0.9
AWV10-112206	Total PCBs	12.0	65.0			mg/kg oc	29.0		
AWV10-112206	Zinc	410.0	960.0	410.0	3800.0	mg/kg dw	503.0		2.0
AWV11-112006	1,2,4-Trichlorobenzene	0.8	1.8			mg/kg oc	0.9	U	0.9
AWV11-112006	2,4-Dimethylphenol	29.0	29.0			ug/kg dw	60.0	U	60.0
AWV11-112006	Benzyl Alcohol	57.0	73.0			ug/kg dw	60.0	U	60.0
AWV11-112006	Cadmium	5.1	6.7	5.1	14.0	mg/kg dw	5.3		0.6
AWV11-112006	Mercury	0.4	0.6	0.4	2.3	mg/kg dw	2.0		0.1
AWV11-112006	Silver	6.1	6.1	6.1	8.4	mg/kg dw	8.2		0.8
AWV11-112006	Total PCBs	12.0	65.0			mg/kg oc	31.0		
AWV11-112006	Zinc	410.0	960.0	410.0	3800.0	mg/kg dw	532.0		2.0
AWV1-112006	1,2,4-Trichlorobenzene	0.8	1.8			mg/kg oc	0.9	U	0.9
AWV1-112006	2,4-Dimethylphenol	29.0	29.0			ug/kg dw	47.0	J	60.0
AWV1-112006	Anthracene	23.0	79.0			mg/kg oc	54.0		0.9
AWV1-112006	Benzyl Alcohol	57.0	73.0			ug/kg dw	60.0	U	60.0

Table 2.5-3. Preliminary Sediment Data Table Summarizing Concentrations Exceeding Various Established Limits (Concentrations Less Than Screening Levels Not Included) (Parametrix 2007)

			SIZM	DMMP			Sample	Lab	Reporting Limit
Sample Number	Analyte	SQS	SCSL	SL	ML	Units	Result	Qualifier	(PQL)
AWV1-112006	Dibenz(a,h)anthracene	12.0	33.0			mg/kg oc	15.0		0.9
AWV1-112006	Mercury	0.4	0.6	0.4	2.3	mg/kg dw	0.9		0.1
AWV1-112006	Total Benzofluoranthenes	230.0	450.0			mg/kg oc	275.0		
AWV1-112006	Total HPAHs	960.0	5300.0			mg/kg oc	1037.0		0.9
AWV1-112006	Total PCBs	12.0	65.0			mg/kg oc	18.0		
AWV1-112006	Zinc	410.0	960.0	410.0	3800.0	mg/kg dw	499.0		2.0
AWV1-112006DL	Benzo(a)pyrene	99.0	210.0			mg/kg oc	136.0		6.0
AWV1-112006DL	Chrysene	110.0	460.0			mg/kg oc	166.0		6.0
AWV12-112006	1,2,4-Trichlorobenzene	0.8	1.8			mg/kg oc	1.1	U	1.1
AWV12-112006	2,4-Dimethylphenol	29.0	29.0			ug/kg dw	59.0	U	59.0
AWV12-112006	Benzyl Alcohol	57.0	73.0			ug/kg dw	59.0	U	59.0
AWV12-112006	Mercury	0.4	0.6	0.4	2.3	mg/kg dw	1.1		0.1
AWV12-112006	Total DDT	12.0	65.0			mg/kg oc	25.0		
AWV13-112006	1,2,4-Trichlorobenzene	0.8	1.8			mg/kg oc	0.9	U	0.9
AWV13-112006	2,4-Dimethylphenol	29.0	29.0			ug/kg dw	60.0	U	60.0
AWV13-112006	Benzyl Alcohol	0.4	57.0	73.0		ug/kg dw	60.0	U	60.0
AWV13-112006	Mercury	0.4	0.6	0.4	2.3	mg/kg dw	1.1		0.1
AWV14-112006FDp	1,2,4-Trichlorobenzene	29.0	1.8			mg/kg oc	0.9	U	0.9
AWV14-112006FDp	2,4-Dimethylphenol	57.0	29.0			ug/kg dw	31.0	J	59.0
AWV14-112006FDp	Benzo(g,h,i)perylene	960.0	78.0			mg/kg oc	39.0		0.9
AWV14-112006FDp	Benzyl Alcohol	12.0	73.0			ug/kg dw	59.0	U	59.0
AWV14-112006FDp	Dibenz(a,h)anthracene	31.0	33.0			mg/kg oc	21.0		0.9

