



Protecting Seattle's Waterways

Ship Canal Water Quality Project

Final Supplemental Environmental Impact Statement

January 2017





City of Seattle
Seattle Public Utilities

January 26, 2017

Dear Affected Agencies, Tribes, Organizations, and Interested Parties:

Seattle Public Utilities (SPU) is pleased to issue the Final Supplemental Environmental Impact Statement (Final Supplemental EIS) for the Ship Canal Water Quality Project. The Final Supplemental EIS documents the evaluation of the project under the State Environmental Policy Act (SEPA) after consideration of comments on the Draft SEIS issued on September 22, 2016; responds to those comments; and provides modifications and revisions to the analysis as appropriate. The Final Supplemental EIS will be used to assist decision-makers and permit authorities in assessing the environmental effects (adverse and beneficial) associated with the project.

SPU and the King County Department of Natural Resources and Parks (DNRP) are working together to build an underground storage tunnel to reduce the amount of sewage and stormwater (combined sewage) that discharges into the Lake Washington Ship Canal (Ship Canal) from Ballard, Fremont, Wallingford, and north Queen Anne. During storms that exceed the capacity of the wastewater system, combined sewage flows from these areas currently discharge into the Ship Canal without treatment. These discharges are referred to as combined sewer overflows (CSOs). The Ship Canal Water Quality Project would convey the excess flows to a large underground storage tunnel, which would store the flows until they can be conveyed to the existing West Point Wastewater Treatment Plant in Magnolia. The proposed facilities would be owned and operated by SPU.

In 2014, SPU drafted a comprehensive long-range plan to reduce overflows from its combined sewer system and to reduce pollutant loading from CSO discharges, referred to as The Plan to Protect Seattle's Waterways (Plan). The Ship Canal Water Quality Project is one of the first components of the Plan to be implemented. The Supplemental EIS focuses on what is new or different from the Ship Canal Tunnel option that was analyzed in the 2014 Plan EIS. It describes project-specific information that has been developed as part of the Draft Facility Plan for the project, including the impacts of potential construction options and the impacts of operating the Ship Canal Water Quality Project.

The main components of the project include:

- A minimum 15.24-million gallon (MG) offline storage tunnel, approximately 14 to 18 feet in diameter and approximately 2.7 miles long or as defined during the design phase of the project.
- Portals (West Portal and East Portal) to serve as access and egress for a tunnel boring machine necessary to construct the tunnel.
- Pier reconstruction and temporary pier extensions and mooring dolphins to support tunnel construction.
- Drop structures to convey influent CSO flow into the storage tunnel.
- A pump station (Tunnel Effluent Pump Station) at the West Portal to empty the storage tunnel.
- Odor control facilities.
- Conveyance facilities to convey SPU and DNRP CSO flows into the tunnel and to drain flows from the tunnel.

Mami Hara, General Manager/CEO
Seattle Public Utilities
PO Box 34018
Seattle, WA 98124-4018

Tel (206) 684-5851
Fax (206) 684-4631
TDD (206) 233-7241
<http://www.seattle.gov/util>

The Draft Facility Plan and a preliminary Draft Supplemental EIS were submitted to the Washington State Department of Ecology (Ecology) and United States Environmental Protection Agency (EPA) for review in January 2016. SPU is preparing a Final Facility Plan that addresses comments received from Ecology and EPA and that incorporates the conclusions from subsequent preliminary engineering evaluations. Specifically, SPU is evaluating several design options and refinements, including a shallower tunnel depth, modifications to the configuration of the Tunnel Effluent Pump Station, modifications to grit removal facilities, and addition of odor control at the South 3rd Avenue drop shaft. SPU expects to select the preferred options and submit the Final Facility Plan to Ecology and EPA in early 2017.

The Supplemental EIS analyzes the impacts of the potential range of options on the natural and built environments. Environmental elements covered in the Final Supplemental EIS include Earth and Groundwater, Surface Water, Air Quality and Odors, Fisheries and Biological Resources, Land and Shoreline Use/Visual Quality, Recreation, Transportation, Noise and Vibration, Energy and Climate Change, and Cultural Resources.

This Final Supplemental EIS responds to comments received during the Draft Supplemental EIS comment period and includes some modifications and revisions to the analysis provided in the Draft Supplemental EIS as appropriate. The Final Supplemental EIS is a standalone document addressing all of the SEPA-required environmental elements (rather than a summary of the changes from the Draft Supplemental EIS). Modifications and revisions in Chapter 1 through Chapter 14 are shown in highlighted format for easy identification.

The appeal period associated with this Final Supplemental EIS is January 26, 2017 through February 9, 2017.

Thank you for your interest in the Ship Canal Water Quality Project.

Sincerely,

A handwritten signature in blue ink that reads "Betty Meyer". The signature is written in a cursive, flowing style.

Betty Meyer
SEPA Responsible Official

Fact Sheet

Name of Proposal

Ship Canal Water Quality Project

Proponent

Seattle Public Utilities (SPU) and King County Department of Natural Resources and Parks (DNRP)

Location

The project would be located along the Lake Washington Ship Canal in the following areas:

- Ballard
- Fremont
- Wallingford
- North Queen Anne

Purpose

Seattle Public Utilities (SPU) and King County Department of Natural Resources and Parks (DNRP) are working together to build an underground storage tunnel to reduce the amount of sewage and stormwater (combined sewage) that discharges into the Lake Washington Ship Canal (Ship Canal) from Ballard, Fremont, Wallingford, and north Queen Anne. During storms that exceed the capacity of the wastewater system, combined sewage flows from these areas currently discharge into the Ship Canal without treatment. These discharges are referred to as combined sewer overflows (CSOs). The Ship Canal Water Quality Project would convey the excess flows to a large underground storage tunnel, which would store the flows until they can be conveyed to the wastewater treatment plant. SPU would own and operate the proposed facilities.

The benefit of this project is cleaner water and less pollution in local water bodies. Combined sewer overflows in Ballard, Fremont, Queen Anne, and Wallingford send sewage and stormwater into the Ship Canal 130 times per year on average. This project is needed to meet federal and state regulatory control standards that require SPU and DNRP to limit CSOs to a long-term average of no more than one untreated discharge per year per outfall, on a 20-year moving average. SPU, working with DNRP, has identified control of CSOs from the Ballard area (SPU Outfalls 150, 151, and 152, and DNRP's 11th Avenue NW CSO Outfall DSN004); the Fremont area (SPU's CSO Outfall 174); the north Queen Anne area (DNRP's 3rd Avenue W Outfall DSN008); and the Wallingford area (SPU Outfall 147) as a top priority for implementation of CSO controls. These outfalls currently overflow more than an average of once per year.

Background

In 2014, SPU drafted a comprehensive long-range plan to reduce overflows from its combined sewer system and to reduce pollutant loading from CSO discharges, referred to as the *Plan to Protect Seattle's Waterways* (Plan) (SPU, 2015). Similarly, DNRP's long-range plan (*2012 King County Long-term Combined Sewer Overflow Control Plan Amendment*) evaluated various storage and flow transfer concepts to reduce overflows from its combined sewer system (DNRP, 2012). After extensive review of engineering, environmental, community, and economic considerations, both the City and King County selected a storage tunnel as the recommended option to address discharges into the Ship Canal from Ballard, Fremont, Wallingford, and north Queen Anne.

The Ship Canal Water Quality Project is one of the first components of SPU's Plan to be implemented. The Draft Facility Plan (SPU, 2016) describes the project components and other key considerations, including refinements that have developed since the Plan was adopted by the City Council. The Supplemental Environmental Impact Statement (EIS) focuses on what is new or different from the Ship Canal Tunnel option that was analyzed in the 2014 Plan EIS available at www.seattle.gov/util/ShipCanalProject. It describes project-specific information that has been developed as part of the Draft Facility Plan, including the impacts of potential construction options and the impacts of operating the Ship Canal Water Quality Project.

Project Description

The Ship Canal Water Quality Project would provide offline storage of combined wastewater in an underground storage tunnel constructed between the Ballard and Wallingford CSO areas, on the north side of the Ship Canal. The project would control SPU's Ballard CSO basins (Outfalls 150, 151, and 152); Fremont (Outfall 174) and Wallingford CSO basins (Outfall 147); and DNRP's 3rd Avenue West Regulator (DSN008) and 11th Avenue NW Regulator (DSN004).

The main components of the Ship Canal Water Quality Project include the storage tunnel and appurtenances, and conveyance facilities to convey SPU and DNRP CSO flows into the tunnel and to drain flows from the tunnel.

The storage tunnel and appurtenances would include the following:

- A minimum 15.24-million gallon (MG) offline storage tunnel, approximately 14 to 18 feet in diameter and approximately 2.7 miles long or as defined during the design phase of the project.
- Portals to serve as access and egress for a tunnel boring machine necessary to construct the tunnel.
- Pier reconstruction and temporary pier extensions and mooring dolphins to support tunnel construction.
- Drop structures to convey influent CSO flow into the storage tunnel.
- A pump station (tunnel effluent pump station) located at the West Portal to empty the storage tunnel.
- Odor control facilities.

Conveyance facilities would include the following:

- Diversion structures for diverting combined sewage flows away from existing CSO outfalls and toward the storage tunnel.
- Gravity sewers to convey flows from SPU's diversion structure at Ballard CSO Outfalls 150, 151, and 152 to the tunnel drop shaft.

- Gravity sewers to convey flows from SPU's diversion structure at Fremont CSO Outfall 174 to the tunnel drop shaft.
- Gravity sewers to convey flows from SPU's diversion structure at Wallingford CSO Outfall 147 to the tunnel drop shaft.
- Gravity sewers to convey flows from DNRP's diversion structure at 3rd Avenue W (under the Ship Canal) to the tunnel drop shaft.
- Gravity sewers to convey flows from DNRP's diversion structure at 11th Avenue NW to the tunnel drop shaft.
- Gravity sewers or force main to convey flows from the tunnel effluent pump station to DNRP's existing Ballard Siphon.

SPU is solely responsible for constructing, operating, and maintaining gravity sewers to convey flows from SPU's diversion structures at Ballard CSO Outfalls 150, 151, and 152, and Wallingford CSO Outfall 147 to the tunnel drop shafts. King County and the City of Seattle have entered into a Joint Project Agreement (JPA) that defines the joint project and the roles and responsibilities for each agency. King County's participation as a partner with SPU on the Ship Canal Water Quality Project has been approved and documented by modification to its Consent Decree with the United States Environmental Protection Agency and State of Washington Department of Ecology (Ecology), filed October 25, 2016 with the United States District Court, Western District of Washington.

Additional detail on the proposed facilities can be found in Chapter 10 of the Draft Ship Canal Water Quality Project Facility Plan, available at www.seattle.gov/util/ShipCanalProject.

Implementation Date

If the project is approved, construction is anticipated to occur from mid-2017 to the end of 2025.

Final Action

The proposed project may not proceed before permits and approvals are obtained from government agencies. Decisions approving or denying permits and approvals are expected to occur in 2017 – 2018.

Required Approvals or Permits

- Federal
 - Rivers and Harbors Act Section 10/Clean Water Act Section 404 permit; Section 408 Decision Letter — U.S. Army Corps of Engineers
 - Endangered Species Act consultation — National Marine Fisheries Service and U.S. Fish and Wildlife Service
 - King County Consent Decree Modification — U.S. Environmental Protection Agency/U.S. Department of Justice/Ecology
- State
 - Facility Plan Approval — Ecology
 - National Pollutant Discharge Elimination System (NPDES) Construction Stormwater General Permit — Ecology

- 401 Water Quality Certification — Ecology
- Coastal Zone Consistency Determination — Ecology
- State Environmental Review Process (SERP) Compliance — Ecology
- Hydraulic Project Approval — Washington Department of Fish and Wildlife
- Section 106 National Historic Preservation Act Consultation — Department of Archaeology and Historic Preservation
- Aquatic Lands Use Authorization or Right of Entry — Washington Department of Natural Resources
- Local
 - Initiative 42 Approval (Park Lands Conversion) — Seattle City Council
 - Type V Council Land Use Decision, Concept Approval for City Facility — Seattle Department of Construction and Inspections
 - Master Use Permit II, State Environmental Policy Act (SEPA) Conditioning Approval — Seattle Department of Construction and Inspections
 - Master Use Permit II, Shoreline Substantial Development Permit — Seattle Department of Construction and Inspections
 - Environmentally Critical Areas Approval — Seattle Department of Construction and Inspections
 - Clear and Grade Permit — Seattle Department of Construction and Inspections
 - Building Permit — Seattle Department of Construction and Inspections
 - Shoring and Excavation Permit — Seattle Department of Construction and Inspections
 - Electrical Permit — Seattle Department of Construction and Inspections
 - Plumbing Permit — Seattle Department of Construction and Inspections
 - Mechanical Permit — Seattle Department of Construction and Inspections
 - Nighttime Noise Variance — Seattle Department of Construction and Inspections
 - Project Review — Seattle Design Commission
 - Street Use and Haul Route Permit — Seattle Department of Transportation
 - Shoreline Street End Use Permit — Seattle Department of Transportation
 - Street Improvement Permit — Seattle Department of Transportation
 - Revocable Use Permit — Seattle Parks and Recreation
 - Water Availability Permit — Seattle Public Utilities
 - Joint Project Agreement and Operational Agreement (JPA) — King County / City of Seattle
 - Health Permit (Air Gap) — Public Health – Seattle and King County
 - Notice of Construction Permit — Puget Sound Clean Air Agency
 - Air Operating Permit — Puget Sound Clean Air Agency
 - Local Project Approval (LPA) — King County
 - Industrial Waste Discharge Permit/Construction Dewatering Approval — King County

Authors and Principal Contributors to this Supplemental EIS

This Supplemental EIS was prepared under the direction of SPU. The following consulting firms provided research and analysis associated with this Supplemental EIS:

- **ESA** – lead Supplemental EIS consultant, document preparation
- **Lindsey Amtmann, LLC** – Supplemental EIS support, document preparation
- **CH2M Hill** - engineering support
- **Heffron Transportation, Inc.** – transportation analysis
- **The Greenbusch Group, Inc.** – noise analysis
- **Aqua Terra Cultural Resources Consultants** – cultural resources analysis

Project Proponent and Lead Agency

Seattle Public Utilities
700 5th Avenue, Suite 4900
P.O. Box 34018
Seattle, WA 98124-4018

Project Information / Background Data Contact Person

Ed Mirabella
Ship Canal Water Quality Project Executive
Phone: (206) 684-5959
E-mail: J.Edward.Mirabella@seattle.gov

Date of Issuance of this Final Supplemental EIS

January 26, 2017

Availability of the Final Supplemental EIS and Background Materials

The Final Supplemental EIS is available for viewing at the following locations:

- Seattle Public Utilities, General Manager/CEO's Office Main Reception Area, Seattle Municipal Tower, Suite 4900, 700 5th Avenue, Seattle, Washington
- Seattle Central Library, Public Review Documents, Level 5 Reference
- Online at www.seattle.gov/util/ShipCanalProject

The Final Supplemental EIS can be downloaded for free from the City's website www.seattle.gov/util/ShipCanalProject, or purchased on CD for \$10 or in paper form for \$65. Purchased copies will be mailed upon receipt of a check made payable to SPU.

Additional background materials can be viewed on the City's website: www.seattle.gov/util/ShipCanalProject.

These materials may also be viewed in paper form by arranging a time with Ed Mirabella at the number or e-mail listed above.

Appeal of the Final Supplemental EIS

Appeals of the Final Supplemental EIS must be accompanied by an \$85.00 filing fee and must be filed by 5:00 p.m. on February 9, 2017. Delivery of appeals filed by any form of USPS mail service may be delayed by several days. Allow extra time if mailing an appeal.

Written appeals must be sent to:

City of Seattle Hearing Examiner
700 5th Avenue Suite 4000
P.O. Box 94729
Seattle, WA 98124-4729

Appeals can be filed electronically. Details on electronic filing procedures are available under “e-File” at the Office of the Hearing Examiner’s web site: <http://www.seattle.gov/examiner/>.

Filing fees must be paid by the appeal deadline and can be paid via check (made payable to the City of Seattle) or credit/debit card (Visa and MasterCard only). Credit/debit card payments can be made in-person or over-the-phone.

You should be prepared to make specific factual objections. Please refer to the Hearing Examiner Rules of Practice and Procedure for rules that govern appeals, which are available on the Hearing Examiner’s website at www.seattle.gov/examiner/rules-toc.htm or by calling (206) 684-0521.

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List of Abbreviations

| Term | Definition | Term | Definition |
|-------------------|--|------------------|---|
| AHERA | Asbestos Hazard Emergency Response Act | kWh | kilowatt hours |
| AWDT | Average Weekday Daily Traffic | L _{eq} | equivalent sound level |
| BDSL | Ballard Terminal Railroad | L _{max} | maximum sound level |
| BMP | best management practice | LPA | Local Project Approval |
| BNSF | Burlington Northern Santa Fe | Metro | King County Metro Transit |
| BTRR | Ballard Terminal Railroad | MG | million gallons |
| C-2 | Commercial-2 | MPPCV | Major Public Project Construction Variance |
| CFR | Code of Federal Regulations | MTCA | Model Toxics Control Act |
| City | City of Seattle | MUP | Master Use Permit |
| CN | Conservancy Navigation | NHPA | National Historic Preservation Act |
| CO ₂ | carbon dioxide | NMFS | National Marine Fisheries Service |
| CO ₂ e | carbon dioxide equivalents | NPDES | National Pollutant Discharge Elimination System |
| CSO | combined sewer overflow | NRHP | National Register of Historic Places |
| CY | cubic yards | OHWM | ordinary high water mark |
| DAHP | Washington Department of Archaeology and Historic Preservation | PAH | polycyclic aromatic hydrocarbon |
| dB | decibel | PCB | polychlorinated biphenyl |
| dBA | decibel (A-weighted) | PCE | tetrachloroethylene |
| DCI | Department of Construction and Inspections | Plan | Plan to Protect Seattle's Waterways |
| DNRP | King County Department of Natural Resources and Parks | PM | particulate matter |
| DPS | distinct population segment | PPV | peak particle velocity |
| Ecology | Washington State Department of Ecology | PSCAA | Puget Sound Clean Air Agency |
| EIS | Environmental Impact Statement | rms | root mean square |
| EPA | U.S. Environmental Protection Agency | SBSG | Salmon Bay Sand & Gravel |
| ESU | evolutionarily significant unit | SDOT | Seattle Department of Transportation |
| FAS | Finance and Administrative Services | SEPA | State Environmental Policy Act |
| FHWA | Federal Highway Administration | SERP | State Environmental Review Process |
| FRA | Federal Railroad Administration | SF | square feet |
| FTA | Federal Transit Administration | Ship Canal | Lake Washington Ship Canal |
| GAR | Geotechnical Assessment Report | SMC | Seattle Municipal Code |
| GDR | Geotechnical Data Report | SMP | Shoreline Master Program |
| HDPE | high density polyethylene | SPCP | Spill Prevention and Control Plan |
| HPA | Hydraulic Project Approval | SPU | Seattle Public Utilities |
| Hz | hertz | SWPPP | Stormwater Pollution Prevention Plan |
| IB | Industrial Buffer | TBM | tunnel boring machine |
| IG | Industrial General | TCE | trichloroethylene |
| JPA | Joint Project Agreement | TEPS | tunnel effluent pump station |
| | | UG | Urban General |
| | | UI | Urban Industrial |

| | | | |
|-------|--|---------|---|
| USFWS | U.S. Fish and Wildlife Service | WDNR | Washington Department of Natural Resources |
| VdB | vibration decibel | WHR | Washington Heritage Register |
| VOC | volatile organic compound | WISAARD | Washington Information System for Architectural and Archaeological Records Data |
| WAC | Washington Administrative Code | | |
| WDFW | Washington Department of Fish and Wildlife | | |

CHAPTER 1

Summary

This summary highlights the major components of the Supplemental Environmental Impact Statement (Supplemental EIS) for the Ship Canal Water Quality Project. It provides an overview of the project, background of efforts leading up to the project development, and a summary of impacts and proposed measures for reducing them.

1.1 What is the Ship Canal Water Quality Project?

Seattle Public Utilities (SPU) and King County Department of Natural Resources and Parks (DNRP) are working together to build an underground storage tunnel to reduce the amount of sewage and stormwater (combined sewage) that discharges into the Lake Washington Ship Canal (Ship Canal) from Ballard, Fremont, Wallingford, and north Queen Anne. During storms that exceed the capacity of the wastewater system, combined sewage flows from these areas currently discharge into the Ship Canal without treatment. These discharges are referred to as combined sewer overflows (CSOs). The Ship Canal Water Quality Project (Ship Canal Project) would convey the excess flows to a large underground storage tunnel, which would store the flows until they can be conveyed to the wastewater treatment plant. SPU would own and operate the proposed facilities.

The approximately 14 to 18 feet in diameter and approximately 2.7-mile long tunnel would provide a minimum of 15.24 million gallons (MG) of storage. Flows would be released back into the combined sewer system as peak flows subside to allow the flows to be treated rather than discharged untreated into the Ship Canal. Chapter 2 includes a more detailed project description.

King County and the City of Seattle have entered into a Joint Project Agreement (JPA) that defines the joint project and the roles and responsibilities for each agency. **King County's participation as a partner with SPU on the Ship Canal Project has been approved and documented by modification to its Consent Decree with the United States Environmental Protection Agency (EPA) and State of Washington Department of Ecology (Ecology), filed October 25, 2016 with the United States District Court, Western District of Washington.**

1.2 Why is the project needed?

The benefit of this project is cleaner water and less pollution in local water bodies. Combined sewer overflows in Ballard, Fremont, Queen Anne, and Wallingford send sewage and stormwater into the Ship Canal 130 times per year on average. This project is needed to meet federal and state regulatory control standards that require SPU and DNRP to limit CSOs to a long-term average of no more than one untreated discharge per year per outfall, on a 20-year moving average. SPU, working with DNRP, has identified control of CSOs from the Ballard area (SPU Outfalls 150, 151, and 152, and DNRP's 11th Avenue NW CSO Outfall DSN004); the Fremont area (SPU's CSO Outfall 174); the north Queen Anne area (DNRP's 3rd Avenue W Outfall DSN008); and the Wallingford area (SPU Outfall 147) as a top priority for implementation of CSO controls (Figure 1-1). These outfalls currently overflow more than an average of once per year.

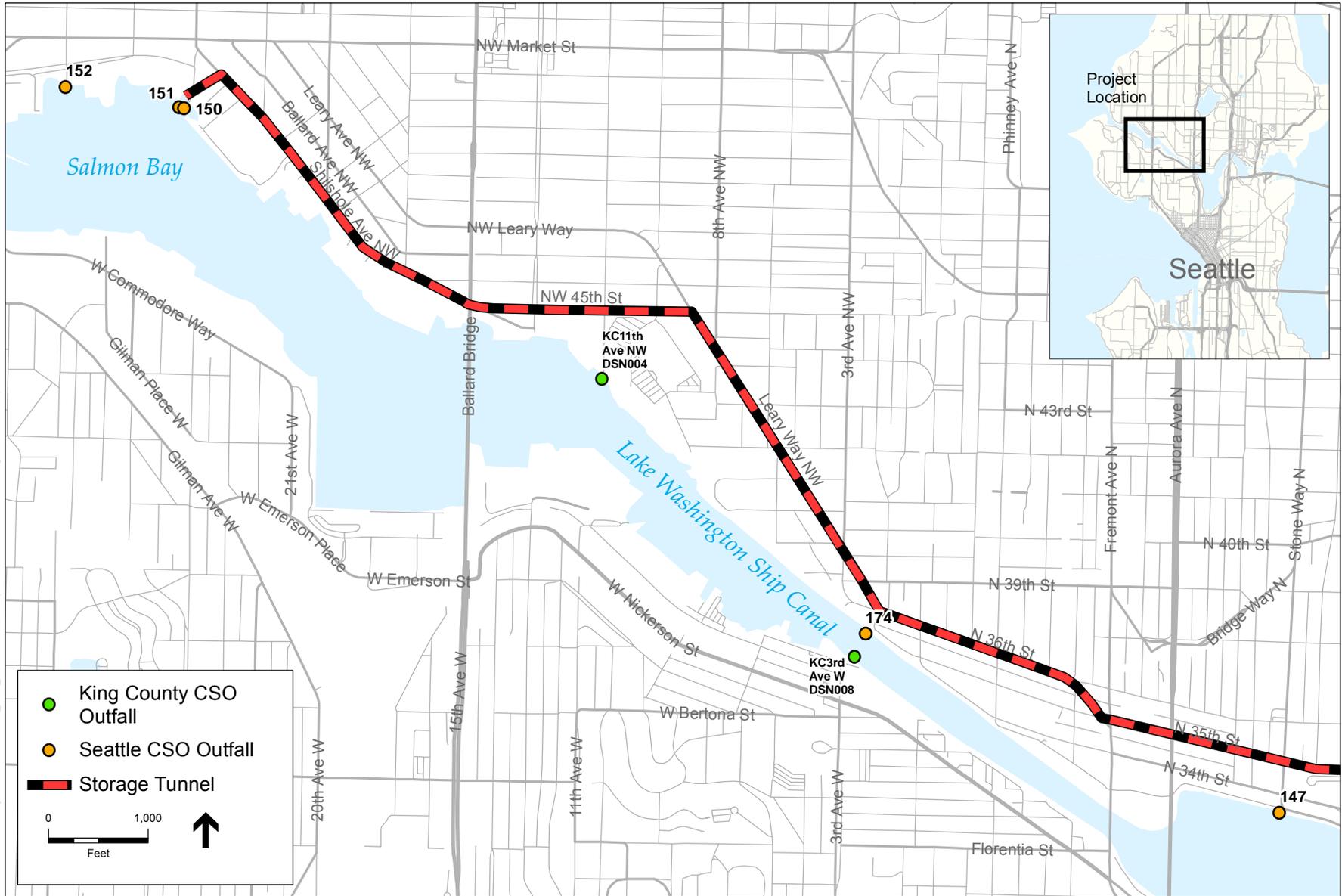


Figure 1-1 Outfall locations

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1.3 How does this project relate to the Plan to Protect Seattle's Waterways?