Table 2.5-3. Preliminary Sediment Data Table Summarizing Concentrations Exceeding Various Established Limits (Concentrations Less Than Screening Levels Not Included) (Parametrix 2007)

			SIZM	DMMP			Sample	Lab	Reporting Limit
Sample Number	Analyte	SQS	SCSL	SL	ML	Units	Result	Qualifier	(PQL)
AWV14-112006FDp	Indeno(1,2,3-cd)pyrene	12.0	88.0			mg/kg oc	41.0		0.9
AWV14-112006FDp	Mercury	160.0	0.6	0.4	2.3	mg/kg dw	1.8		0.1
AWV14-112006FDp	Total Benzofluoranthenes	99.0	450.0			mg/kg oc	282.0		
AWV14-112006FDp	Total HPAHs	0.8	5300.0			mg/kg oc	1151.0		
AWV14-112006FDp	Total PCBs	12.0	65.0			mg/kg oc	30.0		
AWV14-112006FDpD	Benzo(a)pyrene	34.0	210.0			mg/kg oc	150.0		6.1
AWV14-112006FDpD	Chrysene	230.0	460.0			mg/kg oc	139.0		6.1
AWV14-112006FDpD	Fluoranthene	110.0	1200.0			mg/kg oc	212.0		6.1
AWV2-112006	1,2,4-Trichlorobenzene	0.8	1.8			mg/kg oc	2.1	U	2.1
AWV2-112006	2,4-Dimethylphenol	63.0	63.0			ug/kg dw	72.0	U	72.0
AWV2-112006	4-Methylphenol	29.0	29.0			ug/kg dw	88.0		72.0
AWV2-112006	Benzoic Acid	360.0	690.0			ug/kg dw	720.0	U	720.0
AWV2-112006	Benzyl Alcohol	57.0	73.0			ug/kg dw	72.0	U	72.0
AWV2-112006	Mercury	0.4	0.6	0.4	2.3	mg/kg dw	1.2		0.1
AWV2-112006	Phenanthrene	100.0	480.0			mg/kg oc	103.0		2.1
AWV3-112206	1,2,4-Trichlorobenzene	0.8	1.8			mg/kg oc	1.8	U	1.8
AWV3-112206	2,4-Dimethylphenol	29.0	29.0			ug/kg dw	59.0	U	59.0
AWV3-112206	Benzo(a)anthracene	110.0	270.0			mg/kg oc	128.0		1.8
AWV3-112206	Benzyl Alcohol	57.0	73.0			ug/kg dw	59.0	U	59.0
AWV3-112206	Dibenz(a,h)anthracene	12.0	33.0			mg/kg oc	20.0		1.8
AWV3-112206	Indeno(1,2,3-cd)pyrene	34.0	88.0			mg/kg oc	37.0		1.8
AWV3-112206	Phenanthrene	100.0	480.0			mg/kg oc	107.0		1.8

Table 2.5-3. Preliminary Sediment Data Table Summarizing Concentrations Exceeding Various Established Limits (Concentrations Less Than Screening Levels Not Included) (Parametrix 2007)

Sample Number	Analyte	SQS	SIZM SCSL	DMMP SL	DMMP ML	Units	Sample Result	Lab Qualifier	Reporting Limit (PQL)
AWV3-112206	Total Benzofluoranthenes	230.0	450.0			mg/kg oc	302.0		
AWV3-112206	Total HPAHs	960.0	5300.0			mg/kg oc	1340.0		
AWV3-112206	Total PCBs	12.0	65.0			mg/kg oc	13.8		
AWV3-112206DL	Benzo(a)pyrene	99.0	210.0			mg/kg oc	149.0		6.1
AWV3-112206DL	Chrysene	110.0	460.0			mg/kg oc	220.0		6.1
AWV3-112206DL	Fluoranthene	160.0	1200.0			mg/kg oc	265.0		6.1
AWV5-112206	1,2,4-Trichlorobenzene	0.8	1.8			mg/kg oc	0.9	U	14.0
AWV5-112206	Pentachlorophenol	63.0	63.0			ug/kg dw	98.0	U	1568.0
AWV6-112206	4-Methylphenol	29.0	29.0			ug/kg dw	180.0		20.0
AWV6-112206	Pentachlorophenol	63.0	63.0			ug/kg dw	99.0	U	99.0
AWV7-112206	1,2,4-Trichlorobenzene	0.8	1.8			mg/kg oc	1.9	U	1.9
AWV7-112206	4-Methylphenol	29.0	29.0			ug/kg dw	60.0	U	60.0
AWV7-112206	Benzyl Alcohol	57.0	73.0			ug/kg dw	60.0	U	60.0
AWV7-112206	Pentachlorophenol	63.0	63.0			ug/kg dw	300.0	U	300.0
AWV8-112006	1,2,4-Trichlorobenzene	0.8	1.8			mg/kg oc	1.1	U	1.1
AWV8-112006	2,4-Dimethylphenol	29.0	29.0			ug/kg dw	59.0	U	59.0
AWV8-112006	Benzo(g,h,i)perylene	31.0	78.0			mg/kg oc	49.0		1.1
AWV8-112006	Benzyl Alcohol	57.0	73.0			ug/kg dw	59.0	U	59.0
AWV8-112006	Dibenz(a,h)anthracene	12.0	33.0			mg/kg oc	25.0		1.1
AWV8-112006	Dibenzofuran	15.0	58.0			mg/kg oc	17.0		1.1
AWV8-112006	Indeno(1,2,3-cd)pyrene	34.0	88.0			mg/kg oc	55.0		1.1
AWV8-112006	Mercury	0.4	0.6	0.4	2.3	mg/kg dw	1.1		0.1

Table 2.5-3. Preliminary Sediment Data Table Summarizing Concentrations Exceeding Various Established Limits (Concentrations Less Than Screening Levels Not Included) (Parametrix 2007)

			SIZM	DMMP			Sample	Lab	Reporting Limit
Sample Number	Analyte	SQS	SCSL	SL	ML	Units	Result	Qualifier	(PQL)
AWV8-112006	Total Benzofluoranthenes	230.0	450.0			mg/kg oc	391.0		
AWV8-112006	Total HPAHs	960.0	5300.0			mg/kg oc	1677.0		
AWV8-112006	Total PCBs	12.0	65.0			mg/kg oc	64.0		0.3
AWV8-112006DL	Benzo(a)anthracene	110.0	270.0			mg/kg oc	116.0		7.6
AWV8-112006DL	Benzo(a)pyrene	99.0	210.0			mg/kg oc	186.0		7.6
AWV8-112006DL	Chrysene	110.0	460.0			mg/kg oc	209.0		7.6
AWV8-112006DL	Fluoranthene	160.0	1200.0			mg/kg oc	361.0		7.6
AWV8-112006DL	Phenanthrene	100.0	480.0			mg/kg oc	228.0		7.6
AWV9-112006	Benzyl Alcohol	57.0	73.0			ug/kg dw	60.0	U	60.0
AWV9-112006	Dibenz(a,h)anthracene	12.0	33.0			mg/kg oc	14.0		0.7
AWV9-112006	Fluorene	23.0	79.0			mg/kg oc	29.0		0.7
AWV9-112006	Mercury	0.4	0.6	0.4	2.3	mg/kg dw	1.5		0.1
AWV9-112006	Total PCBs	12.0	65.0			mg/kg oc	21.0		
AWV9-112006DL	Benzo(a)pyrene	99.0	210.0			mg/kg oc	105.0		4.6
AWV9-112006DL	Phenanthrene	100.0	480.0			mg/kg oc	160.0		4.6

Exceeds the SQS and the SL and the SL
Exceeds Both SMS Criteria and the SL
Exceeds both SMS Criteria and both DMMP Criteria
Exceeds SQS but lab reports Non-Detect
Exceeds both but lab reports Non-Detect

Source: WSDOT 2007

Appendix B

Waterfowl, Marine Birds, and Algae

Waterfowl and other Marine Birds Documented or Potentially Occurring in the Project Area