In 2014, SPU drafted a comprehensive long-range plan to reduce overflows from its combined sewer system and to reduce pollutant loading from CSO discharges, referred to as the Plan to Protect Seattle's Waterways (Plan). The Plan was evaluated in an EIS issued as a draft by SPU in May 2014 and finalized in December 2014 (referred to as the 2014 Plan EIS). The 2014 Plan EIS evaluated the effects of two alternatives, the Long-Term Control Plan Alternative and the Integrated Plan Alternative, as well as the No Action Alternative. Following publication of the 2014 Plan EIS, SPU identified the Integrated Plan as its preferred alternative and prepared a Final Plan in 2015. The Final Plan was adopted by the Seattle City Council and signed by the Mayor on May 8, 2015. The Plan was submitted to EPA and Ecology on May 29, 2015 and was subsequently approved on August 26, 2015. The Ordinance to implement the Plan went into effect on June 8, 2015. The Final Plan and 2014 Plan EIS include additional discussion of alternatives previously evaluated and can be viewed at www.seattle.gov/util/ShipCanalProject.

Various storage and flow transfer concepts were evaluated in SPU's Plan (SPU, 2015) and DNRP's CSO Control Plan (DNRP, 2012). The Ship Canal Water Quality Project (also called the Ship Canal Project, and formerly referred to as the Shared West Ship Canal Tunnel Option) has been selected as the recommended option by both the City of Seattle and King County.

The Ship Canal Project is one of the first components of the Plan to Protect Seattle's Waterways to be implemented. The Draft Facility Plan (SPU, 2016) describes the project components and other key considerations, including refinements that have developed since the Plan to Protect Seattle's Waterways was adopted by the City Council. The Supplemental EIS focuses on what is new or different from the Ship Canal Tunnel Option that was analyzed in the 2014 Plan EIS. It describes project-specific information that has been developed as part of the Draft Facility Plan, including the impacts of potential construction options and the impacts of operating the Ship Canal Project.

The Draft Facility Plan and a preliminary Draft Supplemental EIS were submitted to Ecology and EPA for review in January 2016. SPU is preparing a Final Facility Plan that addresses comments received from Ecology and EPA and that incorporates the conclusions from subsequent preliminary engineering evaluations. Specifically, SPU is evaluating several design options and refinements, including a shallower tunnel depth, modifications to the configuration of the Tunnel Effluent Pump Station, modifications to grit removal facilities, and the addition of odor control at the South 3rd Avenue Drop Shaft. SPU expects to select the preferred options and submit the Final Facility Plan to Ecology and EPA in early 2017. In the meantime, this Supplemental EIS analyzes the impacts of the potential range of options on the natural and built environments.

1.4 What is a Supplemental EIS and why is it being prepared?

As stated in Washington Administrative Code (WAC) 197-11-600 and Seattle Municipal Code (SMC) 25.05.600, a supplemental EIS is required if a new or amended proposal has likely significant adverse impacts that have not been analyzed in an existing EIS. A supplemental EIS adds to the analysis in an existing EIS without needing to duplicate it.

The Ship Canal Project was evaluated at a general level in the 2014 Plan EIS; however, specific project locations and facility details had not been developed and as such were not identified. This Supplemental EIS describes updates to project components, designs, construction, and locations.

SPU, as the lead agency under the State Environmental Policy Act (SEPA), has determined that the newly developed project-level information on the Ship Canal Project requires additional analysis to reflect changes and refinements in the proposed project since issuance of the Plan EIS in December 2014 (SPU, 2014). SPU is the project proponent and is serving as the SEPA lead agency. DNRP is partnering with SPU on this project.

As stipulated in WAC 197-11-620(1) and SMC 25.05.620.A, a supplemental EIS “should not include analysis of actions, alternatives, or impacts” discussed in the previously prepared EIS. Accordingly, this Supplemental EIS only includes analysis of new information regarding proposed facilities, locations, and impacts. Because the No Action Alternative has not changed since publication of the 2014 Plan EIS, it is not described here.

In accordance with SMC 25.05.560.E, the Final Plan EIS consisted of the Draft Plan EIS and an addendum. The Draft EIS included an Introduction and Background, Summary, Description of Alternatives, Affected Environment, Impacts, and Mitigation chapters. The addendum included comments on the Draft Plan EIS, and changes to the Draft Plan EIS, which were minor. Only those sections with changes were reprinted in the addendum. The Supplemental EIS includes references to some sections included only in the Draft Plan EIS, which are cited according to the appropriate chapter or section in the Draft Plan EIS.

The Draft Supplemental EIS was issued on September 22, 2016. Comments on the Draft Supplemental EIS were accepted through October 24, 2016. A public hearing was held on October 18, 2016. All comments received are included in Appendix A, along with responses to those comments. The Final Supplemental EIS text has been revised in response to comments and to provide updated information associated with refined project design. These changes are shown as highlighted text in the Final Supplemental EIS.

1.5 What are the potential impacts of the proposed Ship Canal Water Quality Project?

Table 1-1 summarizes the identified potential impacts specific to the Ship Canal Project, as well as measures that SPU may take to reduce or eliminate potential impacts. Potential impacts and measures to reduce impacts are described in more detail in Chapters 3 through 13. Final measures will be determined as part of permitting during final design. General impacts and measures to reduce or eliminate impacts would remain as described in the 2014 Plan EIS.

| Table 1-1. Summary of Potential Impacts and Measures to Reduce Impacts | | |
|---|---|--|
| Earth and Groundwater | Impacts | <p>Construction</p> <ul style="list-style-type: none"> • Areas that are disturbed during construction would be subject to increased erosion. • Ground settlement from dewatering could cause minor settlement of nearby structures, roadways, and utilities. • Contaminated soil and groundwater would likely be encountered at some sites, and the contamination would require special handling and remediation on site or disposal off site in accordance with regulatory requirements. • Vibration and soil loss associated with tunneling could result in minor (less than 0.2 inch) soil movement and settlement along the tunnel alignment. |
| | Measures to reduce or eliminate impacts | <p>Construction</p> <ul style="list-style-type: none"> • Conduct site-specific surveys during design. • Monitor for settlement and vibration during construction to identify potential adverse conditions. • Implement ground improvement measures in areas prone to instability. • Cover loads during hauling to minimize dust generated during transport. • Review construction activities for consistency with the Model Toxics Control Act and |

Table 1-1. Summary of Potential Impacts and Measures to Reduce Impacts

| | | |
|-----------------------|---|--|
| | | <p>Sediment Management Standards.</p> <ul style="list-style-type: none"> Use containment measures in accordance with regulatory requirements when handling contaminated soils or groundwater. Pump and treat contaminated groundwater to meet discharge standards prior to discharge to the Ship Canal. Require all contractors to prepare Health and Safety Plans that address work with contaminated soil and groundwater. |
| Surface Water | Impacts | <p>Construction</p> <ul style="list-style-type: none"> In-water construction in Salmon Bay has the potential to cause localized turbidity and resuspension of contaminated sediments during pier replacement. If not properly controlled, barge transport of excavation spoils could result in spillage of materials into the Ship Canal, particularly Salmon Bay. If not properly controlled, there is a potential for contaminated groundwater to be discharged to water bodies during construction dewatering. If not properly controlled, there is a potential for construction site runoff to enter surface water bodies. |
| | Measures to reduce or eliminate impacts | <p>Construction</p> <ul style="list-style-type: none"> All in-water construction would be conducted in accordance with applicable permit requirements, including the Corps of Engineers Section 10/404 permit, Ecology 401 Water Quality Certification, Washington Department of Fish and Wildlife (WDFW) Hydraulic Project Approval (HPA), and other requirements. During in-water work to support pier replacement and outfall rehabilitation activities at the West Portal, appropriate best management practices (BMPs) would be used as necessary to isolate construction activity from the Ship Canal and prevent the release of pollutants into open water. Water discharged from the project sites during construction would be monitored and, if necessary, treated. Settling tanks and other treatment measures would be used if needed to ensure that this water meets water quality standards before it is discharged to the stormwater collection system, the sewer system, or surface waters. Contaminants removed during treatment would be disposed of at an approved disposal site. Implementation of applicable measures would be included in project construction contract specifications. Site design for the completed project would include stormwater management control measures to address runoff control and treatment as required by the City of Seattle |
| Air Quality and Odors | Impacts | <p>Construction</p> <ul style="list-style-type: none"> Construction would increase dust and vehicle emissions adjacent to construction sites. Contaminated soils would likely be encountered at some sites. If the contaminated soils are not handled in accordance with application federal, state, and local laws, there is a risk that people could be exposed to contaminated vapors or particulates. <p>Operation</p> <ul style="list-style-type: none"> Operation of the facilities could generate odors, but the facilities would be designed to minimize odor generation. |
| | Measures to reduce or eliminate impacts | <p>Construction</p> <ul style="list-style-type: none"> Implement construction BMPs, including the following: <ul style="list-style-type: none"> Measures to control dust, such as watering construction surfaces or other temporary stabilization practices upon completion of grading. Require use of well-maintained or newer construction vehicles to reduce vehicle emissions. Measures to reduce vehicle trips and duration of trips. Special handling of contaminated soils in compliance with all applicable regulatory requirements under federal, state, and local laws. |

Table 1-1. Summary of Potential Impacts and Measures to Reduce Impacts

| | | Operation |
|------------------------------------|---|---|
| | | <ul style="list-style-type: none"> Design project to minimize the generation of odors by using odor control facilities in accordance with applicable permit requirements. |
| Fisheries and Biological Resources | Impacts | <p>Construction</p> <ul style="list-style-type: none"> Fish may be temporarily affected by localized turbidity plumes, underwater noise from in-water construction of the pier and outfall replacement, increased underwater shading from moored work barges, and increased nighttime lighting. Impacts are not considered significant. If barges are used to haul spoils, barge traffic would increase marine traffic through the Ballard Locks; limited impacts are expected due to recent fish passage improvements at the Locks, which have minimized injury and mortality rates of juvenile migrating fish. Construction near great blue heron nests may result in temporary disturbances during high intensity activities; however, construction will occur outside of the seasonal buffers recommended by WDFW and the City of Seattle, so impacts will not be significant. |
| | Measures to reduce or eliminate impacts | <p>Construction</p> <ul style="list-style-type: none"> Develop and implement a Construction Stormwater and Erosion Control Plan, Stormwater Pollution Prevention Plan (SWPPP), and a Spill Prevention Control and Countermeasure Plan. For all equipment operating water ward of the ordinary high water mark of the Ship Canal, use either nontoxic or vegetable oil-based hydraulic fluids. For timing of in-water work, comply with dates established through the permitting process and discussions with Tribal representatives. Install a turbidity or silt curtain around in-water construction activities to minimize the spread of turbidity in the Ship Canal, as determined by permit requirements. Use vibratory pile driving equipment where possible, with impact pile driving used for only short periods of time, primarily to meet load-bearing capacity standards. Use bubble curtain or other noise attenuation methods (wood blocks, nylon blocks, etc.) during impact installation or proofing of steel piles, if necessary. For all creosote-treated piles (if they are cut at the mudline) or their holes (if the piles are removed), cap with clean sediment to minimize leaching of chemicals into water or sediment, or as specified in permit conditions. The finished 24th Avenue NW pier would be designed to include increased light passage, compared to the existing pier. Replace trees removed as part of the project in accordance with the City of Seattle's tree protection ordinances. Minimize work area lighting at night to reduce light spillage. The project will comply with the Seattle Department of Construction and Inspections' Great Blue Heron Management Plan Director's Rule, as adopted or revised, to ensure that impacts to great blue heron do not occur. |

Table 1-1. Summary of Potential Impacts and Measures to Reduce Impacts

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| Land and Shoreline Use and Visual Quality | Impacts | <p>Construction</p> <ul style="list-style-type: none"> • Temporary and permanent easements for construction from some private landowners would be needed. • Some live-aboard boat relocations would be required associated with the pier reconstruction and barging of spoils. • Light, dust, and noise/vibration from construction equipment and staging could affect nearby uses; these temporary land use and visual impacts would be experienced for a longer period of time at the West Portal site compared to other project areas. <p>Operation</p> <ul style="list-style-type: none"> • Permanent easements for operations would be required for some facilities, but are not anticipated to interfere with existing site uses and access. At the South 3rd Avenue Drop Shaft, the presence of the drop shaft would restrict certain future uses in the surface area above the facility. The area is currently used for parking, and impacts are not considered significant. • The completed facilities would largely be constructed below ground. Aboveground facilities would have minimal visual impacts with the use of appropriate design and screening. |
| | Measures to reduce or eliminate impacts | <p>Construction</p> <ul style="list-style-type: none"> • Screen construction equipment and staging areas where feasible to buffer noise, dust, and views of construction equipment and materials. • SPU would comply with applicable federal, state, and local requirements regarding property acquisition and relocation assistance, including relocation assistance to moorage facilities affected by barging operations where applicable. • Locate and shield construction light sources to block direct views from residential areas, and aim lighting away from adjacent roadways, residential areas, and the Ship Canal; minimum wattage would be used to provide the necessary illumination. <p>Operation</p> <ul style="list-style-type: none"> • Minimize the size of permanent aboveground facilities and design them to blend with the surroundings. • Measures to reduce or eliminate impacts to land use, shoreline use, and visual quality would remain as described in the 2014 Plan EIS. At the West Portal site, aboveground facilities would be designed and located to maximize the future potential for reuse of the vacant restaurant building and allow for new development on the rest of the site. |
| Recreation | Impacts | <p>Construction</p> <ul style="list-style-type: none"> • Construction within City of Seattle parks would require approval by Seattle Parks and Recreation through a Revocable Use Permit. • If barging is used to haul spoils, the existing pier at the 24th Avenue NW street end would be inaccessible during construction. • Portions of West Ewing Mini Park and potentially Fremont Canal Park would be inaccessible during construction. • Portions of the Burke-Gilman Trail near the North 3rd Avenue /174 and 11th Avenue NW Drop Shafts could be closed or rerouted during construction. • Portions of the Ship Canal Trail near the South 3rd Avenue Drop Shaft could be closed or rerouted during construction. • Access to Seattle Pacific University's Crew Dock may be restricted or reduced during construction. • Construction activities would be visible and audible to recreationists at other parks and recreation sites in the vicinity of the project. <p>Operation</p> <ul style="list-style-type: none"> • Maintenance activities at facilities located within or adjacent to parks or the Burke-Gilman Trail would be noticeable to park and trail users but would be minor and unlikely to disrupt recreational activities. |

Table 1-1. Summary of Potential Impacts and Measures to Reduce Impacts

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| | Measures to reduce or eliminate impacts | <p>Construction</p> <ul style="list-style-type: none"> • During construction, maintain access to all recreational areas (except for the 24th Avenue NW pier and portions of Fremont Canal Park and West Ewing Mini Park needed for construction). • SPU would coordinate and provide Seattle Department of Transportation (SDOT) with advance notice of the construction period for the 24th Avenue NW pier construction and barge operations. • SPU would coordinate approval for any construction activities within City of Seattle parks through the Revocable Use Permit process. • SPU would provide Seattle Parks and Recreation with advance notice of times that parks would need to be closed for construction. • Project construction updates would be posted or delivered to interested parties so that park and trail users could anticipate when construction would occur. • Require the contractor to provide safe pedestrian and bicycle access to parks and trails affected by construction (except for any areas that are temporarily closed). • Early coordination and public outreach efforts would be conducted for construction along portions of the Burke-Gilman Trail. • SPU would coordinate with Seattle Pacific University throughout the construction process to reduce impacts to the University's recreational facilities. |
| Transportation | Impacts | <p>Construction</p> <ul style="list-style-type: none"> • Transportation impacts during construction would include temporary roadway lane and sidewalk narrowings or closures adjacent to construction activities. Some closures could require temporary detours of vehicular, transit, or non-motorized traffic. • Parking availability could be reduced in some neighborhoods. • If Ballard conveyance facilities were constructed via NW 54th Street, transportation impacts would be considered significant and unavoidable if adequate measures cannot be identified to maintain access to the businesses that use this segment of NW 54th Street. • Construction-generated truck trips would not significantly affect roadway operations, but would likely be noticeable. • If barges are used to haul spoils, barge traffic would increase marine traffic in Salmon Bay, but impacts to commercial and recreational navigation are not expected at the Ballard Locks or elsewhere in Salmon Bay. If rail is used during construction, increases in train traffic may result in potential conflicts with other vehicular or non-motorized traffic. • Construction of Ballard conveyance along Shilshole Avenue NW would require trench support approximately 1 foot from the end of the ties of the Ballard Terminal Railroad's (BTRR, also known as BDTL) main tracks for approximately the full length of the Salmon Bay Sand & Gravel (SBSG) siding. Without measures to reduce impacts, trenching adjacent to the tracks would disrupt train service at that location. Measures to limit the length of time and physical length of railroad closures would allow BTRR operations to be maintained during construction. The tracks would be fully operational after construction of the conveyance facilities is complete. • BTRR tracks would be temporarily disrupted at the 11th Avenue NW Drop Shaft construction area. Without measures to reduce impacts, trains would not be able to operate on the tracks between the areas east and west of this location for the duration of construction. With one or more of the rail maintenance measures described in Section 9.3 in place, BTRR operation could be maintained during construction. The drop shaft would be designed so that its permanent features would not interfere with the tracks, and the tracks would be fully restored after construction. <p>Operation</p> <ul style="list-style-type: none"> • Traffic associated with the operation and maintenance of facilities would be minimal, and would not be noticeable on area roads. |

Table 1-1. Summary of Potential Impacts and Measures to Reduce Impacts

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| | Measures to reduce or eliminate impacts | <p>Construction</p> <ul style="list-style-type: none"> • SPU would comply with conditions of the SDOT Street Use Permit. • The contractor would be required to prepare traffic plans for any work within the public right-of-way that affects vehicular, transit, bicycle, or pedestrian traffic. • Haul routes and appropriate times of travel for construction-generated truck traffic would be established by the City as part of the project permitting process. • To avoid creating long vehicle queues and high vehicle delays on principal and minor arterials during weekdays when traffic volumes and transit ridership are highest, off-peak, nighttime, and/or weekend construction may be required to reduce weekday traffic closures. • The project would prohibit construction employees from parking on public streets within 12 blocks of the project site in the contractor specifications, encouraging construction employees to carpool or take public transportation to the project site. • Manual traffic control would be needed when construction occurs through an intersection. • The contractor would be required to coordinate with property owners when driveways or alleys are affected by construction, and access to residences and businesses, including delivery loading and garbage pick-up, would need to be maintained at all times. • For locations with commercial loading zones that would be disrupted by project construction, SPU would need to work closely with business owners to ensure that access is maintained not only for their customers, but for the delivery of goods and services needed to maintain their operations. • Alternative detection equipment (e.g., camera detectors) might need to be installed to maintain proper signal function at in-pavement induction loops that control traffic signal operations. Loops or permanent cameras would need to be installed as part of restoration. • Compensation would be required for lost parking revenue from any paid on-street parking taken out of service during construction. • Some bus stops might need to be closed or relocated during construction. The contractor would be required to coordinate with Metro Transit to close or relocate a bus stop. • The Capital Projects and Roadway Structures Division of SDOT would coordinate the construction needs and impacts of this project with the other infrastructure and development projects in the study area. • A construction outreach team would be established to work closely with affected residents and business owners to minimize construction-related impacts throughout the duration of project construction. A contact person would be identified whom community members can contact to address specific concerns both prior to and during project construction. • The contractor would work with King County Metro Power Distribution to temporarily relocate or deactivate the trolley lines during construction if it is required for the construction equipment clearances along or across NW Market Street. SPU would work closely with Metro to avoid or minimize disruption to trolley buses. Otherwise, if sufficient numbers of non-trolley buses were not available, it could be necessary to limit construction activities to off-peak periods. • To minimize the impact of railroad track closures during construction of Ballard conveyance facilities along Shilshole Avenue NW, SPU would coordinate with BTRR to determine an appropriate period when the tracks are not used for railroad operation to implement construction closures. SPU would coordinate with BTRR to identify the periods for temporary closures with the least disruption to rail operation. Subject to BTRR's franchise agreement with the City, SPU would coordinate with BTRR to identify and implement the appropriate measures to mitigate project construction impacts to rail operation at this location. • If using rail to carry materials to or from the project work sites, additional signage, and/or flaggers would be provided at key crossing locations to minimize the potential conflict with other vehicular or non-motorized traffic. Additional signage may also be needed to warn drivers that parking on the railroad tracks is illegal and violators will be towed. • For construction activities near the BTRR tracks, the contractor would be subject to safety regulations set forth by the Federal Railroad Administration (FRA) and BTRR. |
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Table 1-1. Summary of Potential Impacts and Measures to Reduce Impacts

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| | | <ul style="list-style-type: none"> • Potential measures to maintain BTRR operation when project construction would disrupt the mainline tracks at 11th Avenue NW/NW 45th Street include one or more of the following: <ul style="list-style-type: none"> ○ Use of design and contracting approaches to reduce impacts to BTRR operations during construction, such as siting facilities in areas that minimize construction/post construction impacts, and/or stipulating construction methods that reduce excavation or other construction conflicts. ○ Temporary or permanent realignment of the main track between 9th Avenue NW and 11th Avenue NW to avoid conflicts with construction activities. ○ Rehabilitation of the BTRR main track between the Yankee Diner Switch and Salmon Bay Switch to enable its use for railcar storage and locomotive turnaround operation. Additional signage and enforcement of parking prohibition would be required at all times to replace railcar storage capacity. ○ Rehabilitation of the Western Pioneer Transfer Yard, including track rehabilitation and one new turnaround to enable its use for railcar storage, locomotive turnaround operation, and potentially, trans-load operations. Additional signage and enforcement of parking prohibition would be required at all times to replace railcar storage capacity. ○ Subject to BTRR’s franchise agreement with the City, SPU would coordinate with BTRR to identify and implement the appropriate measures to reduce project construction impacts to rail operation at this location. |
| <p>Noise and Vibration</p> | <p>Impacts</p> | <p>Construction</p> <ul style="list-style-type: none"> • Residential areas near the Ballard and Wallingford conveyance facilities have the greatest potential for experiencing intermittent noise impacts. • Construction activities at the West Portal are expected to exceed nighttime sound level limits. A noise variance would be required from the City of Seattle. • If rail is used during construction, increases in train traffic could increase noise levels along the BTRR tracks. • Vibration impacts such as minor cosmetic damage to structures or annoyance of occupants may occur. <p>Operation</p> <ul style="list-style-type: none"> • Operation of the facility would generate noise, but noise levels are generally not expected to be noticeable to surrounding properties. The operation of the completed facilities must comply with the SMC sound level limits at adjacent property lines. |
| | <p>Measures to reduce or eliminate impacts</p> | <p>Construction – Noise</p> <ul style="list-style-type: none"> • Establish daytime and nighttime sound level limits at nearby noise sensitive receptors (this may be required during the procurement of a Noise Variance). • Develop a Noise Control Plan and monitor sound levels during construction. • Monitor sound levels during construction. • Line truck beds with rubber bed liners, or keep 1 foot of dirt in the bottom of the trucks to reduce impact noise from loading materials. • Change backup warning devices to the least intrusive broadband type, or use backup observers as permitted by law. • Direct generators, compressors, and other stationary equipment away from noise-sensitive receptors. • Remove debris spilled on pavement by hand and do not use scraping type equipment where practical. • Use rubber tired equipment in lieu of track type equipment whenever possible and safe to do so. • Limit engine idling to not more than 5 minutes when the vehicle or equipment is not directly engaged in work activity, such as on-site pickup trucks and waiting haul trucks. • Fit equipment with high-grade engine exhaust silencers and/or engine shrouds to reduce noise emissions. • Enclose stationary equipment such as generators, pumps, and compressors, or use noise curtains when barriers are infeasible. |

Table 1-1. Summary of Potential Impacts and Measures to Reduce Impacts

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| | | <ul style="list-style-type: none"> Use electric equipment in lieu of pneumatic or diesel equipment, where feasible. Install noise barriers to reduce or block line-of-sight to neighboring noise-sensitive receptors. Limit the use of impact equipment to daytime hours. <p>Operation - Noise</p> <ul style="list-style-type: none"> Install sound traps on all odor control fan air discharges. Size the odor control fan discharge duct to prevent discharge airflow from exceeding 300 feet per second. If duct work is installed outside of a structure, use either double-walled duct or round duct. Install acoustical louvers on all air intakes and discharges, or install sound traps as close to the wall penetrations as possible. Install insulated metal doors with adjustable neoprene seals on all external doors. Use the quietest equipment available, where feasible. Install acoustical panels, acoustical decking, or spray-on acoustical treatments inside structures containing loud equipment. Develop noise limits based on site-specific sound criteria during final design. Conduct additional noise analysis and identify additional measures to reduce noise as appropriate during final design. <p>Construction - Vibration</p> <ul style="list-style-type: none"> As needed, conduct further investigation and analysis during final design to determine the site-specific soil vibration propagation characteristics. Develop site-specific vibration limits during final design. Monitor vibration levels at receiving properties during construction. Develop a Vibration Control Plan including predicted vibration levels from the contractor's proposed methods and equipment as well as any mitigation measures that would be required to satisfy the project's vibration limits. Offer to temporarily relocate residents during activities expected to generate prolonged vibration impacts. Limit the distances between vibration generating equipment and sensitive vibration receiving properties. Locate stationary vibration generating equipment away from vibration sensitive receptors. Develop site-specific vibration mitigation measures during final design. Conduct vibration generating activities during periods when nearby occupants may not be present (e.g., during the middle of the day near residents). <p>Operation - Vibration</p> <ul style="list-style-type: none"> Install vibration isolation on fans, pumps, and generators, where feasible. Assess vibration produced by equipment during final design. |
| Energy | Impacts | <p>Construction and Operation</p> <ul style="list-style-type: none"> The greenhouse gas emissions and energy consumption of the project represent a small portion of regional emissions and consumption. |
| | Measures to reduce or eliminate impacts | <p>Construction</p> <ul style="list-style-type: none"> Incorporate specifications into construction contracts that encourage the use of fuel-efficient construction equipment. Encourage contractors to offer carpooling options for employees. Specify the use of more bio-degradable and biologically non-reactive chemicals as part of the tunnel boring operation, where feasible. Minimize engine idling during construction. Reduce greenhouse gas emissions associated with increases in traffic congestion and idling near the construction site by moving materials via barge and rail when possible. Incorporate specifications into construction contracts that require use of well-maintained or newer construction vehicles to reduce vehicle emissions. Specify particular mixes of concrete that reduce greenhouse gas emissions where feasible. |

Table 1-1. Summary of Potential Impacts and Measures to Reduce Impacts

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|--------------------|---|---|
| | | <p>Operation</p> <ul style="list-style-type: none"> Comply with state and City of Seattle requirements related to energy efficiency of the new CSO facilities. Design systems that minimize energy use throughout the life-cycle of the project. Engineer systems that use gravity flows for stormwater conveyance in lieu of energy-intensive pumping stations, where feasible. |
| Cultural Resources | Impacts | <p>Construction and Operation</p> <ul style="list-style-type: none"> No probable significant impacts are anticipated to aboveground historic resources. While no archaeological resources have previously been identified in the project study area, if archaeological resources were identified during construction, potential impacts to archaeological resources would be permanent. |
| | Measures to reduce or eliminate impacts | <p>Construction and Operation</p> <ul style="list-style-type: none"> This project requires compliance with the National Historic Preservation Act (NHPA). A cultural resources assessment is being completed, which will include geotechnical monitoring, documentation of historic structures, and background research to support consultation under the NHPA. When the final design is prepared, any specific avoidance or minimization measures would be developed in consultation with the City of Seattle Historic Preservation Program. If required, measures might include additional survey activities or vibration monitoring. Under Revised Code of Washington Chapter 27.53, archaeological resources identified during construction would need to be evaluated. If considered significant, any impacts on archaeological resources would require mitigation that would likely entail archaeological investigation such as excavation and analysis. At a minimum, an Archaeological Monitoring Plan and an Inadvertent Discovery Plan would be prepared in consultation with the Washington State Department of Archaeology and Historic Preservation (DAHP) that outlines the procedures to follow if archaeological resources were identified during construction activities. |

1.6 Would there be significant adverse impacts that could not be reduced or eliminated?

Potential construction and operation impacts are expected to be less than significant because of measures designed to reduce or eliminate adverse impacts, with one potential exception. If the proposed Ballard conveyance is constructed via NW 54th Street, transportation impacts would be considered significant and unavoidable unless measures could be implemented to maintain adequate access to adjacent businesses during construction. Current plans indicate that a portion of the NW 54th Street conveyance option would be constructed using microtunneling. In addition to microtunneling along sections where trenching would leave no access options, a very high level of coordination with business owners would be required to identify other measures needed to maintain access to these properties during construction. If adequate measures cannot be identified, the transportation impact of this option would be considered significant and unavoidable.