Common Name	Scientific Name	Documented by Nysewander et al. 2005
common loon	*Gavia immer*	✓
yellow-billed loon	*Gavia adamsii*	
Pacific loon	*Gavia pacifica*	
red-throated loon	*Gavia stellata*	✓
western grebe	*Aechmophorus occidentalis*	✓
red-necked grebe	*Podiceps grisegena*	✓
horned grebe	*Podiceps auritus*	✓
eared grebe	*Podicepts nigricollis*	
double-crested cormorant	*Phalacrocorax auritus*	✓
Brandt's cormorant	*Phalacrocorax penicillatus*	
pelagic cormorant	*Phalacrocorax pelagicus*	
greater scaup	*Aythya marila*	
lesser scaup	*Aythya affinis*	
black scoter	*Melanitta nigra*	✓
surf scoter	*Melanitta perspicillata*	✓
white-winged scoter	*Melanitta fusca*	✓
common goldeneye	*Bucephala clangula*	✓
Barrow's goldeneye	*Bucephala islandica*	✓
bufflehead	*Bucephala albeola*	✓
American coot	*Fulica americana*	
hooded merganser	*Lophodytes cucullatus*	✓
red-breasted merganser	*Mergus serrator*	✓
common merganser	*Mergus merganser*	✓
pigeon guillemot	*Cepphus columba*	
rhinoceros auklet	*Cerorhinca monocerata*	✓
common murre	*Uria aalge*	
belted kingfisher	*Ceryle alcyon*	
great blue heron	*Ardea hrodias*	
herring gull	*Larus argentatus*	✓
California gull	*Larus californicus*	✓
western gull	*Larus occidentalis*	✓
Bonaparte's gull	*Larus philadelphia*	✓
ring-billed gull	*Larus delawarensis*	✓
mew gull	*Larus canus*	✓
Heermann's gull	*Larus heermanni*	✓
Thayer's gull	*Larus thayeri*	✓

Source: Parametrix 2004 in City of Seattle 2006 and Nysewander et al. 2005

Marine Algae Documented in the Study Area

Common Name	Scientific Name
Green Algae	
Green tuft	*Cladophora columbiana*
Sea hair	*Enteromorpha* spp.
Sea cellophane	*Monostroma grevillei*
Sea lettuce	*Ulva* spp.
Brown Algae	
Fringed sieve kelp	*Agarum fimbriatum*
Ribbon kelp (wing kelp)	*Alaria marginata*
Seersucker	*Costaria costata*
Desmarestia	*Desmarestia ligulata*
Feather boa	*Egregia menziesii*
Rockweed	*Fucus gardneri*
Sea cabbage	*Hedophyllum sessile*
Sugar kelp	*Laminaria saccharina*
Leathesia	*Leathesia difformis*
Bull kelp	*Nereocystis luetkeana*
Wireweed	*Sargassum muticum*
Soda straws	*Scytosiphon lomentaria*
Red Algae	
Violet sea fan	*Callophyllis violacea*
Turkish towel	*Chondracantbus exasperatus*
Winged rib	*Delesseria decipiens*
Sea moss	*Endocladia muricata*
Sea spaghetti	*Gracilaria sjoesttedtii* or *G. pacifica*
Veined fan	*Hymenena flabelligera*
Rock crust	*Lithothamnion* spp.
Turkish washcloth	*Mastocarpus papillatus*
Splendid iridescent seaweed	*Mazzaella splendens*
Red ribbon (dulse)	*Palmaria mollis (palmata)*
Criscross network	*Polyneura latissima*
Bull-kelp laver	*Porphyra nereocystis*
Purple laver	*Porphyra perforata*

Source: City of Seattle 2006.

Appendix C

Summary of Nearshore Habitat Surveys November 2007 and February 2008

Tetra Tech, Inc.

Tetra Tech, Inc. biologists, Merri Martz and Jeff Barna, were tasked to visually observe the nearshore habitats along the Seawall study area from Pier 48 up to Myrtle Edwards Park in the winter of 2007-2008. Two trips were made to observe shoreline, substrate, wildlife, and plant species on 5 November, 2007 and 14 February, 2008. These dates provided the lowest daytime winter tides within the project schedule. The first trip in November was made by kayak to most effectively observe conditions in the subtidal and intertidal zones, as well as under the piers. Areas observed extended from Pier 48 to Pier 70. The second trip in February was made on foot by walking the length of the Seawall from Pier 48 to 70 and then also by walking up into Myrtle Edwards Park to Pier 82.

Observations from both trips are combined below by location.

Pier 48:

Pier 48 is composed of concrete in some locations and steel sheet pile in other locations and is generally in poor condition. Extensive undermining is present at the base of the pier and the surface facing the bay is weathered, cracked, and eroded. The extensive riprap toe that spans the majority of the Seawalls length begins north of Pier 48 the historic trolley station. In this area, the shallow subtidal substrate is composed of quarry spalls (<6 inch) and sand, slopes into the bay at a rate of around 2:1 (horizontal distance in feet to vertical distance in feet). In areas near Pier 48 that are free of riprap, the subtidal substrate is primarily sand with very gentle slopes (5:1 or flatter). A small sandy beach around 200 square feet in size is present just north of the historic trolley station. It appears that the small sandy beach was larger in November than in February, perhaps due to storm and wave action during the winter months that erode finer substrates from the intertidal zone. If that is the case, then the beach area would likely be largest in early fall (October) prior to the onset of fall rains. At street level in the vicinity of the trolley station, sections of the walking surface are cracked, buckled, and sinking into the Seawall.

Photo 1. Face of Pier 48

Photo 2. Sheetpile along Northern Side of Pier 48.

Photo 3. Intertidal Substrate Immediately North of Pier 48.

Photo 4. Small Intertidal Beach Area North of Pier 48.

Throughout the southern half of the seawall from Pier 48 to near Pier 55, rockweed (*Fucus distichus*) dominates the upper half of the littoral zone (20-40% cover) with sea lettuce (*Ulva lactuca*) being lightly interspersed within creating a patchy distribution for both species. In the lower half of the littoral zone, the pattern reverses with sea lettuce (20-40% cover) dominating down to a depth of 10 feet below water level (estimated at ~-10 feet m.s.l.) where visibility is difficult. Coralline algae (*Corallina* sp.) and winged Kelp (*Alaria* sp.) are also present throughout the lower half of the littoral zone though there density is low and distribution is very patchy. Terrestrial plants were also seen on the Seawall and on its associated piers throughout this area, though they were only present in areas where the wall or piers had crumbled and plants could become established. Butterfly bush (*Buddleja* sp.), Himalayan blackberry (*Rubus discolor*), and moss (phylum Bryophyta) grow out of the top of the Seawall while licorice ferns (*Polypodium glycyrrhiza*), sword ferns (*Polystichum munitum*), and trailing blackberry (*Rubus ursinus*) are present in areas on the piers.

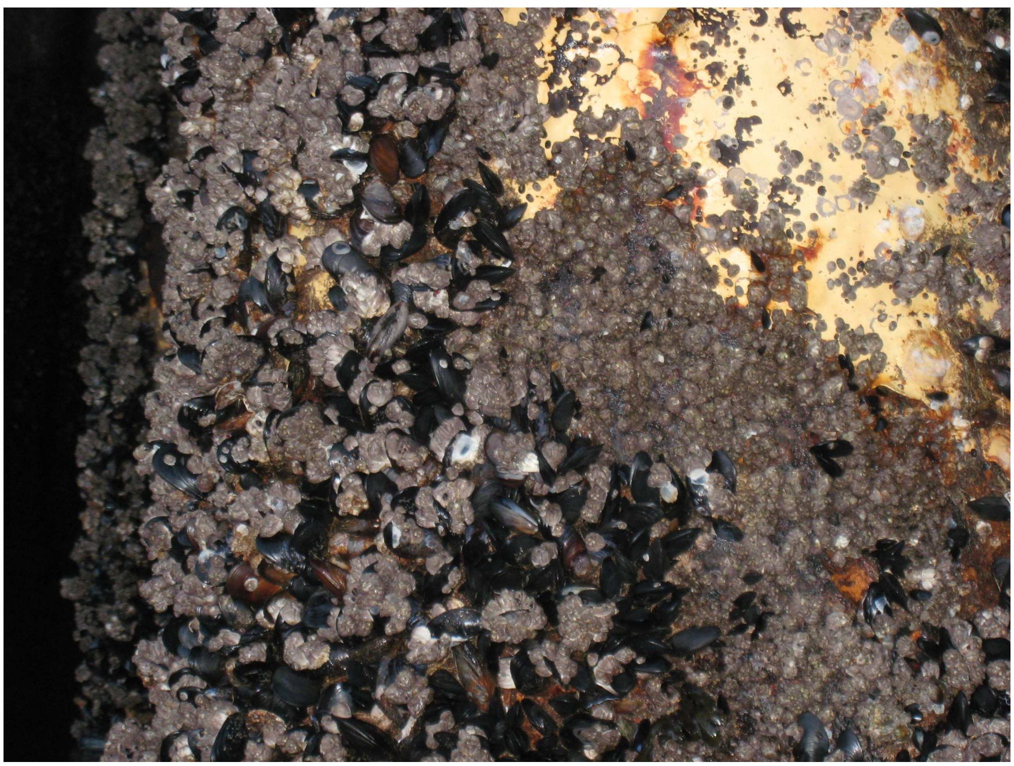

Photo 5. Typical Community on Wooden Pilings.