1.7 What are the cumulative impacts of the Ship Canal Water Quality Project?

Construction of the Ship Canal Project would occur in the context of multiple private development and public infrastructure projects that are expected to be under construction or completed by the time the Ship Canal Project is constructed. These projects and actions are largely the same as described in the 2014 Plan EIS, except that planning for the Burke-Gilman Trail Extension Project (Missing Link) has advanced, and the Nordic Heritage Museum is planning to relocate to the Ship Canal general project area. SDOT is currently preparing a SEPA EIS

for the Missing Link project, which has an overlapping project area in the Ballard area. All Missing Link alternatives would be in the Ballard neighborhood and have locations that overlap with Ship Canal Project components at multiple points. Although the Missing Link Project does not yet have a construction schedule, construction could occur between 2018 and 2024. These estimates suggest that Ship Canal Project construction would overlap with construction of the Burke-Gilman Trail Missing Link.

The Nordic Heritage Museum is relocating to a site south of NW Market Street between 28th Avenue NW and 26th Avenue NW, with a planned opening date in 2018. Construction of conveyance could potentially overlap with construction of their new museum, or could result in access issues for the newly opened facility. Other reasonably foreseeable projects in the Ballard area include a new office campus planned by C.D. Stimson Co. for a site adjacent to the West Portal along Shilshole Avenue NW. No construction dates have been identified for this project. In the Wallingford area, construction of SPU's North Transfer Station project was completed in late 2016, which was a source of temporary and intermittent construction-related effects in the Wallingford neighborhood during its 2-year construction period. In the Fremont area, construction of King County DNRP's Fremont Siphon project is anticipated to occur until early 2017 in the vicinity of the North 3rd Avenue/174 Drop Shaft, but is unlikely to overlap with construction of the drop shaft.

These, and other past and present actions, including numerous private construction projects for offices, multi-unit housing, and other types of projects, have contributed to trends of increasing traffic congestion and delays, noise, vibration, and construction-related air quality issues in the project area.

By consolidating storage in a large tunnel, SPU and DNRP are reducing the total number of CSO control facilities required to meet regulatory requirements. As such, the potential for cumulative impacts associated with the construction of numerous storage facilities is reduced.

1.8 What are the areas of controversy?

Key issues that were raised during scoping and through stakeholder outreach, including a community survey and briefings, include concerns about traffic impacts, access, construction-related noise, dust, and odors. Residents near the East Portal have expressed concern that the construction there is occurring in an area that was disrupted by construction of SPU's North Transfer Station. Community members in the Wallingford/Fremont neighborhood have expressed concerns that the construction is incompatible with the residential neighborhood.

1.9 What public outreach efforts have been conducted?

Public involvement is an important part of the Ship Canal Project. During this project, SPU has built upon public outreach and engagement efforts that began in 2010 as part of the Long-Term Control Plan. Section 2.10 of the 2014 Plan EIS outlines those efforts. SPU conducted public outreach efforts specific to the Ship Canal Project beginning in spring 2015. These efforts included a community survey, outreach to community stakeholders, as well as a SEPA scoping process to determine the scope of issues to be included in the Supplemental EIS. These efforts are described in Section 2.7 of the Final Supplemental EIS.

1.10 What is in this Final Supplemental EIS?

This Final Supplemental EIS includes the following chapters:

- **Chapter 1** provides background information on the Ship Canal Project and the Plan to Protect Seattle's Waterways, a summary of impacts, and a summary of public outreach efforts.
- **Chapter 2** describes the Ship Canal Project and its components, construction activities, and project operation, as well as a description of public outreach efforts.
- **Chapters 3 through 12** describe the existing conditions, potential impacts, measures to reduce or eliminate impacts, and unavoidable significant adverse impacts for specific elements of the environment. Only new information or information not included in the Plan EIS is evaluated in the Final Supplemental EIS. The Final Supplemental EIS includes the following chapters:
 - **Chapter 3** – Earth and Groundwater
 - **Chapter 4** – Surface Water
 - **Chapter 5** – Air Quality and Odors
 - **Chapter 6** – Fisheries/Biological Resources
 - **Chapter 7** – Land and Shoreline Use/Visual Quality
 - **Chapter 8** – Recreation
 - **Chapter 9** – Transportation
 - **Chapter 10** – Noise and Vibration
 - **Chapter 11** – Energy and Climate Change
 - **Chapter 12** – Cultural Resources
- **Chapter 13** – Cumulative Impacts
- **Chapter 14** lists references cited throughout the Supplemental EIS.
- **Chapter 15** includes a distribution list for the Supplemental EIS.

- **Appendix A – Draft Supplemental EIS Comments and Responses**
- **Appendix B – Transportation Technical Information**
- **Appendix C – Noise and Vibration Technical Information**
- **Appendix D – Energy and Climate Change Technical Information**

Description of the Ship Canal Project

As discussed in Chapter 1, SPU and DNRP have determined that the Ship Canal Water Quality Project is the preferred approach for controlling CSOs in the Ballard, Fremont, north Queen Anne, and Wallingford areas, and as such it is the only alternative evaluated in this Final Supplemental EIS. The No Action Alternative has not changed from what was described in the 2014 Plan EIS and is not re-evaluated in this document. This chapter describes the main components of the Ship Canal Project, as refined during the development of the Draft Facility Plan.

2.1 What is the project location?

The project is located in the Ballard, Fremont, Wallingford, and north Queen Anne neighborhoods of Seattle, adjacent to the Lake Washington Ship Canal (Figure 2-1).

2.2 What are the project components?

The Ship Canal Project would provide offline storage of combined wastewater in an underground storage tunnel constructed between the Ballard and Wallingford CSO areas, on the north side of the Ship Canal. The project would control SPU's Ballard CSO basins (Outfalls 150, 151, and 152); Fremont (Outfall 174) and Wallingford CSO basins (Outfall 147); and DNRP's 3rd Avenue West Regulator (DSN008) and 11th Avenue NW Regulator (DSN004). Figure 2-1 illustrates the proposed project location and components.

The main components of the Ship Canal Project include the storage tunnel and appurtenances, and conveyance facilities to convey SPU and DNRP CSO flows into the tunnel and to drain flows from the tunnel.

The storage tunnel and appurtenances would include the following:

- A minimum 15.24-MG offline storage tunnel, approximately 14 to 18 feet in diameter and approximately 2.7 miles long or as defined during the design phase of the project. Two portals to serve as access and egress for a tunnel boring machine necessary to construct the tunnel.
- Drop shaft structures to convey influent CSO flow into the storage tunnel.
- Pier reconstruction and temporary pier extensions and mooring dolphins to support tunnel construction.
- A pump station (tunnel effluent pump station) at the West Portal to empty the storage tunnel.
- Odor control facilities.

Key Facts

- The approximately 2.7-mile long underground storage tunnel would store combined sewage flows during rain storms and prevent overflows into the Ship Canal.
- Construction would be focused at the West Portal in Ballard and at other key sites in Fremont, Wallingford, and north Queen Anne.
- Construction would begin in 2017 and be completed in 2024, lasting about 6 to 7 years. Over this period, active construction would occur in phases at different locations.

Conveyance facilities would include the following:

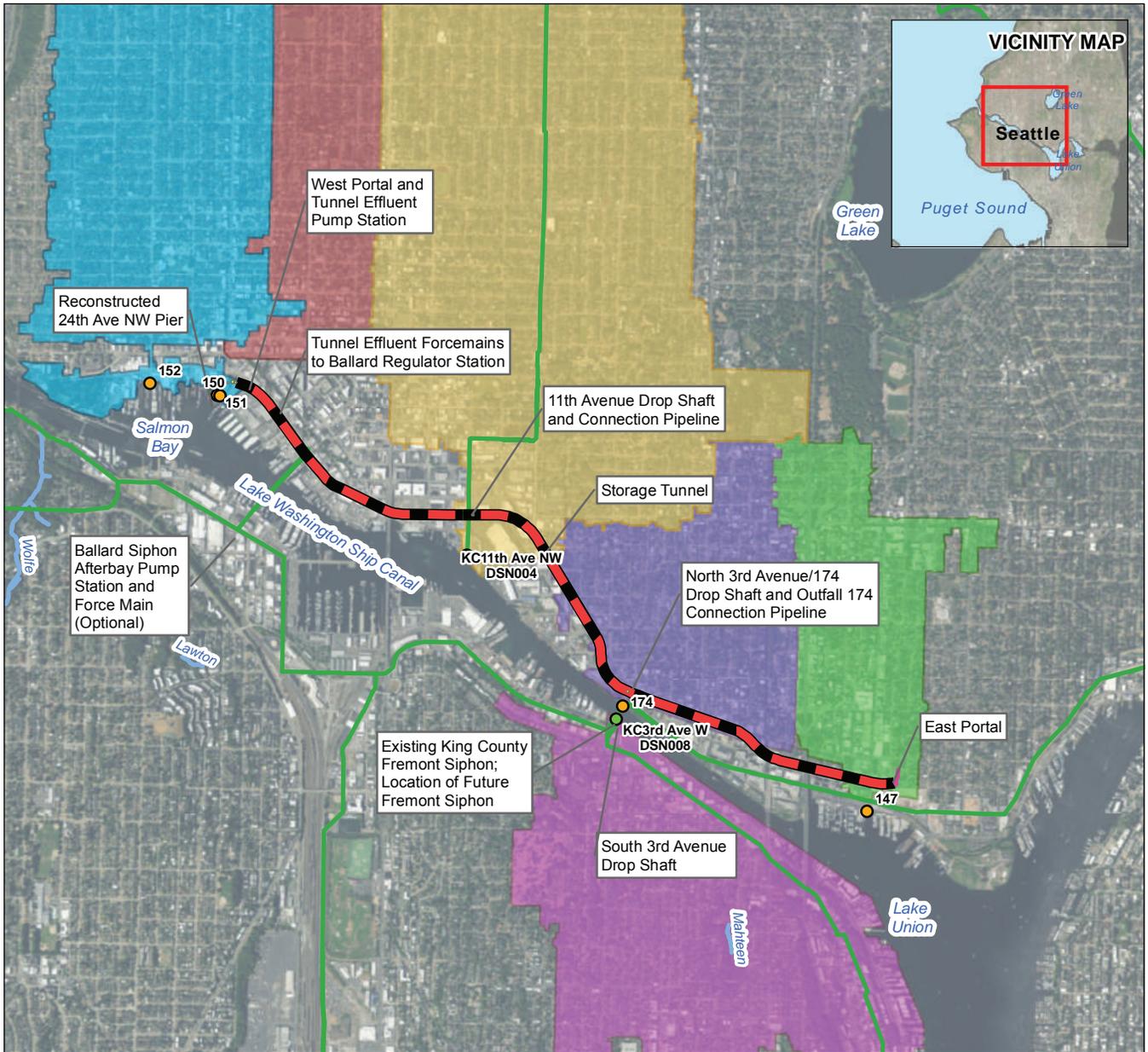
- Diversion structures for diverting combined sewage flows away from the existing CSO outfalls and toward the storage tunnel.
- Gravity sewers to convey flows from SPU's diversion structure at Ballard CSO Outfalls 150, 151, and 152 to the tunnel drop shaft.
- Gravity sewers to convey flows from SPU's diversion structure at Fremont CSO Outfall 174 to the tunnel drop shaft.
- Gravity sewers to convey flows from SPU's diversion structure at Wallingford CSO Outfall 147 to the tunnel drop shaft.
- Gravity sewers to convey flows from DNRP's diversion structure at 3rd Avenue W (under the Ship Canal) to the tunnel drop shaft.
- Gravity sewers to convey flows from DNRP's diversion structure at 11th Avenue NW to the tunnel drop shaft.
- Gravity sewers or force main to convey flows from the tunnel effluent pump station to DNRP's existing Ballard Siphon.

SPU is solely responsible for constructing, operating, and maintaining gravity sewers to convey flows from SPU's diversion structures at Ballard CSO Outfalls 150, 151, and 152, and Wallingford CSO Outfall 147 to the tunnel drop shafts. King County and the City of Seattle have entered into a JPA that defines the joint project and the roles and responsibilities for each agency. **King County's participation as a partner with SPU on the Ship Canal Project has been approved and documented by modification to its Consent Decree with EPA and Ecology, filed October 25, 2016 with the United States District Court, Western District of Washington.**

The major project components described below are based on preliminary design and will be refined during project design. For purposes of this Final Supplemental EIS, the description of these components is organized as follows: **Storage Tunnel, West Portal, East Portal, Drop Shafts, and Conveyance Facilities** (which include diversion structures, conveyance pipelines, and grit removal facilities). Additional detail on the proposed facilities can be found in Chapter 10 of the Draft Ship Canal Water Quality Project Facility Plan, available at www.seattle.gov/util/ShipCanalProject.

2.2.1 Storage Tunnel

Various storage and flow transfer concepts were evaluated in SPU's Plan (SPU, 2014) and DNRP's CSO Long-Term Control Plan (DNRP, 2012). After extensive review of engineering, environmental, community, and economic considerations, both the City and King County selected a storage tunnel as the recommended option.



LEGEND

- | | | |
|---------------------------------------|---------------------------------------|---------------------------------------|
| ● King County CSO Outfall | CSO Basin | ■ SPU Basin 150/151 (Ballard) |
| ● Seattle CSO Outfall | ■ King County 11th Ave NW | ■ SPU Basin 152 (Ballard) |
| — Ship Canal Project Tunnel Alignment | ■ King County 3rd Ave W | ■ SPU Basin 147 (Fremont/Wallingford) |
| — KC Combined Sewer Mainline | ■ SPU Basin 174 (Fremont/Wallingford) | |



A new storage tunnel to store a minimum of 15.24 MG of combined sewage would be built on the north side of the Ship Canal between the Ballard and Fremont/Wallingford CSO areas and would provide storage needed to address sewage overflows in the City's Ballard, Fremont, and Wallingford CSO areas, and King County's 3rd Avenue West and 11th Avenue NW CSO areas in north Queen Anne and Fremont, respectively. The approximately 2.7-mile-long tunnel would be approximately 14 to 18 feet in diameter and would be located approximately 100 to 120 feet below the surface for most of its alignment. A tunnel design option being considered could reduce the average depth of the tunnel from 120 feet to a range of approximately 50 to 90 feet below grade. For both potential ranges of tunnel depths, the tunnel boring machine would operate for a period of approximately **2.5 years**.

Flows would enter the storage tunnel by gravity and would be pumped to the local SPU collection and DNRP's wastewater conveyance system when capacity in these systems is available. All flows drained from the tunnel will be treated at DNRP's West Point Treatment Plant. The storage tunnel would extend from the West Portal in Ballard to the East Portal in Wallingford, following roadway right-of-way where possible along Shilshole Avenue NW, NW 45th Street, Leary Way NW, North 36th Street, Fremont Place North, and North 35th Street. SPU selected this tunnel alignment after considering the required tunnel end points and available properties for permanent facilities, and to locate the tunnel as much as possible along public rights-of-way. The tunnel would be separate from the existing collection and conveyance systems (referred to as an "offline" tunnel), and would store flows only when necessary to prevent CSOs. At other times, flows would be conveyed through the existing collection and conveyance systems. Construction would begin at the West Portal and finish at the East Portal.

2.2.2 West Portal

The West Portal site is an approximately 2.15-acre City-owned site adjacent to the Ship Canal in Ballard, bounded to the west by 24th Avenue NW and to the north by Shilshole Avenue NW (Figures 2-2, 2-3, and 2-4). The West Portal would serve a dual purpose, both during and after construction. During construction, the West Portal would be the site where the tunnel boring machine (TBM) is launched and tunnel spoils removed. The West Portal would have the longest duration and be the most visible component of tunnel construction activity. To support construction, material handling facilities would be located on the portal site, including a pier to support barging and potentially a rail spur to support rail transport of equipment and potentially contaminated soil. When construction is complete, the portal would be used as a drop shaft to convey untreated combined sewage to the tunnel and would also house a pump station, grit handling equipment, odor control facilities, backup power (generators), instrumentation, and electrical equipment. These facilities and

How was the storage tunnel selected?

SPU and DNRP developed and evaluated alternatives for addressing CSOs by first identifying and evaluating high-level CSO control options. SPU and DNRP then developed and evaluated storage options, including both independent and joint storage options, and then determined the preferred options, which were refined into the recommended option. SPU and DNRP separately evaluated the conceptual CSO control options for costs, technical feasibility, and community impacts using a multiple objectives decision analysis that rated the options. The general result of this analysis was that fewer but larger storage facilities are more favorable than multiple smaller facilities. For the Ship Canal Project basins, SPU evaluated both independent and shared offline storage tanks, and independent and shared tunnels. DNRP provided a similar analysis for basins under its control, including independent conveyance pipes, offline storage tanks, and a joint storage tank with SPU. Based on the results of the extensive evaluation, the recommended option is the Ship Canal Water Quality Project.

activities are described below. As previously noted, these descriptions are based on preliminary evaluations and will be refined during project design.

Tunnel Effluent Pump Station (TEPS). A permanent pump station would be constructed at the West Portal. The TEPS would be located within a deep shaft used to construct the tunnel, and would be used to pump the tunnel effluent to the wastewater collection system owned and operated by DNRP. The TEPS would include an aboveground building over the shaft and pumps, which would house a diesel-powered backup generator. An odor control facility would also be located on-site. The TEPS would have automated operation, and would include safety and ventilation systems, electrical/control systems, access facilities such as stairways and potentially an elevator, space for on-site maintenance, permanent lifting equipment, other systems designed for long-term operation and maintenance, and crew facilities.

Barge Transport. Barge transport could support project construction, which would require replacing the existing 271-foot long pier located at the 24th Avenue NW street end with a pier that could support barges transporting excavated earth and construction spoils and equipment (Figure 2-5). In addition to temporary barge mooring facilities at the pier-end, deck extensions alongside the pier within the City-owned right-of-way could be used to provide additional work platforms during barging. Temporary mooring dolphins could be installed around the pier and extend into the Ship Canal beyond the end of the pier. Barges would be loaded with a closed conveyor located on the West Portal site utilizing one lane of the 24th Avenue NW street end and extending onto the pier. Barging would occur for the approximately 2.5-year tunneling duration and potentially for other mass grading activities for the project. The pier would not be available for public use during pier construction and for the duration of barging activity. Upon completion of the project, the temporary pier extensions would be removed and the permanent pier would be restored for public use.

Rail Transport. Rail transport could support project construction using an existing rail line, the Ballard Terminal Railroad (BTRR), operated by the Ballard Terminal Rail Company. (Note: the BTRR is also referred to as BDTL. This reporting mark is an alphabetic code of one to four letters used to identify owners or lessees of rolling stock and other equipment used on certain railroad networks. Because the Ballard Terminal Railroad has been referred to as BTRR in previous City documents and is known to much of the public as BTRR, the Final Supplemental EIS uses the BTRR acronym.) The 3-mile spur extends from north Ballard and connects to the BNSF mainline at the Shilshole yard just north of NW 68th Street. Improvements to the existing rail line such as replacing ties or ballast and/or maintenance could be required, and a rail spur may be constructed to access the West Portal site. The rail line would be used to transport construction equipment and materials to the West Portal, and to transport tunnel spoils and potentially contaminated soil from the site (Figure 2-6).

Using rail and barges would reduce the amount of truck traffic needed to transport tunnel spoils and certain materials and equipment on city streets.

2.2.3 East Portal

The East Portal is the eastern terminus of the tunnel and is located on an approximately 0.5-acre City-owned property in the northeast corner of Interlake Avenue North and North 35th Street (Figures 2-7 and 2-8). Similar to the West Portal, the East Portal would serve dual purposes. During construction, the portal would be the site where the TBM would complete tunneling. After construction is complete, the portal would be used as a drop shaft to convey untreated combined sewage to the tunnel and would house odor control equipment, a standby generator, and a flushing gate and reservoir within the shaft used to clean the tunnel following operation.

2.2.4 Drop Shafts

The drop shafts would convey untreated combined sewage into the storage tunnel. They also would provide access for tunnel maintenance. Drop shafts along the proposed tunnel alignment would be located within the West Portal wet well, at the East Portal, and at or near existing outfalls along the tunnel route at the following locations and as shown on Figures 2-9 and 2-10:

- Near 11th Avenue NW and NW 45th Street in Ballard (**11th Avenue NW Drop Shaft**)
- East of 3rd Avenue NW near the intersection of Leary Way NW and NW 36th Street in Fremont (**North 3rd Avenue/174 Drop Shaft**)
- Near 3rd Avenue W and West Ewing Street on the south side of the Ship Canal in north Queen Anne (**South 3rd Avenue Drop Shaft**)

Small standby generators located at the drop shafts would provide power to instrumentation and nearby control gates located at conveyance system diversion structures.

2.2.5 Conveyance Facilities

Conveyance facilities include pipelines to transport sewage from the combined sewer basins to drop structures, where flow enters the storage tunnel, and pipelines to transport flows from the tunnel to DNRP's wastewater collection system. Approximately 3,300 linear feet of gravity conveyance pipelines ranging from 24 to 72 inches in diameter would be constructed, largely in public rights-of-way, to convey flows to drop structures. Approximately 1,900 feet of gravity or force main pipelines would be constructed to convey stored flows from the tunnel effluent pump station to DNRP's existing Ballard Siphon.

Figures 2-2 through 2-11 show general construction areas, which encompass the areas where conveyance lines and new upstream grit removal facilities would be constructed based on preliminary design. Specific conveyance routes and grit facility locations will be determined during final design, and not all the area shown on the figures would be required for construction. Construction-related disruption could occur on all or part of the following streets, depending on the final conveyance route.

West Portal and Ballard Conveyance

- Shilshole Avenue NW (NW Market Street to NW Dock Place)
- 24th Avenue NW (NW Market Street to the West Portal)

Several options for providing other needed conveyance connections in the Ballard area have been identified (see Figure 2-11). Construction-related disruption could occur on the following streets, depending on the final conveyance route. Microtunneling could be used for some alignments.