Giant acorn barnacles (*Balanus nubilis*) blanket the entire littoral zone throughout this area with blue mussels (*Mytilus edulis*) also being very common though they are in much lower densities. An unidentified sponge species is also present at very low densities throughout the shallow subtidal zone.

Herring gull (*Larus argentatus*) and California gull (*Larus californicus*) are ubiquitous throughout the entire waterfront with ring-billed gull (*Larus delawarensisand*), American crow (*Corvus brachyrhynchos*), and Brewer's blackbird (*Euphagus cyanocephalus*) being present but at lower densities. Introduced species are the most prevalent birds in the area with house sparrows (*Passer domesticus*), European starlings (*Sturnus vulgaris*), and rock pigeons (*Columba livia*) being ubiquitous. Great blue heron (*Ardea herodias*) and herring gull can be seen foraging near the waterline around the riprap and sandy beach area. Examples of other common species that can be found in the study area most of the year are double-crested cormorant (*Phalacrocorax auritus*), pigeon guillemot (*Cepphus columba*), common goldeneye (*Bucephala clangula*), surf scoter (*Melanitta perspicillata*), common merganser (*Mergus merganser*), and western grebe (*Aechmophorus occidentalis*). All of these species are more common north of Piers 62/63 though they are occasionally seen around the southern half of the Seawall.

Pier 50:

Near Pier 50, the condition of the Seawall appears to improve. In this area, the wall is protected by the addition of steel reinforcement and intermittent riprap reaching from the high-tide mark to well below the low tide mark. The substrate slopes steeply at a rate of 2:1 or steeper with quarry spalls and sand providing the substrate in the deeper water. Throughout the southern half of the Seawall, the water clarity is poor with visibility of only 10 feet. Floating trash is ubiquitous throughout this area and odors are present at most piers (sewage, etc.).

Pier 52:

Near Pier 52, the Seawall layout changes to concrete on pilings/timber crib walls with extensive riprap covering the entire littoral zone at its base down to approximately -5 feet m.s.l. Below the low tide mark, the riprap gives way to sand and gravel as the substrate. The rock substrate is steeply sloped (2:1 or steeper). In general, the concrete on pilings Seawall layout continues northward along the remainder of the waterfront up to the northern side of Pier 70 below the Olympic Sculpture Park.

Photo 6. Seawall North of Colman Dock.

Pier 55:

The general pattern of species distribution changes around Pier 55 with sea lettuce becoming the dominant plant in the upper half of the littoral zone (20-40% cover) and rockweed being dominant in the lower half of the littoral zone (20-40% cover). In addition, the size and vigor of all plant species appears to improve substantially as you move north with the greatest diversity and density north of Pier 70, below the Olympic Sculpture Park.

As you move north past Pier 55, the diversity of marine invertebrates also changes with the presence of new species such as ochre starfish (*Piaster ochraceus*), sea snail (*Littorina* sp.), mask limpets (*Notoacmaea persona*), and giant green anemones (*Anthoplura xanthogrammica*) starting to appear in low densities.

Pier 56:

Mats of bull kelp (*Nereocystis lurtkeana*) are present north of Pier 56 during some parts of the year. Bull kelp was still present during the November survey but had largely disappeared by the February survey. The presence of bull kelp seems to be strongly associated with rocky bottoms for attachment at the correct elevation (-3-15 feet m.s.l.), water depths of around 7 to 15 feet, and areas between piers that are not heavily used by boat traffic.

A dead, decapitated harbor seal was observed floating adjacent to Pier 56 during the November survey.

Pier 57:

The substrate around Pier 57 just south of the aquarium slopes off at a rate of around 3:1 and is composed of coarse gravel, rock, and sand.

Photo 7. Pier 57.

Pier 59:

At the Aquarium, the subtidal substrate is primarily sand with a very flat slope, but adjacent to the Seawall is riprap and smaller angular rock. Substrate baskets have been installed in the intertidal zone (on the Seawall) to identify what type of invertebrates and plants will utilize various substrates. Off of Pier 59, hairy crabs (*Telmessus cheiragonus*), coonstripe shrimp (*Pandalus hypsinotus*), and Pacific octopus (*Enteroctopus dofleini*) are present.