Option 1: Conveyance via NW 54th Street

- NW Market Street (crossing at 28th Avenue NW)

Option 2: Conveyance via NW Market Street

- NW Market Street (24th Avenue NW to 28th Avenue NW)

Option 3: Conveyance via NW 56th Street

- NW Market Street (crossing at 24th Avenue NW)

- 24th Avenue NW (NW Market Street to NW 56th Street)

North 3rd Avenue/174 Drop Shaft – Fremont and Associated Conveyance

- Leary Way NW (NW 41st Street to NW 36th Street/2nd Avenue NW)

East Portal and Wallingford Conveyance

In Wallingford, construction-related disruption could occur on the following streets, depending on the final conveyance route:

- Stone Way N (N 38th Street to N Northlake Way)
- N 34th Street (Woodland Park Avenue N to Stone Way N)
- N 36th Street (Stone Way N to Woodlawn Avenue N)
- Woodlawn Avenue N (N 36th Street to N 35th Street)
- N 35th Street (Woodland Park Avenue N to Woodlawn Avenue N)

New grit removal facilities may be needed in the upstream conveyance system to remove grit from flows before they enter the system. The need for grit removal facilities and their specific locations will be identified during detailed design. Table 2-1 summarizes potential locations.

Table 2-1. Grit Removal Structures – Approximate Locations and Construction Area Requirements

| Structure (by Outfall) | Approximate Location | Approximate Construction Area (square feet) |
|------------------------|--|---|
| Outfall 152 | 28th Avenue NW between NW 57th Street and NW 58th Street | 3,000 |
| Outfall 150/151 | 20th Avenue NW between NW Market Street and NW 56th Street | 3,000 |
| Outfall 174 | Leary Way NW near 2nd Avenue NW | 3,000 |
| Outfall 174 | NW 39th Street between Leary Way NW and 3rd Avenue NW | 3,000 |
| Outfall 147a | Stone Way N between N 35th Street and N 36th Street | 3,000 |
| Outfall 147b | Woodland Park Avenue N between N 35th Street and N 36th Street | 3,000 |

Other conveyance components, including points of connection with the tunnel and/or diversion structures, would be included as needed. Real time controls, including automated adjustable gates and level sensors, would be included at diversion structures and would actively control flows entering the storage tunnel. Some existing SPU and DNRP overflow structures would be modified, primarily to reconstruct or adjust weirs. In Wallingford, additional CSO control or conveyance facilities, to be determined during design, may be required to control storm flows that otherwise could not enter the storage tunnel because of gradient issues. The location and size of the facilities would be determined during design following flow monitoring and hydraulic modeling to determine needs, but would likely be located in street right-of-way. As appropriate, additional environmental review under SEPA would be conducted to evaluate any potential impacts and measures to reduce or eliminate impacts not already addressed in this Supplemental EIS.

All conveyance sizing and quantities are estimates based on conceptual planning to date. Actual locations, diameters, and lengths of conveyance facilities will be determined during the design phase of the project.

Note: General construction areas shown are approximate and encompass the anticipated extent of potential construction activity

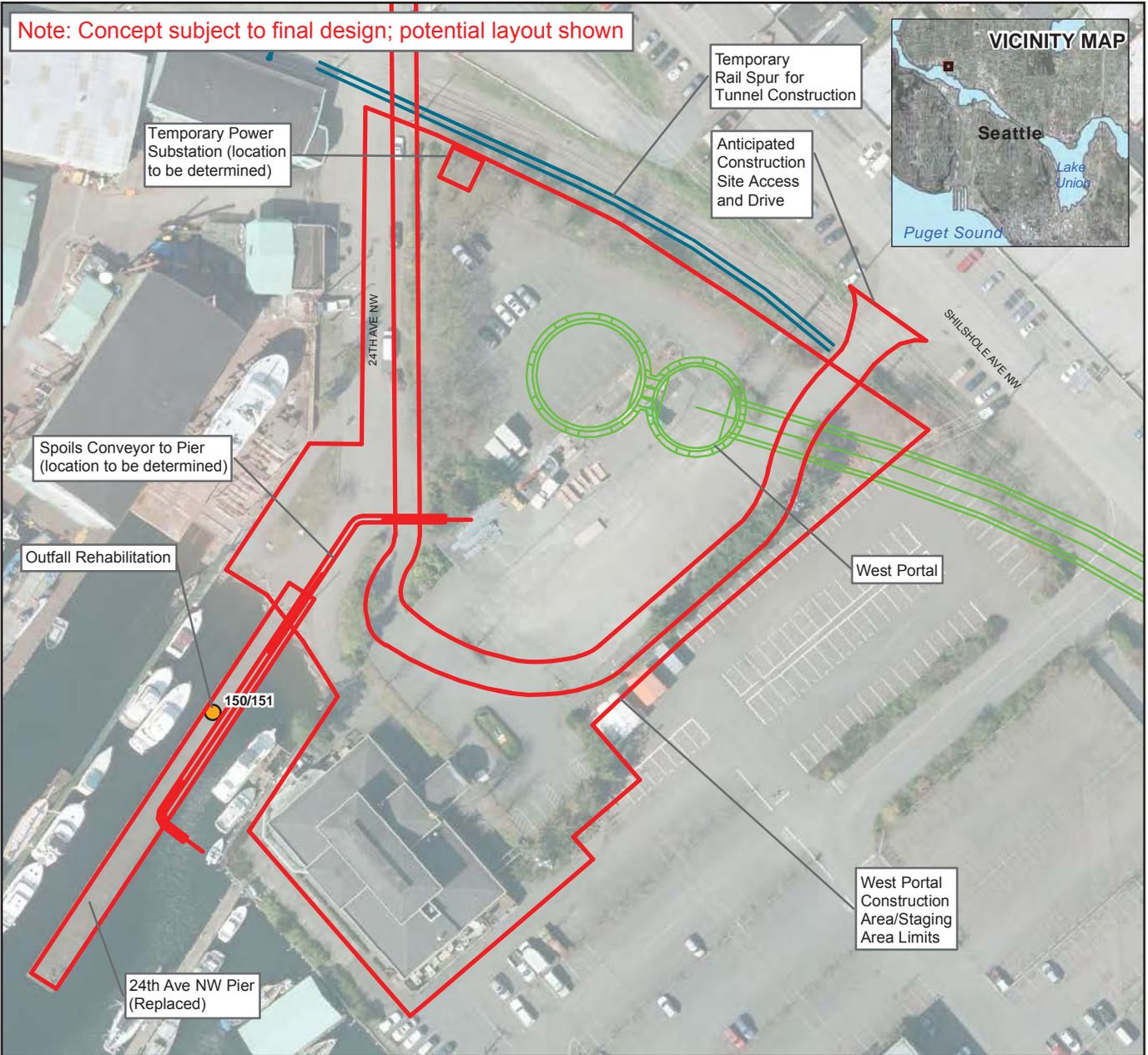


LEGEND

- Seattle CSO Outfall
- Finished Building Footprint
- King County Combined Sewer Mainline
- General Construction Area
- Storage Tunnel



Note: Concept subject to final design; potential layout shown



LEGEND

- Storage Tunnel
- Construction Site Features
- Temporary Rail Spur

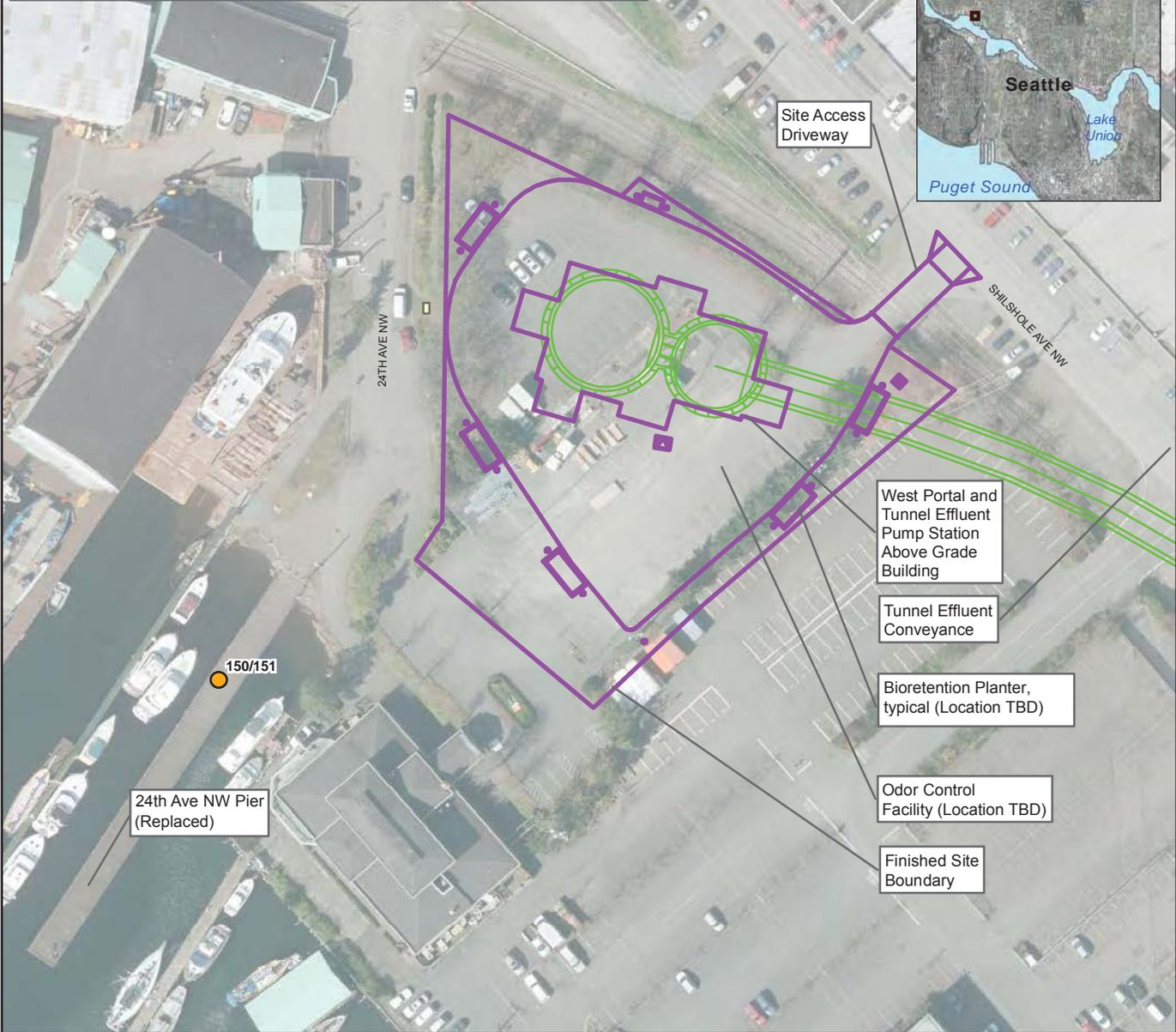


**Ship Canal Water Quality Project
Supplemental EIS**

**West Portal and Effluent Pump
Station Conceptual Construction
Plan**

Figure 2-3

Note: Concept subject to final design; potential layout shown



LEGEND

- Seattle CSO Outfall
- Storage Tunnel
- Finished Site Features

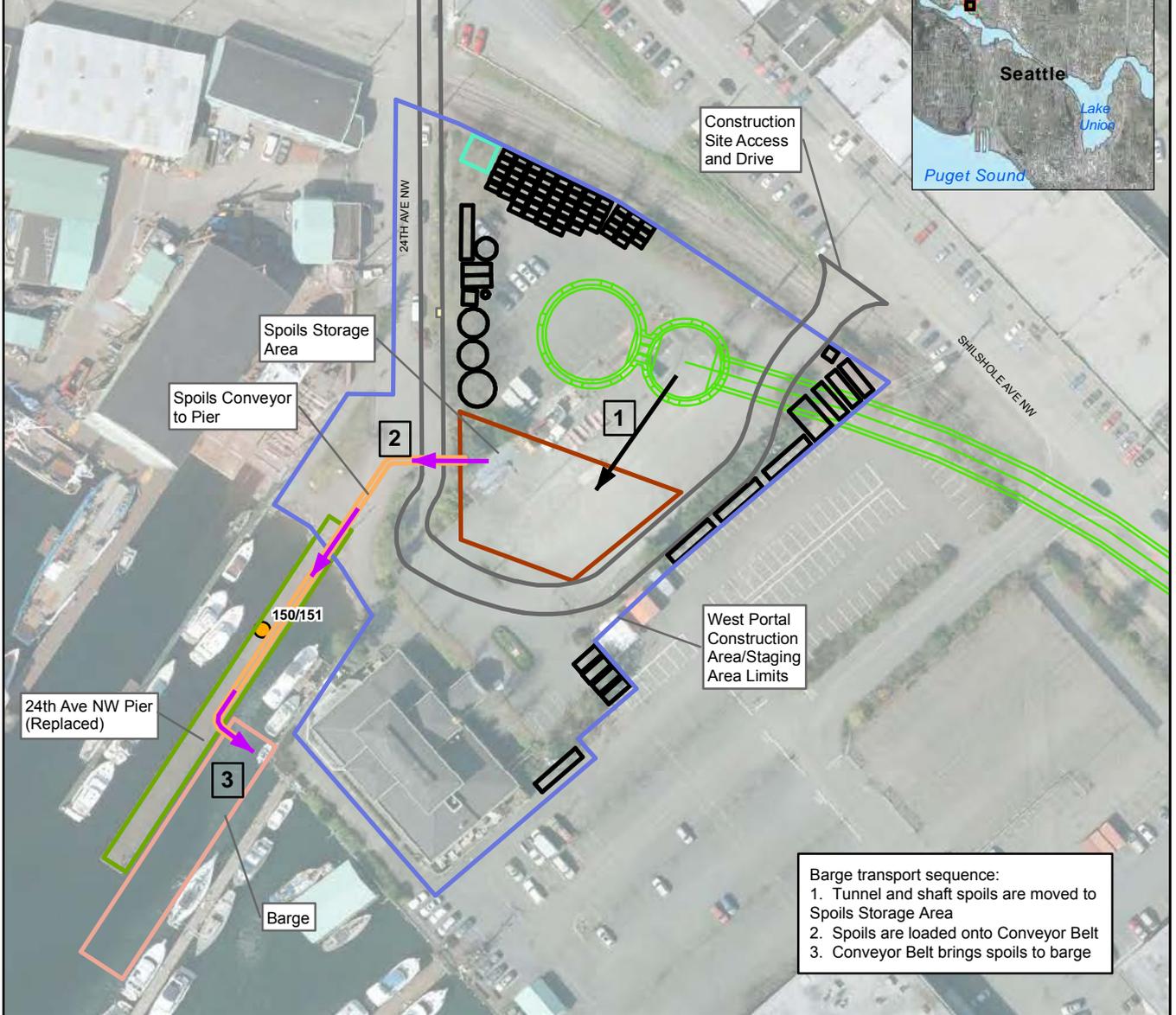


**Ship Canal Water Quality Project
Supplemental EIS**

**West Portal Permanent Facilities
Conceptual Plan**

Figure 2-4

Note: Concept subject to final design; potential layout shown



Barge transport sequence:
 1. Tunnel and shaft spoils are moved to Spoils Storage Area
 2. Spoils are loaded onto Conveyor Belt
 3. Conveyor Belt brings spoils to barge

- LEGEND**
- Storage Tunnel
 - Construction area limits
 - Barge
 - Spoils transport route
 - Conveyor
 - Pier
 - Spoils storage
 - Temporary power substation
 - Drive
 - Construction materials and equipment
 - Seattle CSO Outfall

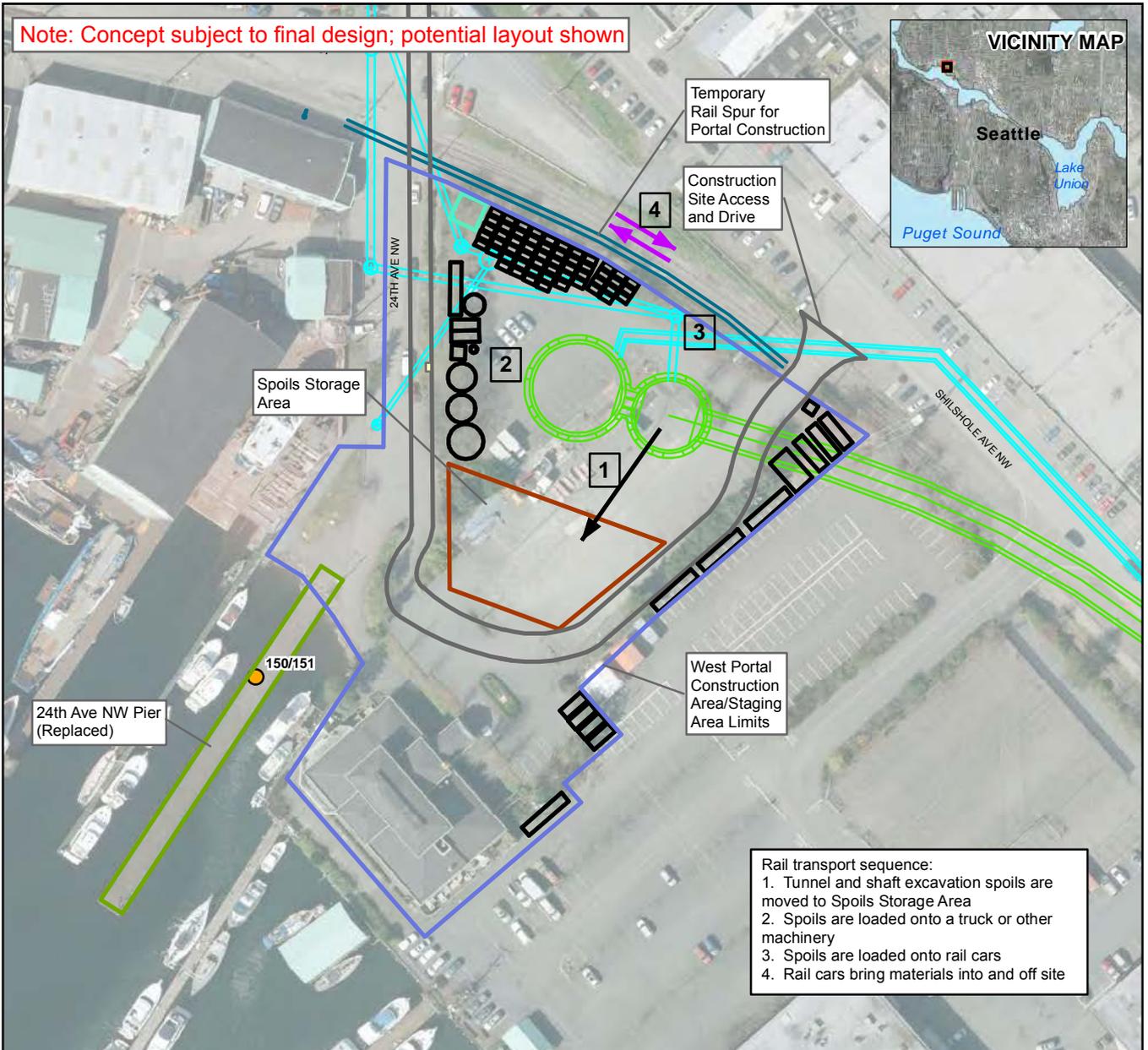


**Ship Canal Water Quality Project
 Supplemental EIS**

**West Portal Construction
 Transport Options: Barge
 Conceptual Plan**

Figure 2-5

Note: Concept subject to final design; potential layout shown

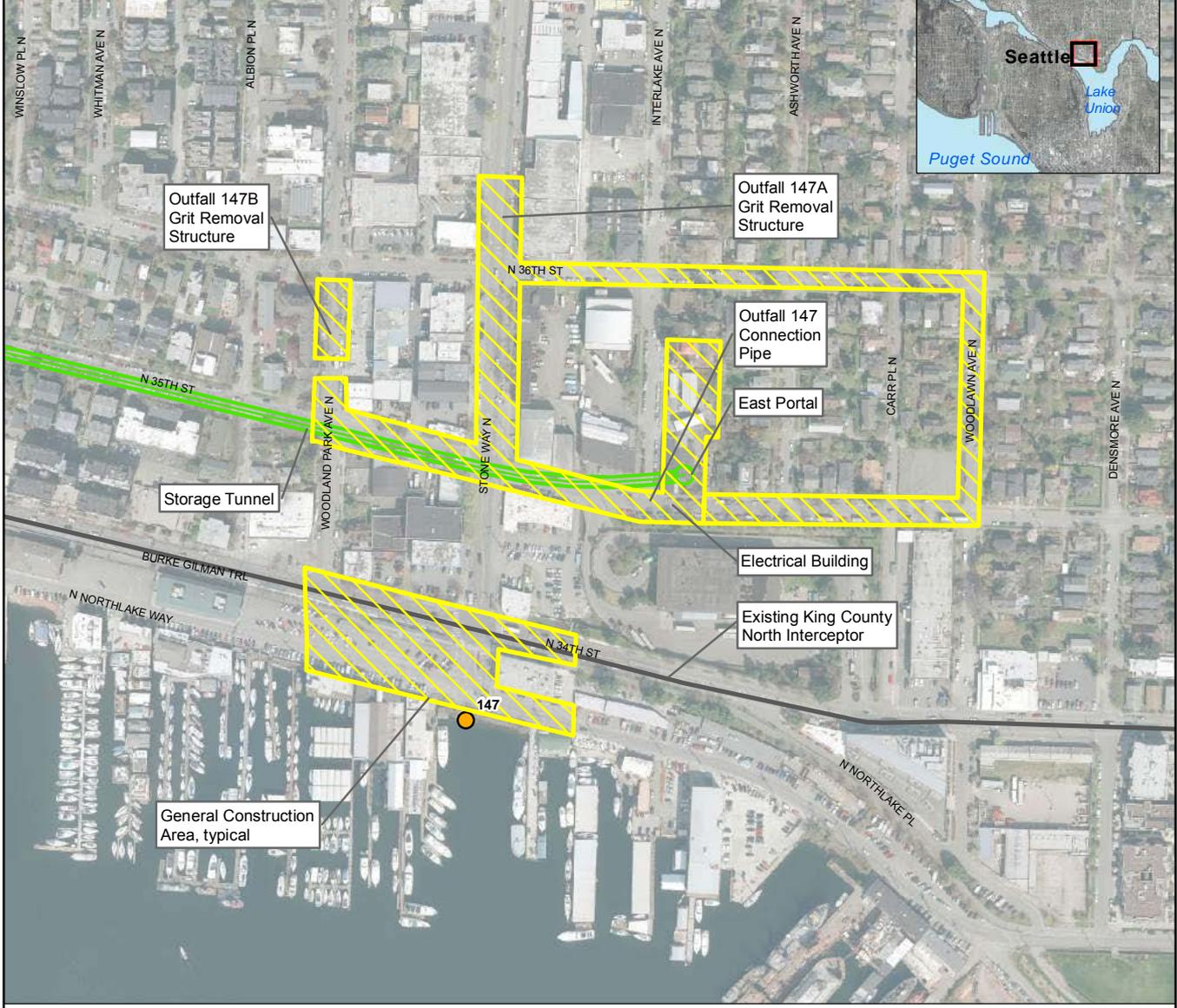


LEGEND

- Storage Tunnel
- New Conveyance Pipeline
- Construction area limits
- Temporary Rail Spur
- Pier
- Rail transport
- Spoils storage
- Temporary power substation
- Drive
- Construction materials and equipment
- Seattle CSO outfall



Note: General construction areas shown are approximate and encompass the anticipated extent of potential construction activity



- LEGEND**
- Seattle CSO Outfall
 - King County Sewer Mainline
 - Construction Area
 - Storage Tunnel



NOTE: Locations to be determined during final design for:

- Maintenance Site Access and Driveway
- Odor Control Facility
- Generator
- Bioretention Cell



LEGEND

- Storage Tunnel
- Site Boundary

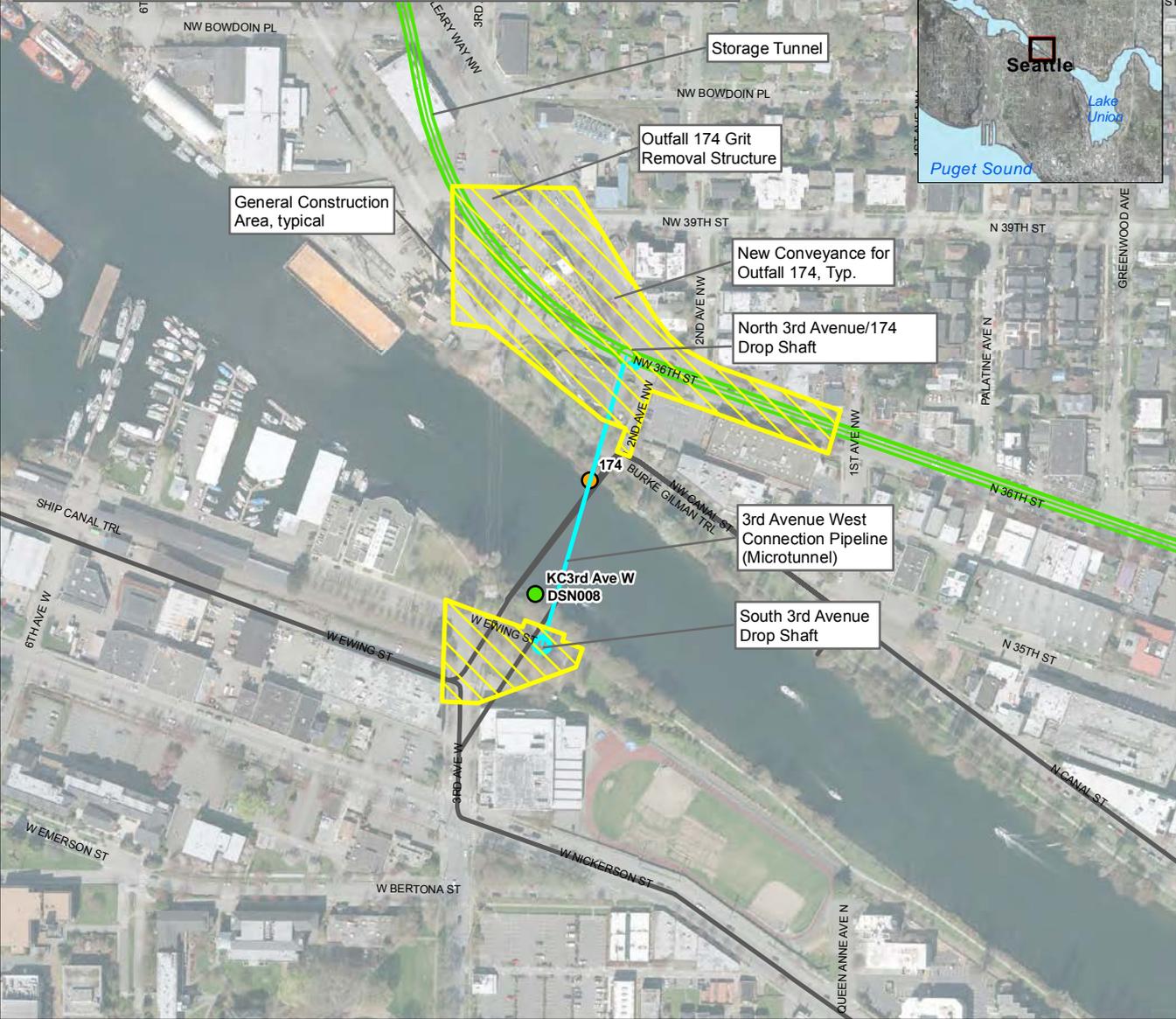




- LEGEND**
- King County CSO Outfall
 - King County Combined Sewer Mainline
 - Construction Area
 - Storage Tunnel



Note: General construction areas shown are approximate and encompass the anticipated extent of potential construction activity



LEGEND

- King County CSO Outfall
- Seattle CSO outfall
- King County Combined Sewer Mainline
- Construction Area
- Storage Tunnel
- 3rd Ave W Microtunnel

Note: General construction areas shown are approximate and encompass the anticipated extent of potential construction activity



LEGEND

- Seattle CSO Outfall
- Ballard Conveyance
- King County Combined Sewer Mainline
- General Construction Area
- Storage Tunnel



**Ship Canal Water Quality Project
Supplemental EIS**

Ballard Conveyance Options

Figure 2-11

2.2.6 Utility Replacement Projects

Prior to construction of the storage tunnel, utility replacements would be required to address conflicts with existing utilities. In addition, there would be the potential to disrupt or damage existing infrastructure due to settlement or direct impacts during tunnel construction, particularly older infrastructure, including sewer lines, water pipes, and other utilities that would need to then be repaired or replaced. In some cases, construction of the tunnel and associated facilities would present an opportunity to proactively replace or repair aging infrastructure, combine construction projects, and reduce disruptions to streets and neighborhoods. The utility replacement work would be concentrated around the drop shaft locations, but could potentially occur at other locations along the tunnel alignment.