Photo 8. Seawall and Intertidal Substrate at Aquarium; Also Substrate Baskets.

Photo 9. Northside of Aquarium Towards Pier 62/63; Shallow Sandy Subtidal Zone Shown.

Piers 62/63:

Piers 62/63, or the Fishing Pier, hosts many sea birds such as rhinoceros auklet (*Cerorhinca monocerata*), double-crested cormorant (*Phalacrocorax auritus*), pigeon guillemot (*Cepphus columba*), surf scoter (*Melanitta perspicillata*), belted kingfisher (*Ceryle alcyon*), and western grebe (*Aechmophorus occidentalis*). The substrate in this area is very shallow, sloping at approximately 5:1 or flatter and is composed mainly of sand. None of this sand, however, is exposed except during extreme low tides.

Bell Street Pier and Marina (Pier 66):

A significant quantity of riprap is present at the toe and up the entire height of the Seawall and other structures at the Bell Street Marina and is generally steeply sloped (2:1 or steeper). Red-necked grebe (*Podiceps grisegena*) are present in the calm waters of Bell Street Marina. A sign limiting weight is present along the edge of the Seawall adjacent to Pier 66.

Photo 10. Bell Street Marina and Seawall.

Photo 11. Weight Limit at Pier 66.

Photo 12. Rock in Inner Marina Under Pier 66.

Pier 67/68:

Large mats of bull kelp are present between Piers 67 and 69. The presence of bull kelp in this area appears to be strongly associated with the rocky substrate and the light vessel traffic present.

Sunflower star (*Pycnopodia helianthoides*), bat star (*Patiria miniata*), and Pacific henricia (*Henricia leviuscula*) are also present in the protected waters near Pier 67/68. Dungeness crab (*Cancer magister*), spider crab (Majidae), shore crab (*Hemigrapsus* spp.), and helmet crab (Cheiragonidae), are also found in this area. A large flock of European starlings numbering around 150 individuals was observed here, flying through this area in route to their evening roost in Myrtle Edwards Park.

The seafloor near Pier 67 is composed of a mix of rock and sand and gently slopes into the bay at a rate of around 4:1.

Pier 70:

Just north of Pier 70 below the Olympic Sculpture Park, the Seawall gives way to a manmade shoreline composed mainly of riprap. A rock/gravel bench is present at approximately mean sea level; however, very few organisms were observed during either survey. In this area, the water clarity is noticeably better than in more southern locations along the Seawall and the size and vigor of all plant species appear to improve substantially. Here, extensive mats of macroalgae are accompanied by a diversity of other marine organisms. Like with the plants, the diversity and density of invertebrate species is also much higher in this area. In general, many of the species seen along the Seawall were found in higher densities in this area with a few species such as some crabs (*Cancer* sp.), being only found in this area.

Photo 13. Looking Towards Pier 70 at Sculpture Park.

Photo 14. Gravel/Rock Bench at Approximately Mean Sea Level at Sculpture Park.

Photo 15. Bull Kelp at Sculpture Park in November 2007.

North of the Alaskan Way Seawall:

The intertidal zone that stretches along Myrtle Edwards Park past the Grain Terminal at Pier 86 on to the Elliott Bay Fishing Pier is composed of riprap interspersed with recently constructed gravel/cobble beaches. Patches of bull kelp are present from 20 to 70 feet offshore. The density of kelp varies seasonally; the maximum distribution of kelp was likely present in the November survey, but was much reduced in February. Various bird species are present in this area; Northwestern crow (*Corax caurinus*) often forage near the tide line while large flocks of European starlings and small flocks of black-capped chickadees (*Poecile atricapillus***)** fly around the many trees and man made structures present in the park. The nearshore waters around the Pier 86 Grain Terminal host 500-600 surf scooter (*Melanitta perspicillata***)**, tens of greater scaup (*Aythya marila)***,** hooded merganser (*Lyphodytes cucullatus*), and common goldeneye. Red-necked grebe, lesser scaup (*Aythya affinis*), American wigeon (*Anas americana*), glaucus gull (*Larus hyperboreus*), pigeon guillemot (*Cepphus columba*), common murre (*Uria aalge*), rhinoceros auklet (*Cerorhinca monocerata*), and Canada goose (*Branta canadensis*) are also seen in this area.

Myrtle Edwards Park has various ornamental conifers and deciduous trees distributed across a large expanse of mowed grass. Few plants found in this area are native.

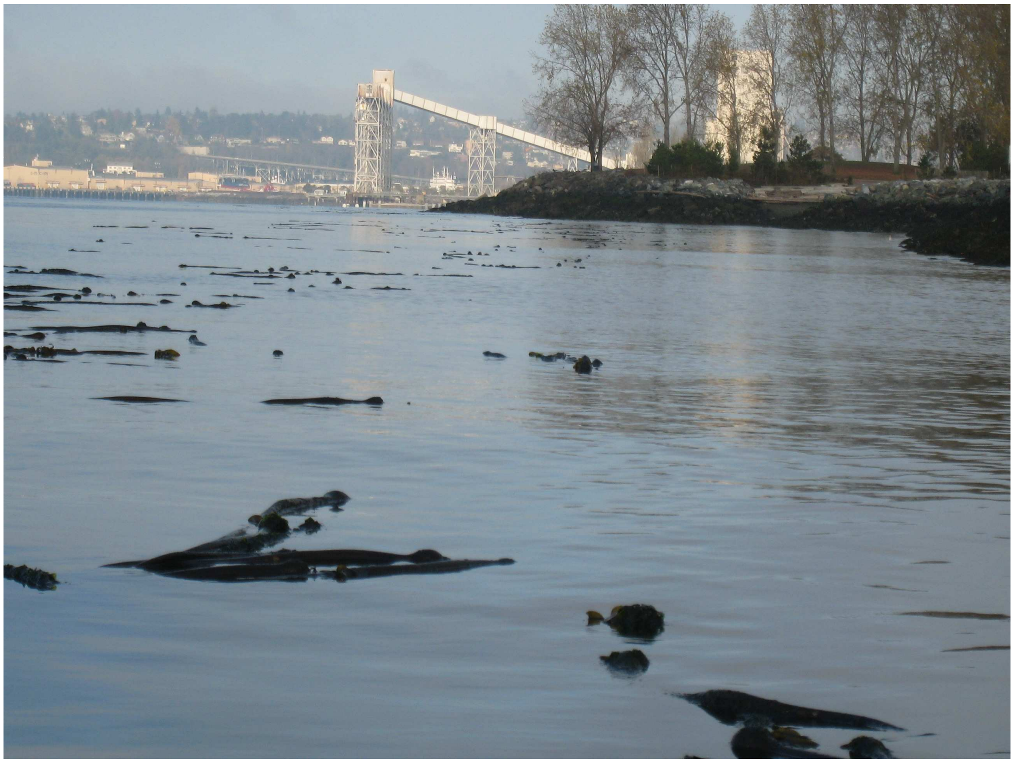

Photo 16. Bull Kelp Along Myrtle Edwards Shoreline in November.

Photo 17. Newly Constructed Beach at Myrtle Edwards Park.

Photo 18. Beach Under Construction at Myrtle Edwards Park.

Photo 19. Seabirds at Grain Terminal.

Appendix D

Fisherman Interview Form

Fisherman Interview Form and Summary

The following fisherman interview form was used to interview fishermen, bait shop managers, Seattle Parks employees and other knowledgable people regarding the use of the Seawall for recreational fishing. In general, few fishermen were found along the Seawall. The Fishing Pier in Myrtle Edwards Park is a more popular destination for fishing, but various publicly accessible piers along the Seawall are used to a lesser extent.

	Alaska Way Seawall -- Fisherman Survey Form Date: Time: Location: Surveyor:
1)	How often do you fish during each season? (ave. days/mo): Fall: Win: Spr: Sum:
2)	How many days per week do you fish (ave.)?
3)	What type of fishing (% time sport / subsistence fishing)?
4)	How many years have you fished on the Seawall?
5)	Where on the Seawall do you fish most often?
6)	Do you fish other areas as well (on the Seawall or other)? Where?
7)	What type of bait do you use most often fishing on the Seawall? Lure: Live bait: Fly:
8)	Where do you purchase your bait / gear / other items while fishing the Seawall?
9)	Species caught in the fall (est. frequency, poundage, hit limits?):
10)	Species caught in the winter (est. frequency, poundage, hit limits?):
11)	Species caught in the spring (est. frequency, poundage, hit limits?):
12)	Species caught in the summer (est. frequency, poundage, hit limits?):
13)	What % of fish landed were below / above the legal size?
14)	What detracts from your fishing at the Seawall (crowds, rowdiness, use fees, rules & regulations, ext.)?
	**Notes on the backside