Utility replacement would also include outfall rehabilitation near 24th Avenue NW. Outfalls 150 and 151 provide overflow capacity for SPU's Basin 150/151. Existing Outfall 151 is in poor condition and existing Outfall 150 does not meet the overflow capacity needs of the entire basin. The outfall rehabilitation would be constructed at the same time the pier at the 24th Avenue NW street end is replaced. The project would remove Outfalls 150 and 151 from service and replace them with a single, larger diameter outfall that meets the current and future overflow needs of the basin.

2.3 What construction activities would occur?

Many of the construction methods that would be used were discussed in Chapter 5 of the 2014 Plan EIS. Applicable updates and additional information developed as part of the Draft Facility Plan are provided in the subsections below. Table 2-2 summarizes the main project components.

Because of the dynamic nature of construction, the sequencing, extent, and timing of construction activities would vary to some degree from what is described here. However, this description is a reasonable scenario that allows an understanding of the range of potential methods that could be used as the project is built. Because the construction methods and options for some components have not yet been finalized, the project is described in terms of the "worst-case" potential for surface disruption and footprint requirements.

| Table 2-2. Ship Canal Project Information | | | | | |
|--|--|---|-------------------------------------|--|---|
| Project component | Construction duration (approx.) | Description | Excavation quantity | Permanent facilities – above ground | Permanent facilities – below ground |
| Storage Tunnel, Portals, and Pier | | | | | |
| Storage Tunnel | 2.5 years (tunneling) | Approx. 14- to 18-foot diameter, ~2.7-mile, ≥15.24 MG storage tunnel, located as deep as 120 feet, or as shallow as 50 feet, for most of its alignment. | 275,000 CY for approx. 18' diameter | See West Portal | Approx. 14- to 18-foot diameter, ~2.7-mile long storage tunnel, portals, drop shafts and conveyance |

| Table 2-2. Ship Canal Project Information | | | | | |
|--|--|---|----------------------------|--|---|
| Project component | Construction duration (approx.) | Description | Excavation quantity | Permanent facilities – above ground | Permanent facilities – below ground |
| East Portal | 9 to 16 months | Eastern terminus of the tunnel. An underground odor control facility and a standby generator building would be located on-site. | 10,000 CY (maximum) | Generator located in sound enclosure, minor operations access facilities; electrical equipment housed in small building | Drop shaft, odor control system, mechanical equipment, electrical equipment |
| West Portal | 6 to 7 years | Where tunnel boring machine would be launched and excavated material removed. TEPS used to empty the tunnel following storms, including facilities for odor control and a standby generator. | 70,000 CY (maximum) | TEPS building, backup power, odor control | Pump station |
| 24th Ave NW Pier | 6 months (pier construction) 2.5 years (barge operation) | Pier replacement to support barging of spoils at the site of the existing 24th Ave NW pier. | N/A | 24th Ave NW pier | N/A |
| Drop Shafts (Intermediate) | | | | | |
| 11th Ave NW Drop Shaft | 12 to 16 months | Multiple drilled shafts up to 12 feet in diameter would convey untreated combined sewage into the storage tunnel. Following construction completion, the shaft may house odor control equipment and standby generators. | 10,000 CY (maximum) | Generator and electrical control panel in aboveground casing | Drop shaft, odor control system, mechanical equipment, electrical equipment |
| North 3rd Ave/Outfall 174 Drop Shaft | 12 to 16 months | Drop shafts would convey untreated combined sewage into the storage tunnel. Following construction, the drop shaft may house odor control equipment, and adjacent below-grade vaults would house electrical gear. | 12,000 CY (maximum) | Same as 11th Ave NW drop shaft | Same as 11th Ave NW drop shaft |

| Table 2-2. Ship Canal Project Information | | | | | |
|--|--|--|----------------------------|--|--|
| Project component | Construction duration (approx.) | Description | Excavation quantity | Permanent facilities – above ground | Permanent facilities – below ground |
| South 3rd Ave Drop Shaft | 6 to 9 months | Drop shaft would convey flows from the 3rd Ave W CSO diversion to a new pipe (microtunnel) under the Ship Canal. | 3,000 CY | None | Drop structure; up to 700 foot long, 6- to 8-foot microtunnel below the Ship Canal |
| Conveyance Facilities | | | | | |
| Ballard (TEPS, 150/151, and 152) | 24 months | Conveyance facilities would transport combined sewage to the tunnel. Facilities include pipes, diversion, grit removal facilities, and modifications to the existing system. Surface disruption of streets and public rights-of-way would be required to construct many of these facilities. Some sections would be constructed using microtunneling (trenchless methods) including the 3rd Ave W CSO connection under the Ship Canal. | 18,000 CY | Electrical cabinets; valves | Conveyance pipes, ranging from 36 to 72 inches in diameter. Approximately 3,300 feet of pipe would be used. Additional 1,900 feet of 24-inch pipe connecting TEPS to Ballard Siphon. Six grit removal structures, 3,000 SF construction area each (two each in Ballard, Fremont, and Wallingford). |
| Ballard East (11th Ave NW) | 12 months | | 1,400 CY | Electrical cabinets; valves | |
| Fremont (174) | 18 months | | 6,000 CY | Electrical cabinets; valves | |
| North Queen Anne (3rd Ave) | 12 months | | 2,000 CY | Electrical cabinets; valves | |
| Wallingford (147) | 12 months | | 1,500 CY | Electrical cabinets; valves | |

CY = cubic yards; SF = square feet.

2.3.1 Storage Tunnel

Tunneling would be performed using the best available tunneling technology and ground improvement methods to minimize ground settlement. For deep-bore tunnel construction in the Seattle area, pressurized-face TBMs are typically used to mine below the groundwater table and minimize surrounding ground movements and ground subsidence above the tunnel. This is accomplished by maintaining pressure on the tunnel face to balance ground and water pressures.

The TBM would be launched from the West Portal and complete tunneling at the East Portal. The tunnel construction schedule would be set by the contractor. Tunnel construction would typically occur up to 6 days a week with a seventh day for maintenance of tunneling equipment. Occasionally, tunnel construction may occur up to 7 days a week. Tunnel construction could occur up to 20 to 24 hours a day to maximize efficiency because most activities occur underground and cause limited surface disturbance. However, most surface activities at the tunnel portals could be suspended during nighttime shifts to reduce noise levels. Tunnel construction would take approximately **2.5 years**.

Surface construction activities would be focused at the West and East Portals for the duration of tunnel construction (described below).

2.3.2 West Portal

The West Portal would be the site of most of the tunnel construction activities (see Figure 2-3). Construction at the West Portal would take approximately 6 to 7 years from the start of site preparation, through launch shaft excavation and completion of the tunnel, and would continue through TEPS construction and site restoration. The West Portal construction schedule would be established by the contractor, and is likely to occur largely during the daytime. However, once the portal is constructed and tunneling activities begin, construction activity at the West Portal could occur 24 hours per day.

During construction, the West Portal would be used to lower the TBM, launch the TBM, remove excavated materials associated with tunnel construction, and install tunnel lining materials. It would also serve as the primary staging area for tunnel construction. The construction staging area would provide laydown areas for materials, maintenance workshops, storage areas for excavated spoils and precast-concrete segments, and space for parking and field offices. The West Portal site would also require a temporary electrical substation and electrical systems to provide power to the TBM. This extension of electrical systems to feed the TBM could require improvements to the Seattle City Light electrical distribution system facilities outside the project area.

Activities at the site are further described below and would relate to: (1) site preparation and West Portal shaft construction; (2) TBM operations; and (3) TEPS construction.

2.3.3 Site Preparation and West Portal Shaft Construction

Activities at the West Portal site to establish the staging area and set up the tunnel construction may include the following: constructing fencing; creating new driveways and site access routes; repurposing an existing building formerly housing the Yankee Grill restaurant; establishing contractor parking; constructing associated buildings, including equipment trailers; preparing a laydown area; creating areas for tunnel liner storage, a temporary substation, a muck storage area, and a wheel wash area; installing a crane; and constructing the conveyor system. Most of the 2.15-acre site would be used for construction.

Shaft construction at the West Portal could include excavation of a pair of connected shafts, or one larger shaft. The shaft(s) would include shoring and associated supports and dewatering systems. Soil conditions at the entrance and exit of the shaft(s) could require ground improvement such as dewatering, ground freezing, jet grouting, and/or soil mixing.

If dewatering is required, the dewatering water would be discharged as permitted to the local sewer system or to local water bodies. The water would be treated in accordance with King County construction dewatering discharge requirements. Refer to Chapter 3, Earth and Groundwater, for a discussion of dewatering impacts and disposal methods.

Pier Replacement. Barge transport of tunnel spoils and certain materials and equipment would reduce the project-related impacts on truck traffic. As described above, the existing City-owned pier at the 24th Avenue NW street end would be reconstructed to allow barge use during project construction. Pier replacement would be one of the earliest construction activities.

Pier construction would occur in two stages: (1) Demolish the existing pier and construct a new, slightly shorter pier (Permanent Pier); and (2) construct temporary fixed pier extensions and mooring dolphins (Temporary Pier). The existing wooden pier decking would be replaced, and new, up to 36-inch diameter concrete or steel piling

would replace existing treated wood piling. Depending on sediment conditions at the site, piles may be driven with vibratory-only, or vibratory and impact pile driving methods. A turbidity curtain would be used to manage turbid water created by in-water construction, in accordance with applicable permit requirements.

Pier construction work would be designed to include outfall rehabilitation as described in Section 2.2.6. Closure of the 24th Avenue NW pier for reconstruction provides an opportunity to replace existing outfalls at the same time the pier is reconstructed in order to minimize impacts. Existing Outfalls 150 and 151 would be removed from service and replaced with a single larger diameter high-density polyethylene (HDPE) pipe affixed to the new pier. Road closures would likely be needed, and parking would be relocated. The contractor would determine closures and relocations.

During tunnel construction, the temporary pier would support barges up to 250 feet in length. Barges would be moved by tugs. There would be a fixed barge tie-up area for staging the tugs and barges while they are being moved in and out of position. The staging area could be at an existing moorage pier owned by the U.S. Army Corps of Engineers, located between the 24th Avenue NW pier and the Ballard Locks, or other sites may be identified. Barging facilities would be in place for the 2.5-year duration of tunneling.

A closed conveyor would be used to transfer tunnel spoils to a barge (to minimize potential for spoils spilling into the water or on land). Conveyor and barge operation would take place largely during daylight hours for the duration of tunnel excavation.

Following project completion, temporary pier extensions, construction equipment (such as the conveyor system), and mooring dolphins would be removed and the pier restored for public use. The finished, permanent pier would remain a public pier with moorage tie-ups for day use.

Rail Transport. If rail is used as a transport option, improvements could be required along the existing BTRR spur to ensure that rail facilities meet construction needs. A rail spur could potentially be constructed at the West Portal, and minor improvements could be required along the existing rail line, such as replacement of ties and ballast and other types of maintenance activities. After construction, the existing (and improved) rail line would remain in place and the construction spur abandoned or removed.

2.3.4 Tunnel Boring Machine Operations

The TBM would launch from the West Portal tunnel shaft and would mine the tunnel from west to east. Tunnel spoils would be removed from the tunnel face and deposited outside the West Portal where they would be stockpiled and transported using a conveyor system, rail car, or slurry piping. Depending on the method for transporting the tunnel spoils, the system would be enclosed or covered, reducing the potential for dust and noise, as well as improving the appearance of the work area. From the conveyor, rail car, or slurry piping, spoils would be loaded onto trucks, barges, and/or trains as described above and transported offsite. Approximately 300,000 cubic yards (CY) would be excavated from the tunnel. As tunneling proceeds, concrete tunnel liner segments would be installed in the tunnel.

2.3.5 East Portal

Construction activities at the East Portal site include establishing a staging area; installing fencing; creating new driveways and site access routes; designating contractor parking; and constructing associated buildings and facilities, including a generator, equipment trailers, and a laydown area. Most of the 0.57-acre site would be used for construction (Figure 2-7). The TBM may be retrieved or abandoned underground at the East Portal. If abandoned underground, once the TBM has been driven through the shaft, the tunneling contractor would remove the inner workings of the TBM, leaving only the steel shell. The interior space would be filled with

concrete fill material, entombing the steel shell below ground. Construction at the East Portal site would last up to approximately 16 months.

2.3.6 Drop Shafts

Construction activities at the three intermediate drop shafts, described in Section 2.2.4 and shown on Figures 2-9 and 2-10, would be similar to those described for the East Portal. Construction would last approximately 12 to 16 months at the 11th Avenue NW and North 3rd Avenue /174 Drop Shafts, and 6 to 9 months at the South 3rd Avenue Drop Shaft.

An existing privately owned pier near the North 3rd Avenue/174 Drop Shaft could be used to support barge transport of construction spoils. The existing pier would not require improvements, as it is an active facility currently used for barge transport.

2.3.7 Conveyance Facilities

Conveyance pipes would be constructed using open-cut construction or microtunneling, depending on the location and context. Microtunneling (trenchless method) would be used to avoid deep trench excavations; to cross under critical utilities, railroads, and streets; to construct the 3rd Avenue West CSO connection under the Ship Canal to the North 3rd Avenue /174 Drop Shaft; and where needed to minimize disruptions.

Construction methods would be generally as described in Section 5.12.5 of the 2014 Plan EIS. Conveyance construction is expected to take place along roads within the general construction area shown on Figures 2-9 and 2-11. Construction would last approximately 12 to 24 months, depending on the conveyance area (see Table 2-2). Staging areas could be required at intervals for equipment laydown and for stockpiling backfill and spoils from the trench, but disruption associated with pipeline installation would generally be limited to one section at a time rather than the entire length of the conveyance alignment. Staging areas would be determined by the contractor.

As described above, a conveyance would cross under the Ship Canal to convey flows from 3rd Avenue West to the storage tunnel. A TBM would be launched from the North 3rd Avenue /174 Drop Shaft in Fremont and retrieved at the South 3rd Avenue Drop Shaft on the south side of the Ship Canal in north Queen Anne. The microtunnel would be up to approximately 700 feet long and 6 to 8 feet in diameter.

Stored flows in the storage tunnel would be discharged to DNRP's wastewater system through the existing Ballard Siphon.

2.4 When would construction occur at the project sites?

Construction would begin as early as 2017 and be completed in 2024, lasting about 6 to 7 years. Over this period, active construction would occur in phases at different locations. Construction timing would vary at the project element sites. Construction durations are estimated to be approximately **2.5 years** for the storage tunnel, 6 to 7 years at the West Portal, 9 to 16 months at the East Portal, 12 to 16 months at the 11th Avenue NW Drop Shaft, 12 to 16 months at the North 3rd Avenue /174 Drop Shaft, 6 to 9 months at the South 3rd Avenue Drop Shaft, 12 to 24 months for conveyance facilities, and intermittently over the construction period for existing utility replacement opportunities. There may be gaps during the 6- to 7-year period when no active construction takes place. Table 2-1 summarizes the construction durations at the various sites.

2.4.1 Construction Sequencing

The sequence of construction activities has not yet been determined, but a high level potential sequence of activities is described below. Early advance activities would include utility relocations along the tunnel alignment and soil remediation at the West Portal site. Any near-surface contamination at the West Portal site would be removed or capped. The 24th Avenue NW pier would be modified and improved, and set up for barging of tunnel spoils and other clean soils removed from the West Portal.

Primary construction activities would begin with procuring the TBM and with mobilizing and set up activities at the West Portal. The West Portal shaft would then be constructed.

Next would be the intermediate drop shaft construction for the 11th Avenue NW and North 3rd Avenue/174 Drop Shaft sites, followed by East Portal construction. The South 3rd Avenue Drop Shaft is less dependent on tunnel construction sequencing and could be constructed at other times.

After tunnel mining is complete, the permanent TEPS building structure would be constructed at the West Portal site. This would be followed by construction of the TEPS conveyance pipelines along Shilshole Avenue NW and related improvements at the site of the existing King County Ballard Siphon.

Other conveyance segments, connections, and grit removal facilities do not depend on the sequencing of other project elements and can be constructed in any order. The general locations are as follows:

- Ballard (connecting to the tunnel at the West Portal)
- Ballard East (connecting to the tunnel at the 11th Avenue NW Drop Shaft)
- Fremont (connecting to the tunnel at the North 3rd Avenue /174 Drop Shaft)
- Wallingford (connecting to the tunnel at the East Portal shaft)
- North Queen Anne (connecting to the tunnel via the microtunnel beginning at the South 3rd Avenue Drop Shaft, traveling under the canal, and connecting to the tunnel)

2.5 What would the proposed project areas look like after construction?

Upon completion of construction, the areas within the limits of construction would be restored and permanent facilities would be as described below.

- **Storage Tunnel.** The tunnel would be underground and would not be visible after construction.
- **West Portal.** A low-rise building would house operating equipment at the site surrounded by safety fencing. The building footprint would be approximately 8,000 square feet (SF). The maximum building height above the surrounding grade would be approximately 35 feet. It would be designed to blend in with the existing commercial setting. The odor control facility would be fenced. There would be a new driveway from Shilshole Avenue NW for SPU vehicles. The former Yankee Grill building, which would be repurposed as the construction office, would remain in place to be sold or re-purposed. The site would be landscaped with a mix of native plants and decorative species. The pier would be designed and built consistent with current permitting requirements. See Figure 2-4.
- **East Portal.** A small building at the East Portal site would house a generator and a secure cabinet housing an electrical control panel. The aboveground facilities would be surrounded by an improved retaining wall with chain-link fencing. The odor control facility would be underground. The site would be

landscaped with a mix of native plants and decorative species. Some portions of the TBM could remain underground permanently at the East Portal. A portion of the site needed for permanent operations would be transferred from City of Seattle Finance and Administrative Services' (FAS) jurisdiction to SPU following completion of the project. See Figures 2-7 and 2-8.

- **Drop Shafts.** At the 11th Avenue NW and North 3rd Avenue /174 Drop Shaft sites, access lids would be recessed into the pavement of the street. At the South 3rd Avenue Drop Shaft site, the access hatch would be recessed into the parking lot. Because most of the drop shafts are primarily in the public right-of-way, landscaping would be provided in accordance with SDOT street planting requirements.
- **Conveyance Facilities.** These project components would be underground. Once construction is complete, disturbed surface areas would be restored and landscaping provided in accordance with SDOT street planting requirements.
- **Utility Replacement.** Once construction is complete, disturbed surface areas would be restored and landscaping provided in accordance with SDOT street planting requirements.

2.6 How would the storage tunnel work?

Implementing the Ship Canal Project would reduce discharges from existing Ship Canal outfalls to no more than one untreated discharge per year at each outfall on a 20-year moving average. These CSOs would occur only during extreme storm events.

The tunnel would fill automatically when there is a large rainstorm and flows in the system are high. When this occurs, primary weirs within the sewer pipes would be overtopped and water would begin flowing through open gates in the collection and conveyance systems toward the tunnel. Flows would enter the tunnel drop shafts. From the drop shafts, flows would enter the tunnel and be stored until there is capacity in the DNRP conveyance system and West Point Treatment Plant for the tunnel to drain. Flows stored in the tunnel would flow from the upstream end at the East Portal to the downstream end at the West Portal, where the pumps would be located. The pumps in the TEPS would pump the stored flows in the tunnel through one or two conveyance pipelines to DNRP's Ballard Siphon. This draining of stored flows would occur gradually over a 12-hour period. Preliminary modeling results indicate that the TEPS would operate approximately 40 to 60 or more times per year.

Combined sewage would be stored in the tunnel for a few hours to a few days, depending on the length of the rainstorm, how much water flowed into the tunnel, and the capacity of the DNRP wastewater conveyance and treatment system to accept flows. A sophisticated instrumentation program that is coordinated with the DNRP system would control when the tunnel is drained. During extreme storms when the tunnel water level reaches full, the open gates to the conveyance pipes would close and water levels would rise at the diversion structures, overtop the secondary weir, and flow to the existing CSO outfalls. This would allow SPU to optimize its system to achieve the control standard of one overflow per year per outfall on a 20-year moving average.

To clean the tunnel, some retained combined sewage in the east shaft (at the East Portal) would be released as a flushing wave through the tunnel to the west shaft (at the West Portal). Wash water and debris would collect in the wet well inside the West Portal. A grit/dewatering pump would discharge this water into DNRP's wastewater system and then to the treatment plant.

Upstream of where flows enter the tunnel, grit and debris may need to be removed from the combined sewage before it enters the conveyance to the tunnel. These new grit removal structures would also remove grit when the flows are not high enough to activate the tunnel; the grit chambers would require periodic maintenance by SPU personnel.

When the tunnel system is in standby mode (i.e., when no flows are entering the tunnel), odor control may need to be continuously working. In addition, the grit/dewatering pump inside the West Portal would pump any incidental groundwater that infiltrates the system to the sewer and the treatment plant, to avoid potential for detained flows to generate odor.

2.7 How has the public been involved?

Public involvement is an important part of the Ship Canal Project. During this project, SPU has built upon public outreach and engagement efforts that began in 2010 as part of developing the *Plan to Protect Seattle's Waterways*. Section 2.10 of the 2014 Plan EIS outlines those efforts. SPU conducted public outreach efforts specific to the Ship Canal Project, beginning in 2014. These efforts included outreach to community stakeholders, as well as a SEPA scoping process to determine the scope of issues to be included in the Supplemental EIS.

2.7.1 Draft Supplemental EIS public notification and comment process

Note: Section 2.7.1. and 2.8 have been included in the Final Supplemental EIS to summarize the comment process and input received on the Draft Supplemental EIS. These sections represent new information, and are not revisions, and are not shown in track change mode.

SPU issued a Notice of Availability of the Draft Supplemental EIS on September 22, 2016. The Notice of Availability invited agencies, affected tribes, and members of the public to comment on the Draft Supplemental EIS; provided the date, time, and location of the Draft Supplemental EIS public hearing; provided the name, address, email address, and phone number of the project manager and the SEPA Responsible Official; and directed people to respond with their comments via email or in writing by October 24, 2016 to the SEPA Responsible Official. Additional SEPA required public notification included the following:

- The Draft Supplemental EIS was posted to Ecology's SEPA Register on September 22, 2016.
- The Notice of Availability was posted on the Seattle Department of Construction and Inspections' (DCI) Land Use Bulletin on September 22, 2016.
- The Notice of Availability was published in the Daily Journal of Commerce on September 22, 2016.
- The Notice of Availability and the Draft Supplemental EIS were mailed to agencies with jurisdiction, organizations and individuals who requested copies, and organizations and individuals who commented during the scoping process.
- The Notice of Availability and the Draft Supplemental EIS were made available for public review at SPU's main office on the 49th floor of the Seattle Municipal Tower, the Seattle Central Library, and online at www.seattle.gov/util/ShipCanalProject.

2.8 What comments were received on the Draft Supplemental EIS?

SPU received eight written comment submissions during the Draft Supplemental EIS comment period, representing two agencies, five organizations, and one tribe. The public hearing was attended on October 18, 2016 by 17 individuals, three of whom commented. The comments on the Draft Supplemental EIS addressed the following issues or concerns:

- Questions regarding transportation impacts and driveway access;
- Concerns about tunnel construction, noise, and vibrations;
- Outreach and stakeholder coordination;

- Recreation impacts to local parks;
- Concerns about soil remediation and air quality;
- Questions regarding surplus property;
- Inclusion of additional protected species and additional analysis of fisheries impacts; and
- Request for explanation of the alternatives selection/modeling process.

A complete list of the comments and SPU's responses are included in Appendix A.

Earth and Groundwater

3.1 What are the existing earth and groundwater resources in the project area?

The study area for earth and groundwater resources includes the project construction limits and the regional confined aquifer. The affected environment described in Section 4.1 of the 2014 Plan EIS has not materially changed. Additional information is provided for specific earth and groundwater conditions that were not described in detail in the 2014 Plan EIS.

After the 2014 Plan EIS was issued, geotechnical assessment investigations were completed for the tunnel (and associated shafts), providing additional information on the regional geologic and hydrogeologic setting and anticipated subsurface conditions specific to the project. This information is provided in the Draft Geotechnical Data Report (GDR) (Shannon & Wilson, 2015a). The GDR is currently a draft version, as additional geotechnical investigations are ongoing and the GDR will be updated as new information is obtained. A preliminary Geotechnical Assessment Report (GAR) was also completed based on geotechnical investigations completed to date, associated field and laboratory testing, and professional experience on similar projects. The report provides preliminary geotechnical design criteria, recommendations, and construction considerations (Shannon & Wilson, 2015b).

In addition, an analysis was conducted along the proposed tunnel alignment to assess the risk of contaminated materials within a quarter mile of the project corridor that could pose risks to earth and groundwater (Riley & Associates, 2010). Because tunnel depths exceed at least 50 feet below ground surface for most of the project footprint, there is a very low likelihood of contamination reaching that depth. The analysis identified the potential for encountering some contaminated materials at excavations near the ground surface such as the portals and drop shaft structures. Areas that are found to be contaminated will be remediated in advance of tunnel construction; contaminated soils and groundwater will be disposed of as described in Section 3.2.1.4.

3.1.1 Earth

Three soil groups are expected along the tunnel alignment: till and till-like deposits, cohesionless sand and gravel, and cohesive silt and clay. These soils have similar engineering properties and anticipated ground behavior (Shannon & Wilson, 2015b). These soil types are found throughout the region and are generally favorable soils for tunneling.

Earth and Groundwater Key Findings

- Areas that are disturbed during construction would be subject to increased erosion, and erosion control measures would be required.
- Ground settlement from dewatering could cause minor settlement of nearby structures, roadways, and utilities.
- Vibration and soil loss associated with tunneling could result in minor soil movement and settlement along the tunnel alignment.
- Removing contaminated soil and groundwater during construction would reduce risks for future contamination.

3.1.2 Groundwater

Groundwater within the project area, with a few exceptions, is generally 10 to 30 feet below the ground surface. An exception is in the vicinity of the East Portal, where groundwater is near the ground surface or above (artesian groundwater conditions). Additional groundwater monitoring in the project area is ongoing, including a planned near-surface aquifer pumping test at the West Portal. The GAR will be updated as the information is obtained to inform design criteria and construction methodology considerations.

3.1.3 Contamination

The environmental risk analysis completed for the project identified 13 properties along the tunnel alignment and within construction areas that have known or suspected contamination (Riley & Associates, 2010). Four types of known or suspected contamination were identified on these properties:

- Petroleum hydrocarbons (oil and gasoline);
- Heavy metals (such as arsenic, chromium, lead, and mercury);
- Volatile organic compounds (VOCs), including dry cleaning and degreasing solvents (such as trichloroethylene [TCE] and tetrachloroethylene [PCE]); and
- Asbestos.

Most contaminants typically accumulate within the first 15 feet of the ground surface. Along the deep tunnel alignment, most contaminants would not reach the depths of the tunneling activity because the contaminants are not mobile in the subsurface soils, or are less dense than water, and would therefore not sink through saturated soils. The most notable exceptions are dry cleaning solvents (perchloroethylene) and chlorinated degreasing solvents used in automobile repair. The latter are denser than water and commonly used both currently and historically. At the same time, there are dozens of drycleaners along the Ship Canal Project corridor, and not every facility poses the same risk of contamination. This analysis includes drycleaners, auto repair facilities, and other enterprises that use chlorinated solvents and that have documented leaks close to the right-of-way.

Of the 13 properties identified, one property is near the West Portal, 11 are along the tunnel alignment, and one is near the East Portal. The Salmon Bay Hotel Group property, a former plating shop at 5300 - 24th Avenue NW near the West Portal, was investigated in 2010 and again in 2015; soil and groundwater contamination with petroleum, metals, and chlorinated solvents was documented in concentrations in excess of regulatory cleanup levels (Riley & Associates, 2010; Gladstone, 2015). The 11 sites along the tunnel alignment include historical dry cleaning operations, automotive repair shops, a fuel depot, auto wrecking yards, a paint store, a print shop, and a former industrial site. The property at the East Portal is a former government storage site and commercial building. It was also used by the City of Seattle as an interim fire station. The structure was demolished in 2015 (not related to the Ship Canal Project). The demolition was accomplished in accordance with city, state, and federal regulations. Based on the age of the building, there may have been asbestos, lead-based paint, and mercury in the building materials. All debris from the demolition was removed from the site. Based on preliminary assessments at the East Portal site, contaminants of potential concern in soil and groundwater include petroleum, VOCs, and metals (Innovex, 2016). Additional assessments are being conducted to evaluate contaminant presence and levels on the property.

Contaminated sediments have been identified in various areas within the Lake Union/Ship Canal system. Information on the presence of contaminated sediments and potential impacts related to the Ship Canal Project is presented in Chapter 4, Surface Water.

3.2 How would the project affect earth and groundwater?

3.2.1 During Construction

As described in Section 4.1 of the 2014 Plan EIS, construction-related impacts to earth and groundwater would be associated with excavation, dewatering, trenching, tunneling, and the presence of contaminated soil and groundwater. The project's overall construction effects on earth and groundwater resources are consistent with those described in Section 4.1 of the 2014 Plan EIS. The following section describes design and construction updates related to the tunnel, West Portal, East Portal, drop shafts, and conveyance facilities.

3.2.1.1 Dewatering

West Portal, East Portal, Drop Shafts, and Conveyance Facilities. Dewatering may be required in some locations to prevent groundwater from interfering with construction. However, the project will be designed to require minimal amounts of dewatering. If dewatering is performed, flow rates would vary over the excavation and dewatering period depending on the methods, duration, variability of ground conditions, groundwater movement and chemistry, and other factors. The drop shaft and tunnel excavations are anticipated to encounter artesian conditions at the East Portal. Watertight shoring would likely be required to manage groundwater disposal volumes and potential settlement associated with depressurization of the artesian aquifer.

Groundwater discharge is discussed in Chapter 4, Surface Water. As discussed in Section 5.2.1 of the 2014 Plan EIS, dewatering during excavation below the groundwater table could result in settlement of nearby structures, roadways, and utilities. However, the potential for impact is low if proper measures to minimize and avoid dewatering are used. Dewatering could encounter contaminated groundwater requiring treatment, particularly at the West Portal near the Salmon Bay Hotel Group property, discussed below in Section 3.2.1.2 – Contaminated Materials. Treated water would most likely be discharged to the sewer system. As part of the ongoing geotechnical investigation at the West Portal site, groundwater transport studies could be performed to measure movement of groundwater. Settlement is discussed below in Section 3.2.1.3 – Vibration and Settlement.

3.2.1.2 Contaminated Materials

Contaminated soils would likely be encountered during construction at some sites. Spread of contamination can occur if the contaminated soil is placed or allowed to migrate through runoff or airborne pathways onto clean soil or into surface water or groundwater, whether on or off the construction site. Contaminated groundwater would also likely be encountered during excavation at some sites. Encountering contaminated groundwater could create potential exposure and contaminant migration similar to that described for contaminated soil. Due to known contamination, soils and water collected from upland excavations would require special handling and possible treatment prior to disposal in accordance with federal, state, and local regulatory requirements.

Storage Tunnel. The potential for encountering contaminated soils during tunnel boring is low because the tunnel would be deep. If contaminated soil or groundwater is encountered, it would be managed in accordance with the state Model Toxics Control Act (MTCA) and other applicable requirements.

West Portal, East Portal, Drop Shafts, Conveyance Facilities. The contamination associated with the West Portal at the Salmon Bay Hotel Group property is documented and would require cleanup under MTCA requirements. Cleanup efforts will start in 2017. Contamination in soil removed from the East Portal or other construction areas would also require cleanup in accordance with applicable requirements.

Property acquisition and demolition needs would be determined during final project design, including any specific management requirements under the Asbestos Hazard Emergency Response Act (AHERA). All contaminated

materials would be handled in accordance with applicable requirements and disposed of at an appropriate facility. Removal of contaminated materials during construction would provide an overall benefit to human health and worker safety, and it would reduce the risk of future contamination of earth and groundwater.

3.2.1.3 Vibration and Settlement

Storage Tunnel. Based on currently available data, building damage from vibration is not anticipated because of the depth of the tunnel (see Chapter 10 for further discussion of vibration). A baseline study of naturally occurring settlement along the alignment will be performed before tunnel construction to separate naturally occurring settlement from potential tunnel mining settlement. As is typical of tunnel projects, the Ship Canal Project would require excavation that could result in minor ground settlement in localized areas. For this type of project, minor settlement at the surface is anticipated to be less than 0.1 to 0.2 inch over the tunnel alignment. Where needed, protective measures such as grouting would be used during tunnel boring to prevent or limit settlement. These measures have been successfully used on other tunnel projects in the Seattle area. The use of these measures is expected to prevent damage to most buildings and utilities.

West Portal, East Portal, Drop Shafts, and Conveyance Facilities. Ground settlement could occur in areas where soils are excavated and dewatering occurs. Activities such as pile driving, sheet pile installation, and other activities could cause vibration, which could also result in ground settlement. Excessive settlement could impact or apply loads to nearby roadways, rail lines, utilities, and structures. More detailed analysis would be conducted during project design to determine areas where soils could settle.

If areas were prone to settlement, engineers would propose measures to minimize effects. Ground improvement would likely be needed to minimize settlement at the East Portal, West Portal, and drop shafts. Possible ground improvement methods to improve soil strength at these sites include dewatering, ground freezing, jet grouting, permeation grouting, fracture grouting, and soil mixing.

Any settlement from construction of the portals, drop shafts, or conveyance facilities is expected to be minor. Uneven settlement may cause minor cracks in pavement and sidewalks adjacent to the construction area. Damage to items on the surface street (such as trees, manholes, drains, and signals) is expected to be minor and would be repaired. The streets and sidewalks would be permanently repaired where needed once construction is completed and no further settlement is occurring. In addition, soils supporting roads or other areas could settle because of heavy construction equipment. In this case, settlement damage would be repaired either during or after construction.

3.2.1.4 Spoils Disposal

Spoils consist of soil or other debris removed during construction. Based on the maximum potential tunnel and shaft depths, approximately 409,000 CY of spoils would be generated from site demolition, excavation, foundation installation, and ground improvement activities (see Table 2-2, Chapter 2). Approximately 345,000 CY of this amount would be spoils removed at the West Portal (275,000 CY of tunnel spoils and 70,000 CY of spoils from shaft construction). As discussed in Section 5.2.1 of the 2014 Plan EIS, spoils that are unsuitable for reuse by the Ship Canal Project would need to be disposed of at an appropriate facility. Potential impacts from disposal of spoils include erosion and sedimentation where excavated materials are stored onsite or if they are spilled during transport.

Spoils removed from the West Portal would be hauled by trucks, barges, and/or rail cars to a predetermined disposal site. Spoils removed from the East Portal, drop shafts, and conveyance areas would be transported primarily by truck. Transport of spoils could result in dust deposited on roadways, rail corridors, or water. Covering of loads during hauling would reduce dust. Some of the excavated soil would originate from areas with known or

suspected contamination. Soils would be tested during construction to determine if they are contaminated. If contaminated, they would be transported in accordance with applicable containment and transport methods to an approved disposal site.

3.2.2 After Construction

Operational impacts on earth and groundwater resources are not expected to change from those described in Section 6.2 of the 2014 Plan EIS. Removal of contaminated material would benefit soil and groundwater quality.

3.3 What measures would reduce or eliminate potential impacts to earth and groundwater resources?

Measures to reduce or eliminate impacts to earth and groundwater would remain as described in Section 6.2.4 of the 2014 Plan EIS. In addition, settlement impacts to items on surface streets, such as trees, manholes, drains, and signals, are expected to be minor and would be repaired. Streets and sidewalks would be permanently repaired where needed once construction is completed and no further settlement is occurring. If heavy construction equipment causes settlement damage to soils supporting roads or other areas, this would be repaired either during or after construction.

SPU would implement the following measures to reduce or eliminate potential earth and groundwater impacts during construction:

- Starting in 2017, contaminated soils at the West Portal site will be cleaned up in accordance with MTCA requirements. Deep excavation, removal, and backfilling with clean fill will be conducted.
- Geotechnical borings would take place to determine site-specific conditions at the proposed construction areas.
- Settlement and vibration monitoring would be carried out during construction to identify potential adverse conditions to critical structures and facilities.
- Ground improvement measures would be implemented around proposed structures to stabilize soils in areas prone to unacceptable subsidence or instability.
- Loads would be covered during hauling to minimize dust generated during transport.
- All construction activities would be reviewed for consistency with MTCA (WAC 173-340-700(3)) and Sediment Management Standards (Chapter 173 -204 WAC).
- Containment measures and protective equipment would be used in accordance with regulatory requirements when handling contaminated soil or groundwater to minimize the risk of exposure. For example, contaminated soil would be directly loaded to trucks for off-site disposal as it is excavated, or stockpiles would be covered with Visqueen or a similar material to prevent dispersion from rain or wind prior to transport to a permitted disposal facility. Contaminated soils would be stored within the boundaries of the construction zone and would not be easily accessible to the public.
- The construction contractors would be required to prepare Health and Safety Plans to address the specific construction tasks that involve working with contaminated sediment, soil, and water.

In addition, where applicable, construction means and methods would be specified to minimize the potential for settlement and ground loss conditions.

Adverse effects to earth and groundwater from project operation are not anticipated.

3.4 Unavoidable Significant Adverse Impacts

There would be no unavoidable significant adverse impacts to earth and groundwater.

Surface Water

4.1 What are the surface water resources in the project area?

The study area for surface water resources is the Ship Canal, and a portion of Lake Union, with a focus on waters within the project limits and in close proximity to in-water construction areas. Within the study area, the Ship Canal includes the interconnected waterways of the Hiram M. Chittenden Locks (also known as the Ballard Locks), Salmon Bay, Salmon Bay Waterway, and Fremont Cut. Water from the Cedar River, Sammamish River, and Lake Washington flows through Lake Union into the Ship Canal and then into Salmon Bay and the Ballard Locks to Puget Sound. The Ballard Locks allow boats to pass between the fresh water of the Ship Canal and the salt water of Puget Sound.

The affected environment described in Section 4.3 of the 2014 Plan EIS has not changed. This chapter provides additional information for the Ship Canal, including Salmon Bay, which would potentially be affected by proposed project elements that were not described in the 2014 Plan EIS.

Sources of pollutants that affect these water bodies include discharges from industrial facilities, CSOs, spills, contaminated groundwater, urban stormwater runoff, and saltwater intrusion. Contaminated sediments that contribute to water quality concerns have been identified in various areas within the Lake Union/Ship Canal system. Sediment contamination information for the Ship Canal, Lake Union, and Salmon Bay system is limited and not recent, but known contaminants include nickel, BEHP/DEHP (organic plasticizers), polychlorinated biphenyls (PCBs), silver, polycyclic aromatic hydrocarbons (PAHs), butyltins, arsenic, mercury, lead, and DDE (a breakdown product of pesticides). These contaminants can be introduced to the water column when sediments are disturbed. The most heavily contaminated sites are in Lake Union near former industrial sites (Gas Works Park and the Seattle City Light Steam Plant) with lower levels of contaminants observed in the sediments of the Ship Canal and Salmon Bay (Cubbage, 1992; King County, 2004).

Ship Canal. The project area is located within and adjacent to the Ship Canal, and the project area drains to the Ship Canal. **The Ship Canal is part of the overall Lake Union/Lake Washington Ship Canal system, which serves as a transitional zone between Lake Washington and Puget Sound.** Water quality of the Ship Canal is influenced by freshwater flows coming from Lake Washington and from storm drains and CSOs. The project addresses overflows from seven permitted, currently “uncontrolled” CSO outfalls. Three of these outfalls (SPU Outfall 174 and DNRP’s 3rd Avenue West and 11th Avenue CSO outfalls) overflow to the Ship Canal as shown on Figure 1-1.

Water quality in the Ship Canal is generally good and meets most current Washington State standards. However, baseline water quality in the Ship Canal is affected by localized sources of pollutants. **Ecology has listed some**

Surface Water Key Findings

- The proposed project would result in the potential for construction-related inputs of sediment and turbidity in the Ship Canal. BMPs would minimize these impacts.
- In-water construction in Salmon Bay has the potential to cause localized turbidity and resuspension of contaminated sediments.
- If not properly controlled, barge transport of excavation spoils could result in spillage of materials into the Ship Canal, particularly Salmon Bay.

areas as impaired (Category 5) under the current EPA-approved 2015 303(d) listing (Ecology, 2015). The Ship Canal currently exceeds criteria for both temperature and bacteria. The bacteria criterion was exceeded in 2005, 2007, and 2010. Additionally, salt water from Puget Sound also enters Salmon Bay through the Ballard Locks and can contribute to low dissolved oxygen and other water quality issues. Historically, the Fisherman's Terminal area, adjacent to the West Portal and 24th Avenue NW pier, contributed metal, organic, and oil contaminants. Preparation of a cleanup plan is required for Category 5 listings.

As described in the 2014 Plan EIS, elevated concentrations of some chemicals are present in the sediments near CSO outfalls, including outfalls in the Ship Canal.

Salmon Bay. Salmon Bay is a narrow body of water linking Lake Washington to Puget Sound through the Ballard Locks. It is the westernmost section of the Ship Canal and empties into Shilshole Bay in Puget Sound. Because of the input from the Ballard Locks, the western half of Salmon Bay is dominated by salt water, and the eastern half is predominantly fresh water. As shown in Figure 1-1, three of the seven permitted outfalls in the project area overflow to Salmon Bay: Outfalls 150, 151, and 152.

Water quality in Salmon Bay has been affected by nearshore sediment quality, which has been degraded by urban development near the Ship Canal and Salmon Bay. The numerous industries, marinas, dock facilities, and combined sewer and stormwater discharges have contributed over the decades to contamination of Salmon Bay sediments. Salmon Bay is included on the EPA-approved 2015 303(d) listing as Category 5 (impaired) for lead, pH, Aldrin, and bacteria. It is also listed as a Category 4C (impaired by a non-pollutant) for invasive exotic species and Category 2 (water of concern) for temperature, dissolved oxygen, DDT isomers, and zinc.

In general, sediments in Salmon Bay have been contaminated with metals, petroleum products and byproducts, PCBs, and other organic compounds. Sediment samples in this area have exceeded the sediment quality standards for several metals and organic compounds, including areas near the 24th Avenue NW pier (Cubbage, 1992).

Lake Union. SPU Outfall 147, one of the seven permitted outfalls in the project area, overflows to Lake Union. In general, water quality in Lake Union has improved since the 1960s as wastewater discharges have been eliminated and industries have reduced or eliminated practices that result in contamination. However, Lake Union still experiences water quality issues, including low dissolved oxygen conditions during certain times of the year. Lake Union is part of the Ship Canal and thus has the same 303(d) listing as described above for the Ship Canal.

4.2 How would the project affect surface water?

The impacts on surface water resources from upland activities associated with the Ship Canal Project are generally consistent with those described in Section 5.4 of the 2014 Plan EIS. As described in that section, construction-related impacts would be associated with construction site runoff, dewatering discharge, and inadvertent discharge of toxic materials. When the 2014 Plan EIS was prepared, in-water construction was not anticipated, but the project has been refined to include replacement of the 24th Avenue NW pier to enable barging of construction spoils and other materials. This section assesses the following design and construction changes and additions for potential effects on surface water resources:

- Pier replacement at the West Portal;
- Barge use at the West Portal;
- Outfall rehabilitation near the West Portal; and

- Design and construction updates related to the West Portal, East Portal, drop shafts, and conveyance facilities.

4.2.1 During Construction

As described in Section 5.4 of the 2014 Plan EIS, the project's overall construction effects on surface water resources could include increased turbidity, increased pollutants and sediments entering stormwater runoff, and increased risk of pollutant spills. BMPs would be implemented to reduce the potential for these effects, in accordance with applicable City, state, and federal requirements. Additionally a Stormwater Pollution Prevention Plan (SWPPP) Spill Prevention and Control Plan (SPCP), and a Construction Stormwater and Erosion Control Plan would be prepared to ensure that measures are in place to protect water quality, prevent erosion and sedimentation, and manage activities and potential pollutant sources.

4.2.1.1 In-Water Work

West Portal. Pier replacement at the West Portal to support barge activities during construction would cause short-term, localized turbidity plumes within the water column. Construction would occur in Salmon Bay, in the vicinity of the Ballard Locks. This area is known for historically contaminated sediments. In-water construction could result in the resuspension of contaminants such as petroleum, metals, and semi-volatile and volatile organic compounds. Sediment contaminants associated with historical uses and previous CSO and stormwater discharges could potentially be released into Salmon Bay. If not controlled or contained, these contaminants could temporarily affect surface water quality in the vicinity of construction.

Several measures would be used to minimize potential water quality impacts. As part of pier replacement, a temporary sheet pile containment wall or turbidity curtain would be used to surround the work area and protect water quality during construction. Other appropriate containment measures may be employed to address sediment contamination, if present in the work area.

The project would be required to meet applicable water quality standards and in-water work permit conditions, and BMPs would be implemented to ensure compliance. All in-water work would be subject to the requirements of the U.S. Army Corps of Engineers, Ecology, and Washington Department of Fish and Wildlife (WDFW). Potential impacts to Tribal fishing are discussed in Chapter 6, Fisheries and Biological Resources.

Use of a barge for transporting excavated spoils from tunnel excavation could create the potential for spillage during barge loading and offloading. Barges would be loaded with a closed conveyor located on the West Portal site and extending onto the pier, to minimize potential spillage during loading and offloading. Barges would be filled and operated to avoid spillage during transport. Spoils would be taken to an approved upland disposal site in the Puget Sound area. Barges would not be used to dispose of contaminated material. Potential impacts to marine traffic, including boat traffic at the Ballard Locks, are discussed in Chapter 9, Transportation.

4.2.1.2 Construction Site Runoff

As described in the Section 5.4 of the 2014 Plan EIS, stormwater runoff from construction sites would drain to either sewers or surface waters, depending on the specific location. Construction sites would include erosion and sediment controls, spill control and prevention, and other BMPs such as silt curtains to avoid uncontrolled discharges that could affect water quality. Design updates since the 2014 Plan EIS provide additional information on the pathways for construction site runoff and methods of control.

During construction, runoff from project sites would infiltrate into bioswales or other on-site treatment areas/facilities prior to discharge to the local stormwater collection system, the combined sewer system, Lake Union, or the Ship Canal. The stormwater collection system conveys stormwater to Lake Union, the Ship Canal,

or the combined sewer system. SPU would employ BMPs consistent with the City of Seattle 2016 Stormwater Code (SMC 22.800 - 808) to control surface water runoff from project sites; therefore, no significant surface water impacts are expected.

West Portal. The West Portal site is within 200 feet of Salmon Bay, and construction activities would occur immediately adjacent to Salmon Bay. Work in this area would include portal construction, tunneling and associated activities, spoils handling and transport, and TEPS construction. Because the West Portal location would have the largest extent of site disruption (approximately 2 acres) over the 6- to 7-year construction period, it presents the greatest potential for construction-related runoff to enter receiving waters. Runoff control measures during and after construction would comply with the City of Seattle's stormwater management requirements as described above.

East Portal. Runoff from the East Portal site generally flows south and east toward the north end of Lake Union, approximately 500 feet from the site. Construction runoff would be directed toward existing drainage structures. Runoff control measures during and after construction would comply with the City of Seattle's stormwater management requirements as described above.

Drop Shafts and Conveyance Facilities. Construction runoff at the 11th Avenue NW, North 3rd Avenue/174, and South 3rd Avenue Drop Shafts and conveyance areas would be directed to existing drainage structures located in the rights-of-way. Runoff control measures during and after construction would comply with the City of Seattle's stormwater management requirements as described above.

4.2.1.3 Dewatering Discharge

As described in Section 5.4.1 of the 2014 Plan EIS, discharges of dewatering water could introduce contaminants and sediments into surface waters if not properly managed. Dewatering may be required in some locations to prevent groundwater from interfering with construction. However, the project would be designed to minimize amounts of dewatering. Some temporary, localized lowering of the groundwater table in the immediate vicinity of the dewatering activity would be expected during dewatering operations either inside or outside the excavation, or both. These impacts are considered minor because they would be temporary.

As described in Chapter 3, Earth, the project would be designed to require minimal dewatering following initial shaft construction. Any dewatering water discharged directly to the Ship Canal, Salmon Bay, or Lake Union would be tested to ensure it meets Washington State Water Quality Standards. Water that cannot meet water quality standards and is discharged to the combined sewer could require treatment before discharge to comply with the conditions of the King County Wastewater Discharge Permit or Authorization. Water that does not comply after treatment would be disposed of offsite. Offsite disposal may also be necessary if the volume of water exceeds the permitted discharge limits or if DNRP specifically requests discharges to cease. Dewatering water that is directly reinjected would not be allowed to degrade groundwater quality. If shoring systems are used for tunnel portals, drop shafts, or certain conveyance elements, these systems would act as a cutoff wall to the groundwater and should substantially limit the volume of dewatering necessary.

4.2.1.4 Inadvertent Discharges of Toxic Materials

Accidental spills of oil, solvents, and other chemicals could occur within construction limits. Larger spills that are not contained could flow into adjacent surface waters or seep into the ground and perhaps reach groundwater. If not controlled or contained, these occurrences could locally affect surface water quality. The proposed project would include spill control and prevention planning and other BMPs to avoid uncontrolled discharges that could affect water quality.

West Portal. The West Portal would be the location of most tunneling activity including spoils handling and transport. Given the level of construction activity and proximity to Salmon Bay, there is a greater potential for inadvertent spills affecting surface water compared to other project construction areas. In-water work associated with replacing the existing pier has the highest potential to result in an inadvertent spill. However, all work would be conducted in accordance with applicable permit requirements. Because SPU would employ BMPs consistent with the 2016 City of Seattle stormwater code and would include a Spill Prevention and Control Plan to control surface water runoff from project sites, no major surface water impacts are expected.

Contaminated soils excavated from the site would not be transported by barge, but would be conveyed via rail or truck to an approved disposal site. There is low potential for these materials to enter Salmon Bay or the Ship Canal.

East Portal. The East Portal is located approximately 500 feet from Lake Union. Construction-related discharges could enter the lake if water quality controls malfunctioned. However, onsite runoff controls would be regularly monitored and maintained to prevent offsite discharges, and the potential to affect surface water in Lake Union is low.

Drop Shafts and Conveyance Facilities. Inadvertent construction-related spills could enter the Ship Canal if onsite containment measures malfunctioned. All construction sites would have Spill Prevention and Control Plans consistent with the City of Seattle's requirements as described above. No impacts to surface water are anticipated.

4.2.2 After Construction

Operational impacts on surface water resources are not expected to change from those described in Section 6.4.2 of the 2014 Plan EIS. The project is anticipated to result in substantial water quality benefits in the Ship Canal because of the reduction in number and volume of CSO discharges.

Within the project area, stormwater runoff from completed facilities would be treated to meet the requirements of the 2016 City of Seattle stormwater code (SMC 22.800-22.808), reducing overall pollutants in stormwater flowing into the Ship Canal, Salmon Bay, and Lake Union. The stormwater design would maintain natural drainage patterns to the extent feasible (SMC 22.805.020.A), and would comply with other applicable requirements.

The project would incorporate the following design approaches. A detailed assessment of the drainage systems in the project areas would be completed as part of the final design.

West Portal. The West Portal site is in a separated storm drain area, discharging stormflows from the site to Salmon Bay. The existing site stormwater system would be demolished during construction. The portion of the site that would accommodate the TEPS facility would be paved or graded to direct runoff to onsite water quality treatment facilities to the maximum extent feasible, including filter planter boxes, bioswales, or other treatment technologies.

SPU proposes to construct the new TEPS facility with approximately 44,000 square feet of replaced impervious surface. This would remove approximately 20,000 square feet of existing impervious surface and replace it with landscaping and planting areas. SPU would maintain natural drainage patterns to the extent feasible, which may include runoff reduction methods such as permeable pavement and amended soils. These systems would increase stormwater detention, infiltrate direct precipitation, reduce runoff, and reduce the size of future drainage facilities. Additional site-specific analysis would be required as part of evaluating and selecting appropriate BMPs.

East Portal. Similar to the West Portal site, this site would include a combination of onsite water quality treatment facilities (filter planter boxes, bioswales, or other treatment technologies) and additional runoff reduction strategies as determined during project design.

Drop Shafts. Runoff from the 11th Avenue NW, North 3rd Avenue/174, and South 3rd Avenue Drop Shaft sites would remain in the existing rights-of-way through the use of grading and curb-and-gutter to direct flows to existing drainage structures. Stormwater management strategies for the site could consist of porous sidewalks in the disturbed area or additional runoff treatment systems (e.g., Filterra™ units or comparable technologies). These improvements would infiltrate direct precipitation, remove pollutants, reduce runoff, and reduce the size of future drainage facilities.

Conveyance. Stormwater runoff on replaced pavement would be treated in accordance with applicable City of Seattle requirements.

4.3 What measures would reduce or eliminate potential impacts to surface water resources?

In addition to the mitigation provided in Sections 5.4.5 and 6.4.4 of the 2014 Plan EIS, the following measures would be implemented to avoid and minimize potential impacts to surface water resources from project construction.

- All in-water construction would be conducted in accordance with applicable permit requirements, including the Corps of Engineers Section 10/404 permit, Ecology 401 Water Quality Certification, WDFW Hydraulic Project Approval (HPA), and other requirements.
- During in-water work to support pier replacement and outfall rehabilitation activities at the West Portal, appropriate BMPs would be used as necessary to isolate construction activity from the Ship Canal and prevent the release of pollutants into open water.
- Water discharged from the project sites during construction would be monitored and, if necessary, treated. Settling tanks and other treatment measures would be used if needed to ensure that this water meets water quality standards before it is discharged to the stormwater collection system, the sewer system, or surface waters. Contaminants removed during treatment would be disposed of at an approved disposal site. Implementation of applicable measures would be included in project construction contract specifications.
- Site design for the completed project would include stormwater management control measures to address runoff control and treatment as required by the City of Seattle. At the West Portal site, SPU would maintain natural drainage patterns to the extent feasible (SMC 22.805.020.A), which may include runoff reduction methods such as permeable pavement and amended soils. These systems would increase stormwater detention, infiltrate direct precipitation, reduce runoff, and reduce the size of future drainage facilities. Additional site-specific analysis would be required as part of evaluating and selecting runoff reduction strategies. Similarly, the East Portal site would include a combination of onsite water quality treatment facilities (filter planter boxes, bioswales, or other treatment technologies) and additional runoff reduction strategies as determined during project design.

4.4 Unavoidable Significant Adverse Impacts

Localized turbidity during pier replacement is unavoidable. However, with the implementation of appropriate BMPs in accordance with permitting requirements, significant impacts are not expected.

Air Quality and Odors

5.1 What are the existing air quality conditions in the project area?

The affected environment for air quality and odors described in Section 4.2 of the 2014 Plan EIS has not changed. The regulatory setting for air quality includes the federal Clean Air Act, which is implemented by the EPA. Local air quality is monitored by the Puget Sound Clean Air Agency (PSCAA). Air quality is a concern for the Ship Canal Project because construction of major facilities can generate particulate matter (such as dust, dirt, soot, and smoke), carbon monoxide, and ozone-creating compounds. Odors can be caused by the operation of wastewater facilities, adding to other odors in the area, including vehicle emissions, industrial discharges, and rail-related emissions.

Air quality in King County is generally good. However, King County is designated as a maintenance area for carbon monoxide, ozone, and particulate matter (PM₁₀). Ecology tracks air quality at monitoring sites across Washington state. The nearest air quality monitoring site to the project area is south of downtown Seattle at 10th Avenue South and South Weller Street (Ecology, 2015).

Air Quality and Odors Key Findings

- Construction would increase dust and vehicle emissions adjacent to construction sites. Construction BMPs would minimize impacts.
- Operation of the facilities could generate odors, but the facilities would be equipped with odor control equipment that would minimize odors.

5.2 What are the potential air quality and odor impacts of the project?

5.2.1 During Construction

The Ship Canal Project would cause short-term, minimal to moderate localized effects on air quality during construction activities. As described in the 2014 Plan EIS, construction air quality impacts relate to dust from disturbed soils and odors and emissions from the operation of heavy-duty diesel and gasoline-powered equipment, earth excavation and grading, handling and transport of excavated material, and truck trips. Use of heavy equipment and trucks would end once construction is complete, but would take place over several years in some locations. As described in Chapter 3, Earth and Groundwater, contaminated soils would likely be encountered during construction. In general, individuals closest to the contamination, such as site construction workers, are most likely to be exposed to contaminants. However, if adequate mitigation measures are not consistently implemented, under certain circumstances there is a low likelihood that people passing through the area, neighborhood residents, school students, and employees of nearby businesses could also be exposed. Potential exposure could include the inhalation of contaminated vapors or particulates.

Sewer odors could also be temporarily emitted where existing sewer pipes or vaults are opened during construction. The following section analyzes potential effects to air quality and odor resulting from project changes since the 2014 Plan EIS including design, construction, and location updates to project elements and the potential use of rail or barge for hauling spoils and materials.

West Portal. The West Portal site is located in an industrial area. Surrounding uses include ship and boat repair, small light-industrial uses such as repair shops and metal works; storage units; and office and commercial space. Restaurants with outdoor seating areas are located in the vicinity, along with boats moored in the Salmon Bay Marina. The site is adjacent to a recreational use, the 24th Avenue NW pier, but the pier would be closed during construction of the project, so recreationists would not be impacted by construction emissions. Earthwork would occur at the West Portal site at the beginning of the construction period as the tunnel launch portal is excavated. The site would be used for removal of tunnel spoils for an approximate 2.5-year period. After tunneling is complete, pump station construction would occur for an additional 4 to 5 years, with associated clearing and grading activities.

Truck trips to haul spoils from the West Portal site (and to construct Ballard Conveyance) would cause increased emissions. It is estimated that up to 232 one-way truck trips could be required per day during peak construction periods (without the use of rail or barges). The use of rail and barge for hauling certain materials and equipment would lessen the impact of truck traffic in an area where existing truck traffic, idling vehicles, and diesel emissions are all sources of concern for air quality in affected neighborhoods. Although rail is not emission-free, rail-based transport would generate lower emissions overall and have fewer cumulative impacts to the affected community near the site because it would lead to less traffic, idling, and other sources of emissions. Tugs would also generate emissions, but barges can carry large volumes of materials and would cause fewer cumulative impacts to the community compared to truck trips.

East Portal. Construction at the East Portal site would last 9 to 16 months, and would generate up to 100 one-way trip truck trips per day during peak construction periods. The site is adjacent to residences and a daycare facility, which are sensitive to air quality. The site is also adjacent to SPU's reconstructed North Transfer Station, which reopened in late 2016, and an office building. BMPs would be used to ensure that construction-related dust and emissions would not cause a significant impact to residences.

11th Avenue NW Drop Shaft. The 11th Avenue NW Drop Shaft is located in a commercial and industrial area. Construction would last 12 to 16 months and would result in up to approximately 100 peak one-way truck trips per day. Construction activities and truck trips could generate emissions, but no land uses sensitive to air quality are located within the immediate vicinity.

North 3rd Avenue/174 Drop Shaft. The North 3rd Avenue/174 Drop Shaft would be under construction for 12 to 16 months. It would require up to approximately 100 one-way truck trips per day. Land uses adjacent to the construction area that are sensitive to air quality include the Burke-Gilman Trail and Fremont Canal Park. BMPs would be used to ensure that construction emissions would not cause a significant impact to users of the trail or park.

South 3rd Avenue Drop Shaft. The South 3rd Avenue Drop Shaft would be under construction for 6 to 9 months and would generate up to 100 one-way truck trips per day. Sensitive land uses adjacent to the construction site include the Ship Canal Trail and West Ewing Mini Park. The Seattle Pacific University athletic field (Wallace Field) is also in the project vicinity. BMPs would be used to ensure that construction emissions would not cause a significant impact to users of the trail, park, or athletic field.

Conveyance Facilities. Conveyance improvements in the rights-of-way throughout the project area could cause emissions from earthwork, clearing, grading, truck trips, and use of heavy equipment. Construction of the conveyance facilities would last for a total of approximately 12 to 24 months in each neighborhood, but durations would be shorter at specific locations, such as a specific block or residence. Some localized odors may occur when conveyance connections are made; however, these would be short term (a few days) and would not be expected to be significant. Conveyance facility construction would occur within residential areas and next to

parks, such as the Burke-Gilman Trail, in Wallingford, Fremont, and Ballard. BMPs would be used to ensure that construction emissions would not cause a significant impact to these sensitive land uses.

5.2.2 After Construction

As described in Section 6.3 of the 2014 Plan EIS, operational effects on air quality and odors relate to vehicle and equipment emissions associated with periodic maintenance activities, and the potential for odors associated with operation of wastewater facilities. Potential odor generation was identified as a concern during Supplemental EIS scoping.

5.2.2.1 Emissions

During operation, increased vehicle and equipment emissions could occur during periodic maintenance activities and infrequent use of emergency generators. However, maintenance activities would be infrequent and unlikely to impact air quality because of the limited number of trips and infrequent use of emergency generators. At most times, the East Portal and West Portal sites would only require one truck trip per day for maintenance activities. During pump station operation, the West Portal would have up to five employees. Drop shaft sites would require maintenance visits less frequently, approximately one day per month for regular maintenance activity.

5.2.2.2 Odor

Odors, primarily hydrogen sulfide, often exist in the wastewater collection system. The level of odors depends on many factors, including wastewater characteristics such as dissolved oxygen, temperature and pH, and how long wastewater is kept in the system. Typically the combined sewage during wet weather events has shorter retention time, lower temperature, and is diluted compared to sewage in dry weather; therefore, the odor potential is lower. However, when the combined sewage is diverted to the tunnel through the drop structures, the turbulence caused by falling flow would promote the release of odorous gas.

The portals, drop shafts and pump station associated with the Ship Canal Project could generate odors during operation for the reasons stated above, and as described in Section 6.3 of the 2014 Plan EIS. However, the facilities would be designed to minimize the potential for odor generation, and odor control facilities would be included throughout the project design to minimize emissions of odorous compounds. Grit removal structures could also generate low levels of odors; however, the grit removal structures currently located in the City's collection system have not been the subject of odor complaints and structures can be designed to minimize odor potential. Additional evaluations would be conducted during project design to ensure that all facilities meet applicable requirements from PSCAA, Ecology, and SPU's goal of minimizing public complaints.

West Portal. As noted in Section 6.3.1.2 of the 2014 Plan EIS, the potential for odor emissions is greatest at the TEPS, because all the combined sewage collected along the tunnel would be stored at the wet well and pumped to the wastewater collection and treatment system owned by DNRP. A drop shaft would convey combined sewage from CSO basins 150/151 and 152 to the wet well. Large volumes of wastewater, relatively long retention at the wet well, and the turbulence from the drop structure would allow more odorous compounds to be released, compared to other locations. The combined sewage flows would pass through the pump station primarily during rainy cool periods, when the potential for odor generation is lower. However, some level of odorous compounds would be present in the system when it is operational.

Preliminary modeling indicates that the TEPS would operate approximately 40 to 60 times per year. The storage tunnel would include an automated cleaning system to reduce the potential for settled material to accumulate in the bottom of the tunnel over time and stagnate, generating odors. The storage tunnel would also include an odor control system to ventilate the tunnel and drop shafts under most conditions. A slight negative air pressure would be maintained in the tunnel to help contain the air inside the tunnel and connected structures. When the tunnel

fills, the air inside the tunnel would be pulled downstream to the West Portal and treated by the odor control system, which may include a carbon scrubber, mist/grease filter, fan, or other systems as determined during final design. This system would treat odors that may have been present in the tunnel and reduce the potential for odors to be released offsite. Additional odor control treatment systems would be located at each of the drop shafts connected to the main storage tunnel to treat the increase in air volume expected as the tunnel fills during a storm event. Additional evaluations conducted during project design would refine the odor control system to ensure that the air within the facility is contained and treated all the time and no noticeable odors are present near the facility.

The TEPS would include an on-site diesel-powered generator, which could generate emissions and odors when activated. The generator would be used for backup power during outages (which would occur infrequently), but the generator would also be tested regularly for brief periods. The backup generator would be located inside the TEPS building to reduce the potential for odors and noise, and ensure that emissions are routed through the odor control system.

East Portal. The East Portal is adjacent to the North Transfer Station and adjacent to residential properties, an office building, and a preschool. Adjacent residents and businesses have expressed concern about the potential for odors to be noticeable at their properties. The odor-generating potential at the East Portal is related to turbulence as the tunnel fills. The odor control system at the East Portal as well as at other drop shafts will be sized to handle the maximum anticipated air flow rate from the facility with a safety factor. That is, under normal conditions when the tunnel is empty or when the tunnel is not surcharged during filling, the East Portal would be maintained at a slightly negative pressure so no odorous air can migrate off-site. Under very rare conditions when the tunnel is surcharged during filling, air that tends to be pushed out of the East Portal would pass through the odor control before being released. The carbon media in the odor control unit would provide over 95 percent removal of hydrogen sulfide. The treated and released air from the East Portal would contain minimal odorous compounds and is not anticipated to be noticeable.

Drop Shafts. As flows enter the drop shafts, odors could be released. As a result, odor generated from the 11th Avenue NW conveyance facilities would be treated by an odor control facility at the 11th Avenue NW Drop Shaft, and odor generated by the North 3rd Avenue/174 and South 3rd Avenue conveyance facilities would be treated by an odor control facility at the North 3rd Avenue/174 Drop Shaft. During events when the tunnel is filling, air in the tunnel would be pulled into the odor control system at the West Portal and treated. No air would escape from the drop shafts. Under rare situations, high flows within the tunnel and the TEPS could prevent air from being pulled into the odor control system at the West Portal. Under these circumstances, air that escapes from the drop shafts would be treated by the odor control system at the drop shafts before being released into the atmosphere. Most of the year no air would escape from the 11th Avenue NW and the North 3rd Avenue/174 Drop Shafts. The odor control systems would ensure removal of more than 95 percent of hydrogen sulfide before the air is released.

5.3 What measures would reduce or eliminate air quality and odor impacts?

As described in the 2014 Plan EIS, construction-related dust and emissions would be minimized by implementation of construction BMPs, which could include the following:

- Using measures to control dust, such as watering construction surfaces, using temporary ground covers, sprinkling the site with approved dust palliatives, or using other temporary stabilization practices upon completion of grading.

- Incorporating specifications into construction contracts that require the use of well-maintained or newer construction vehicles to reduce vehicle emissions.
- Encouraging contractors to offer carpooling options for employees.
- Using local building materials to reduce transport distances when possible.
- Complying with all applicable requirements associated with the handling of contaminated soils, including consideration of potential airborne contaminants (see measures to address contaminated materials included in Chapter 3, Earth and Groundwater).

SPU would provide advance notice to project area neighbors when sewer tie-ins or other known odor causing activities would occur during construction and would be on-call to address concerns while the work is being completed.

As described above, the Ship Canal Tunnel would be designed to minimize the generation of odors by using odor control facilities at locations where odors could be released to the atmosphere. The storage tunnel will include automated cleaning systems and odor control systems, which may include carbon scrubbers, mist and grease filters, fans, or other systems as determined during final design. Additional odor control systems would be installed at the drop shafts to allow air vented from the tunnel during filling to be treated prior to discharge to the environment. Because these systems would control odors, additional measures are not proposed.

5.4 Unavoidable Significant Adverse Impacts

There would be no unavoidable significant adverse air quality or odor impacts.

Fisheries and Biological Resources

6.1 What are the existing fisheries and biological resources conditions in the project area?

Fisheries and biological resources include resident and migrant species and the following aquatic and terrestrial habitats: nearshore, riparian corridors, freshwater wetlands, forest, natural areas, and landscaped areas. The study area includes portions of the neighborhoods of Ballard, Fremont, Wallingford, and north Queen Anne, and Ship Canal east of the Ballard Locks. These areas and habitats are described in Section 4.4 of the 2014 Plan EIS. Fish and wildlife species in these areas have not changed since the 2014 Plan EIS. However, this chapter provides more details for the Ship Canal in relation to potential impacts from in-water work.

Federally listed threatened and endangered species that could potentially occur in the study area are listed in Table 6-1 (WDFW, 2015, 2016). These species are the same as in the 2014 Plan EIS except for Steller sea lions, which have been delisted, and yellow-billed cuckoo, which was listed as threatened in November 2014.

While yellow-billed cuckoo was not discussed in the 2014 Plan EIS, its preferred habitat is relatively large forests along rivers or streams. This species is unlikely to be found in the study area due to lack of available habitat (USFWS, 2014). **In addition, the final critical habitat designation for Puget Sound steelhead excludes the entire Lake Washington watershed (NMFS, 2016).** No populations of threatened or endangered plant species are documented in the study area (Washington Natural Heritage Program, 2015).

Fisheries and Biological Resources Key Findings

- Fish may be temporarily affected by in-water construction at the 24th Avenue NW Pier (pier replacement and outfall rehabilitation). Impacts are not considered significant.
- SPU would work with affected Tribes to minimize impacts to Tribal fishing. Tribal concerns regarding potential impacts to Tribal fishing would be addressed during the Corps of Engineers permitting process.

Table 6-1. Federally Listed Species Potentially in the Study Area

| Federally Listed Species | Date Listed | Status ¹ | Critical Habitat in Study Area |
|---|-------------|---------------------|--------------------------------|
| Chinook salmon Puget Sound Evolutionarily Significant Unit (ESU) | 1999 | T | Yes |
| Steelhead Puget Sound Distinct Population Segment (DPS) | 2007 | T | No |
| Bull trout Coastal-Puget Sound DPS | 1999 | T | Yes |
| Marbled murrelet | 1992 | T | No |
| Yellow-billed cuckoo | 2014 | T | No |

1. T = threatened.

Ship Canal. Water from the Cedar River, Sammamish River, and Lake Washington flows through Lake Union into Puget Sound via the Ship Canal. The Ship Canal is an urbanized, busy corridor with high recreational and commercial boat traffic. Habitat and cover are limited in the Ship Canal as its shoreline is almost completely armored and includes many bulkheads, docks, and piers (SPU and U.S. Army Corps of Engineers, 2008). Water quality is generally good due to the large inflow from Lake Washington, but seasonal temperature and dissolved oxygen problems occur, as well as occasional problems with fecal coliform bacteria levels and contaminants, and there are known contaminated sediments in the study area. Water quality is described in more detail in Chapter 4, Surface Water.

The project area provides poor salmon habitat. While salmonids migrate through the area, the Ship Canal is unlikely to be used extensively by salmonids for holding and foraging. In Salmon Bay near the West Portal site the shoreline is lined with docks providing long-term and active boat moorage and there is very little riparian or upland vegetation. Adult salmonids migrate into the Ship Canal from Puget Sound through the Ballard Locks or the fish ladder at the locks. Adult salmonids tend to migrate fairly quickly through the Ship Canal, with an average passage time of 1 to 4 days depending on species. Juvenile salmonids outmigrate through the locks and fish ladder, but can also travel via culverts used to divert fresh water into the locks, the smolt passage flumes, or the spillway gates (SPU and U.S. Army Corps of Engineers, 2008).

Chinook salmon smolts usually take 1 to 4 weeks to pass through the Ship Canal whereas sockeye and coho salmon take less than 1 week. Adult outmigrating salmon, in particular Chinook salmon, often hold just upstream from the Ballard Locks in a cool water refuge near the saltwater drain before going through the locks (SPU and U.S. Army Corps of Engineers, 2008). The project area is within the federally adjudicated usual and accustomed fishing areas of the Muckleshoot and Suquamish Indian Tribes. Treaty Indian Tribes have a right to harvest fish free of state interference, subject to conservation principles; to co-manage the fishery resource with the state; and to harvest up to 50 percent of the harvestable fish (*United States v. Washington, Washington v. Washington State Commercial Passenger Fishing Vessel Ass'n 1979*). Tribal fishing occurs at various times of the year, depending on the timing of adult returns, and the number of returning adults and the associated harvest quotas.

Terrestrial Habitats. The proposed West Portal, East Portal, drop shafts, and conveyance areas are urbanized and consist primarily of paved areas. However, they do contain pockets of greenspace that could provide habitat for urban wildlife such as crows, gulls, raccoons, and rodents. At the West Portal site there are linear habitat patches along 24th Avenue NW and the northern boundary of the property, consisting of mature trees. For an urban setting this is a relatively large vegetated area, and thus likely provides habitat for urban species.

A great blue heron nesting colony is located in Commodore Park, on the south bank of the Ship Canal and adjacent to the Ballard Locks. The colony had 60 active nests in 2016 (Heron Habitat Helpers, 2016). The proposed construction activities closest to the colony would be associated with the 24th Avenue NW pier replacement, which is an estimated 2,589 feet away from the colony. WDFW lists the great blue heron as a priority species and has established management recommendations for protecting the species and its habitat (WDFW, 2012). The City of Seattle also protects great blue heron and their nesting colonies in its critical areas regulations (SMC 25.09.200.D) and Director's Rule 5-2007. The City of Seattle is currently updating the Director's Rule. The revised Director's Rule was sent to the City Council in December 2016 and is expected to be approved in early 2017. Both WDFW and the City establish management buffers for heron colonies and restrict certain disturbances within those buffers during nesting season (February 1 through July 31). WDFW recommends a year-round buffer of 197 feet (60 meters) in urban settings with a seasonal buffer of 656 feet (200 meters) for unusually loud land use activities, and a seasonal buffer of 1,280 feet (400 meters) for very loud activities such as blasting.

The City of Seattle uses a 500-foot Great Blue Heron Management Area per the current Director's Rule. The City requires that all clearing and grading activities inside the management area occur outside the nesting season. It also requires the retention of large trees (greater than 22-inch diameter breast height) that block visual disturbances to the colony and a 15-foot minimum building setback. The proposed revisions to the Director's Rule would change the 500-foot management area to a 197-foot year-round buffer with an additional 300-foot or 500-foot seasonal buffer. The 500-foot seasonal buffer would apply to only the Kiwanis Memorial Preserve Park and North Beach Park colonies, and a 300-foot seasonal buffer would apply to all other active colonies. It is likely that the City could apply the 500-foot seasonal buffer width to the Commodore Park colony because its birds are known to have relocated from the Kiwanis Memorial Preserve Park in 2014.

At the East Portal, the property has minimal vegetation. The site was once fully developed, but the structures have been demolished. Existing vegetation consists of invasive or nonnative species (such as Himalayan blackberry) providing little habitat value.

As described in Chapter 2, Description of the Ship Canal Project, the locations for the drop shafts and conveyance facilities are based on preliminary engineering completed for the Facility Plan (SPU, 2015), and may be refined during project design. The preliminary drop shaft sites are adjacent to greenspaces consisting of lawn grass, shrubs, and some trees, again providing limited habitat for urban wildlife. The South 3rd Avenue Drop Shaft is proposed within a paved, parking area of West Ewing Mini Park. Conveyance areas are primarily within city rights-of-way consisting mainly of paved streets or sidewalks but also some street trees. Street trees provide limited habitat for urban wildlife, particularly birds.

6.2 How would the project affect fisheries and biological resources?

Impacts to fisheries and biological resources would be consistent with those described in Section 6.4.3 of the 2014 Plan EIS. However, some design changes and additions may result in additional potential effects. The changes that are analyzed for potential effects in this Supplemental EIS are the following:

- Pier replacement at the West Portal site;
- Barge use at the West Portal site;
- Outfall rehabilitation near the West Portal site; and
- Design updates related to the West Portal, East Portal, drop shafts, and conveyance facilities.

These activities would require in-water work within the Ship Canal, which was not anticipated when the 2014 Plan EIS was prepared. Impacts associated with this work are described below. Other features of the project would result in impacts consistent with those described in Chapter 5 and Chapter 6 of the 2014 Plan EIS. Impact evaluations are based on preliminary engineering and project refinements will occur during project design.

6.2.1 During Construction

An increase in human activity, noise, and nighttime lighting may disturb terrestrial and aquatic wildlife during construction as described in Section 5.5.1 of the 2014 Plan EIS. There is a risk of impacting aquatic habitats from construction site runoff or in the unlikely event of construction equipment spills. However, impacts would be minimal with implementation of required BMPs as well as a SWPPP and a Construction Stormwater and Erosion Control Plan. See Chapter 4, Surface Water, for more information.

6.2.1.1 Terrestrial Impacts

The project area is urban, with some vegetated areas but is predominantly developed. Vegetated areas are disturbed but provide some habitat to urban wildlife. Disturbances from the project would occur primarily in paved or otherwise developed areas. Impacts to vegetated areas would be limited and would have minimal effect, given the distance from the construction area and adaptability of wildlife living in these areas.

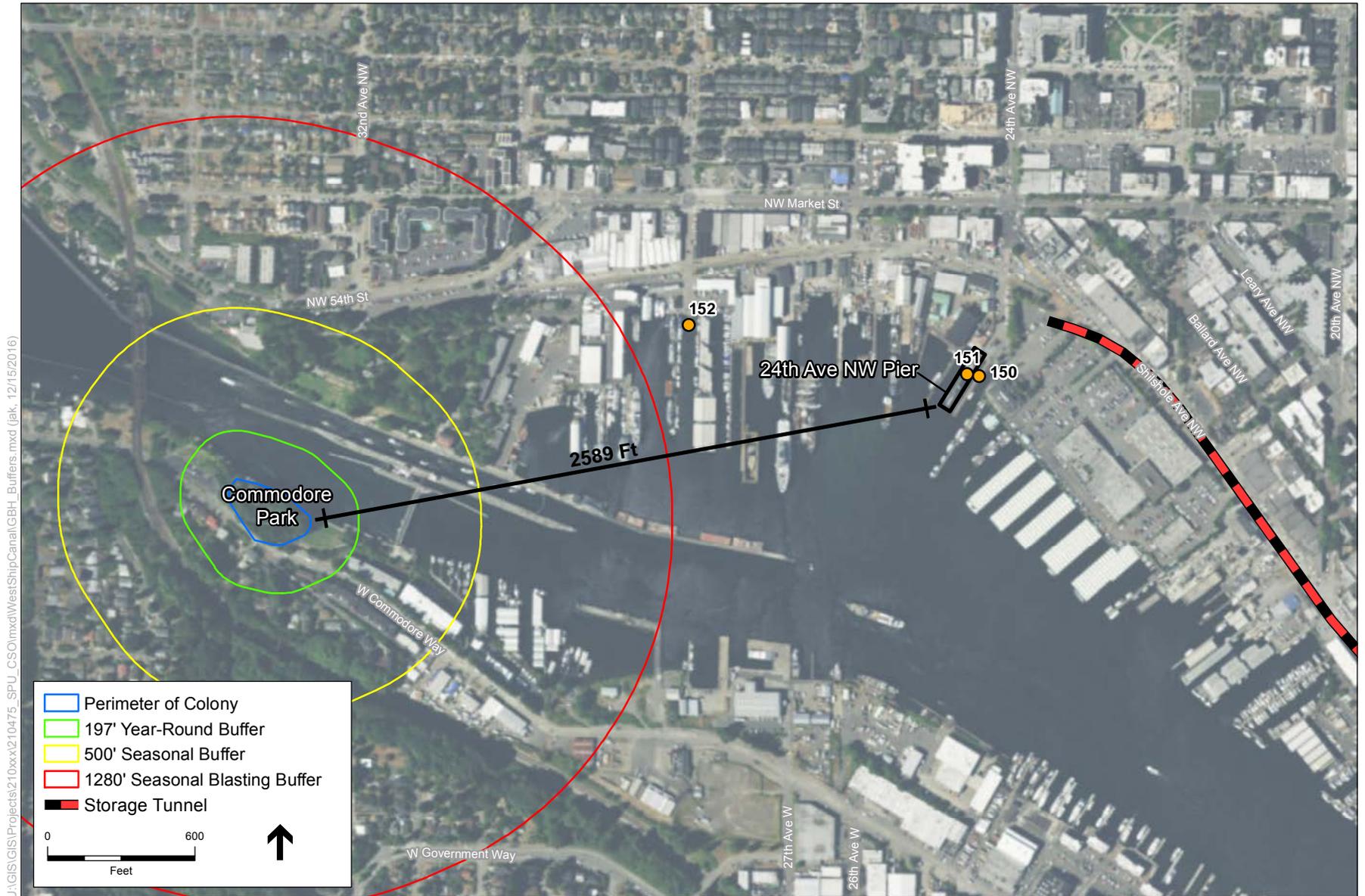
West Portal. The West Portal would be the site of most proposed construction activities. It would be the launch location of the TBM, construction staging and laydown area, temporary storage area for tunneling spoils, and field offices. It would also be the location for the TEPS (see Figure 2-3). Spoils material would be removed from the tunnel at this site and transported via truck, rail, or barge. A closed conveyor or other contained system would be used to transfer spoils to trucks, rail, or barge to minimize potential for spillage. There are linear habitat patches along 24th Avenue NW and the northern boundary of the property, consisting of mature trees and understory vegetation. Wildlife may be temporarily displaced due to noise and increased activity. Efforts will be made to maintain trees in the project area, but trees would likely need to be removed. The trees are ornamental nonnative trees but they likely provide habitat for birds. Following construction, portions of the site not used for permanent facilities will be landscaped with native plant species where feasible.

Pier Replacement. Replacement of the 24th Avenue NW pier would require pile driving with either vibratory only or in combination with impact pile drivers, depending on sediments at the site. This equipment produces noise levels up to 95 decibels at a distance of 50 feet (see Section 10.7.1). The outermost end of the pier is an estimated 2,589 feet from the year-round buffer of the great blue heron nesting colony at Commodore Park (Figure 6-1). The pier is approximately 1,140 feet from the seasonal buffer recommended by WDFW for extremely loud noises and approximately 1,760 feet from the City of Seattle's current 500-foot management area buffer. All project construction is outside the great blue heron management areas, and restrictions on timing of construction would not apply. SPU would comply with applicable permit requirements and would coordinate with the Seattle DCI.

East Portal. Most of the East Portal site would be disturbed by construction (see Figure 2-7). Existing vegetation would be removed, but it consists primarily of nonnative or invasive species such as Himalayan blackberry. Urban wildlife that may use this area could relocate.

Drop Shafts. The areas around the proposed drop shafts would be disturbed during construction. At the 11th Avenue NW and South 3rd Avenue Drop Shaft sites, construction would likely take place in paved areas. The vegetated area of West Ewing Mini Park near the South 3rd Avenue Drop Shaft is not anticipated to be disturbed. Most of the North 3rd Avenue/174 Drop Shaft site is paved, but vegetation and lawn areas adjacent to the Ship Canal and Burke-Gilman Trail would be disturbed during construction.

Conveyance Facilities. Areas disturbed during construction for installation of conveyance facilities would be primarily within paved public rights-of-way. Impacts from construction of conveyance facilities would be minimal. Microtunneling under the Ship Canal to connect to the South 3rd Avenue Drop Shaft would not involve in-water work; however, impacts could occur during construction if the microtunneling process has a failure or significant problem. Proper construction techniques will minimize the potential for this to occur. If street trees are removed, there would be an impact to urban wildlife that may use those trees. Trees would be replaced in accordance with the City of Seattle's tree protection ordinances.



SOURCE: ESA 2016, NAIP 2014

SPU CSO . 210475

Figure 6-1
Great Blue Heron Colony Buffers

6.2.1.2 Aquatic Impacts

Pier Replacement. The 24th Avenue NW pier would be replaced to allow for barging of materials and spoils during construction. The existing wooden pier decking would be replaced, and new concrete or steel piling up to 36-inches in diameter would replace existing treated wood piling. The reconstructed pier would be supplemented with a temporary platform and mooring facilities during construction and used for loading and unloading barges with spoils, construction material and equipment. Temporary mooring dolphins would be constructed adjacent to the pier to accommodate large barges. These mooring dolphins would be removed at the completion of tunneling. After tunnel construction is completed, all temporary platforms and mooring dolphins adjacent to the pier would be removed and the pier would be returned to its original function as a public pier. The reconstructed pier would be slightly shorter but of similar width as prior to construction and would be supported by fewer piles.

There would be a fixed barge tie-up area for staging tugs and barges, likely located at an existing moorage pier owned by the Corps of Engineers, between the 24th Avenue NW pier and the Ballard Locks. The fixed barge tie-up area would not require new construction.

Closure of the pier for reconstruction provides an opportunity to conduct outfall replacement at the same time in order to minimize impacts. Existing CSO outfalls (Outfalls 150 and 151) provide overflow capacity for Combined Sewer Basin 150/151, which serves a portion of the Ballard area. Existing Outfall 151 is in poor condition and existing Outfall 150 does not meet the overflow capacity needs of the entire basin. The project would remove the existing outfalls from service and replace them with a larger diameter outfall that meets the current and future overflow needs of Basin 150/151. The new outfall pipe would be assembled above-grade and attached to the bottom deck of the new pier. After the new outfall pipe is constructed and operating, the existing outfalls would be removed and/or decommissioned.

Construction activities would result in short-term, localized turbidity plumes within the water column; underwater noise and vibrations; increased underwater shading from moored work barges; and increased nighttime lighting. Aquatic habitat quality is poor in the construction area, likely limiting its use by most fish species (particularly the salmonid species which tend to move through the Ship Canal quickly). Nevertheless, timing of in-water work would comply with all regulatory permits and approvals, and BMPs would be implemented to minimize impacts to fish and other aquatic species (City of Seattle, 2013). As a result, impacts to fish and fish habitat from construction would be minor and temporary. SPU would also work with affected Tribes to minimize potential impacts from pier reconstruction and barge moorage along the pier during tunnel construction. Tribal concerns regarding potential impacts to Tribal fishing would be addressed during the Section 10/404 permitting process with the Corps of Engineers.

Increases in turbidity during pile removal or installation may result in altered behavior of aquatic species, such as difficulty in capturing prey, or physical harm if in close proximity to the disturbance. The area contains historically contaminated sediments and thus in-water construction could resuspend contaminants. If disturbed, contaminated sediment could potentially be released into Salmon Bay. If not controlled or contained, these contaminants could temporarily affect surface water quality and harm fish in the vicinity of construction. BMPs would be used to minimize effects from turbidity, and the project would meet all applicable water quality standards and in-water work permit conditions. Furthermore, some of the existing in-water piles are treated with creosote. Removal of creosote-treated piles can temporarily suspend creosote into the water column and increase the amount of creosote in the sediment locally. BMPs for the removal of creosote-treated piles would minimize release of creosote during pile removal. The Seattle Biological Evaluation contains details regarding the impacts of creosote on fish (City of Seattle, 2013). Over the long term, the removal of creosote-treated piles would be beneficial to fish in terms of general habitat improvement.

Noise could negatively affect fish by altering their behavior and, at close proximity, noise may cause physical harm or death. Pile driving would cause the loudest underwater noise of any construction activities. Vibratory pile drivers would be used to reduce in-water sound levels; however, impact hammers would likely be needed to achieve adequate load bearing capacity of the piles. Vibratory pile drivers use an oscillatory motion and heavy weight that produces substantially less intense noise, resulting in less impact to aquatic organisms. Impact hammers pound piles into the substrate, producing sound pressure waves that radiate a substantial distance from the pile location. The underwater sound generated from pile driving may harm, kill, or change the behavior of fish. The sound produced by impact hammers is usually between 100 and 800 hertz (Hz) with a fairly rapid change in pressure, whereas vibratory pile drivers are 20 to 30 Hz with a slower change in pressure (Carlson et al., 2001; Nedwell and Edwards, 2002). The sound levels depend on the type and diameter of the pile, type of hammer, site depth, geologic conditions, and noise attenuation measures used (City of Seattle, 2013). A vibratory pile driver may also be used, resulting in an additional noise source. The Seattle Biological Evaluation contains a detailed description of the potential impacts from pile driving (City of Seattle, 2013). Specific measures and pile driving restrictions will be provided in the project-specific permits and approvals from WDFW, Corps of Engineers, U.S. Fish and Wildlife Service, and National Marine Fisheries Service to minimize potential impacts to fish.

Boat and barge activity can cause fish to change their behavior; however, the Ship Canal already has a large amount of shipping activity. Thus, increased boat activity and underwater construction (other than pile driving) would likely not generate noise above background levels within the Ship Canal. Artificial lighting associated with the nighttime construction activities has the potential to affect the distribution and behavior of fish in Salmon Bay, with the magnitude of such effects varying based on the light intensity reaching the water surface. Behavioral responses to artificial lighting are expected to vary by species, life history stage, feeding strategy, and other environmental factors. Fish may be attracted by or may avoid artificially lighted areas, based on species-specific foraging and predator avoidance strategies. While some predatory fish are adapted to foraging in low light intensities, others are attracted to higher light intensities (Machesan et al., 2005; Celedonia et al., 2009). In addition, some species school and move toward light sources. Therefore, artificial lighting during construction of the project has the potential to serve as an attractant to salmonid species as well as their predators.

While behavior of juvenile salmonids is influenced by artificial lighting, fish tracking studies in the Ship Canal indicate that juveniles do not appear to spend much time close to shore, particularly where there are multiple boat docks or dense aquatic vegetation beds (Celedonia et al., 2011). Juveniles tend to occur in deeper water along the offshore edge of the docks, and generally do not spend much time in areas between docks. The area around the proposed in-water construction site has multiple adjacent piers and relatively dense aquatic vegetation. As a result, few juvenile salmonids are expected to occur in areas that could be illuminated by construction lighting. Therefore, no substantial effects of project lighting are expected.

As with juveniles, returning adult salmon are also not expected to typically occur in the relatively shallow water near the project site, due to the extensive aquatic vegetation and typically warm surface water temperatures (up to 22°C) in the Ship Canal during their typical migration periods. Adults typically occupy deeper water habitats (mean depth of about 21 feet) in the area upstream of the Ballard Locks (Goetz, 2003). While adult salmon have been found to remain in the area just upstream of the locks for up to 47 days (Goetz, 2003), they typically move through the Ship Canal within a few days (SPU and U.S. Army Corps of Engineers, 2008). Therefore, adult salmonids are not expected to be present in areas substantially affected by the project construction lighting.

After completion of the construction phase, no long-term impacts from nighttime lighting are expected. The proposed permanent dock would be slightly smaller than the existing facility, and no additional lighting is proposed.

Outfall Rehabilitation. Outfall rehabilitation at the same time as pier reconstruction is an opportunity to proactively replace aging infrastructure and to reduce the duration of impacts in that area. Existing Outfall 151 is in poor condition and existing Outfall 150 does not meet the overflow capacity needs of the entire basin. The replacement outfall would be a high-density polyethylene pipe and affixed to the 24th Avenue NW pier. Construction of the outfall is anticipated to result in minimal disturbance.

Barge Use. Barges may be used for removal of spoils and may transport material and equipment to support construction at the West Portal. Barges would be moved by tugs and accessed from the reconstructed pier at the 24th Avenue NW street end. Barges would be loaded using a closed conveyer system to minimize material spills or drips from entering the water. The use of barges for transporting excavated spoils from the tunnel excavation could create the potential for spillage during barge loading and offloading. BMPs would be implemented to prevent spillage. Contaminated soils would not be barged but transported by truck or rail. The increased barge traffic would not be a substantial increase over existing conditions in Salmon Bay, as the Ship Canal corridor is already heavily used for barge transport. Barge traffic is described in more detail in Chapter 9, Transportation.

The increased barge traffic through the Ballard Locks during the juvenile salmon outmigration period would result in an increase in the potential impacts to outmigrating juvenile salmon from entrainment in the culverts used to fill the locks with water. However, improvements in the operations and fish guidance features of the locks in recent years have minimized the levels of injury and mortality rates on juvenile migrating fish (SPU and U.S. Army Corps of Engineers, 2008). As a result, limited impacts on fish are anticipated from the increased barge traffic. SPU would also work with affected Tribes to minimize potential impacts from barge movement in the Ship Canal to Tribal fishing. Tribal concerns regarding potential impacts to Tribal fishing would be addressed during the Corps of Engineers permitting process.

6.2.2 After Construction

After completion, the Ship Canal Project would have a long-term beneficial effect on fish and other aquatic species in terms of overall habitat improvement. Combined sewage that enters the combined sewer system would be treated before discharge, and the tunnel would reduce combined sewer overflows from existing Ship Canal outfalls to no more than one per year on a 20-year moving average, thus improving water quality in the Ship Canal. Replacing the existing creosote-treated timber piles supporting the pier at 24th Avenue NW would reduce a contaminant source in the Ship Canal. The finished pier would also have fewer piles than existing, and would include grated decking (or another method) to increase light penetration to minimize impacts to fish and aquatic habitat. The pier would be slightly shorter, but similar in width to existing conditions.

There would be minimal loss of vegetated areas as a result of the project. Most areas disturbed during construction would be restored. Some trees may be permanently removed but will be replaced in accordance with the City of Seattle tree protection ordinances. Operational impacts on fisheries and biological resources are not expected to change from those described in the 2014 Plan EIS.

6.3 What measures would reduce or eliminate potential impacts associated with fisheries and biological resources?

SPU will comply with all applicable permits for in-water construction, including a Section 10/404 permit from the Corps of Engineers, a Section 401 Water Quality Certification from Ecology, and an HPA from WDFW. As part of the federal permit process, SPU would also consult with the National Marine Fisheries Service and U.S. Fish and Wildlife Service to ensure compliance with the federal Endangered Species Act. Furthermore, SPU will work with affected Tribes regarding impacts to fishing and mitigation. Measures to reduce or eliminate potential construction impacts include those discussed in Section 5.5.5 of the 2014 Plan EIS. In addition, avoidance and minimization

measures will be followed. The following list of measures would be implemented to reduce impacts associated with the project.

- A Construction Stormwater and Erosion Control Plan and SWPPP would be developed and implemented specifically for this project.
- A Spill Prevention Control and Countermeasure Plan would be developed and implemented specifically for this project to minimize the potential for accidental spills of construction-related contaminants.
- All equipment operating water ward of the ordinary high water mark of the Ship Canal would use either nontoxic or vegetable oil-based hydraulic fluids.
- Timing of in-water work would comply with all regulatory permits and approvals.
- A turbidity or silt curtain would be installed around in-water construction activities to minimize the spread of turbidity in the Ship Canal, as determined by permit requirements.
- Vibratory pile driving equipment would be used where possible, with impact pile driving used for only short periods of time, primarily to meet load-bearing capacity standards.
- Bubble curtain or other noise attenuation methods (wood blocks, nylon blocks, etc.) would be used during impact installation or proofing of steel piles, if necessary.
- Creosote-treated piles (if they are cut at the mudline) or their holes (if the piles are removed) would be capped with clean sediment to minimize leaching of chemicals into water or sediment, or as specified in permit conditions.
- Following tunnel construction, the finished 24th Avenue NW pier would be designed to include increased light passage, compared to the existing pier.
- Trees removed as part of the project would be replaced in accordance with the City of Seattle's tree protection ordinances.
- While worker and work zone safety issues dictate strict requirements for nighttime lighting, work area lighting will be designed to minimize light spillage into adjacent water surfaces. All nighttime lighting will be kept to the minimum necessary, with regard to intensity and illuminated area. Typical minimization measures would include the following:
 - Directing the lights away from the water;
 - Shielding the lights with visors, louvers, shields, or screens to concentrate the size of the illuminated area;
 - Placing the lights as low as possible above the work areas; and
 - Limiting lighting in areas other than the immediate work zones, when lighting is not needed for safety.
- Construction for the 24th Avenue NW pier replacement and West Portal would be coordinated with the Seattle DCI to avoid impacts to great blue herons at the Commodore Park nesting colony.

6.4 Unavoidable Significant Adverse Impacts

While temporary impacts would be associated with in-water construction, all work would be done in accordance with applicable permit requirements. There would be no significant unavoidable impacts to fish or other biological resources from in-water construction activities, microtunneling, or other construction-related work.

Land and Shoreline Use and Visual Quality

7.1 What are the existing land and shoreline use and visual quality conditions in the project area?

The study area for land use, shoreline use, and visual quality consists of portions of the Ballard, Fremont, and Wallingford neighborhoods on the north side of the Ship Canal and a small area on the south side of the Ship Canal in the north Queen Anne neighborhood. The affected environment described in Section 4.8 of the 2014 Plan EIS has not materially changed. This chapter provides additional information for specific land use, shoreline use, and visual quality conditions that were not described in detail in the 2014 Plan EIS.

7.1.1 Land and Shoreline Use

This section describes existing land and shoreline uses at the sites for each of the main project components. Current zoning and shoreline environment designations from the Seattle Land Use Code and Shoreline Master Program (SMP) are also indicated for each site.

7.1.1.1 Storage Tunnel

The approximately 2.7-mile tunnel extending from the West Portal in Ballard to the East Portal in Wallingford would be located entirely underground. The tunnel would be as deep as 120 feet or as shallow as 50 feet, for most of its alignment. The tunnel would be located primarily under street rights-of-way in areas zoned industrial and commercial. These areas are developed with a variety of industrial, general commercial, warehouse, office, retail, and utility uses. A one-block area on the north side of Leary Way NW between NW 40th Street and NW 41st Street is zoned residential (Single Family 5000 and Lowrise 1). An approximately three-block area on both sides of N 35th Street between Aurora Avenue N and Albion Place N is zoned residential (Lowrise 2 – north side, and Lowrise 3 - south side). Both of these areas are developed with multi-family and some single-family uses. The tunnel alignment generally follows paved arterial or secondary streets and attempts to avoid residential street rights-of-way and private property whenever possible.

The City of Seattle SMP regulates development within 200 feet of the ordinary high water mark (OHWM) of the Ship Canal as well as overwater construction. Two separate areas of the tunnel alignment pass through Seattle's shoreline jurisdiction: (1) an area on Shilshole Avenue NW near the convergence of 20th Avenue NW and NW Dock Place that is developed with a private marina on the south side of Shilshole Avenue NW, and (2) an area on NW 45th Street immediately east of the Ballard Bridge at 15th Avenue NW that is the site of the Seattle Maritime

Land and Shoreline Use and Visual Quality Key Findings

- Temporary and permanent easements from some private landowners would be needed.
- Some relocations would be required; the City would follow applicable requirements for property acquisition, compensation, and relocation.
- Temporary land use and visual impacts would be experienced for a longer period of time at the West Portal.

Academy on the south side of NW 45th Street. Both of these areas are designated as Urban Industrial (UI) shoreline environments.

7.1.1.2 West Portal

The West Portal would be located on an approximately 2.15-acre City-owned property at the southeast corner of Shilshole Avenue NW and 24th Avenue NW. The site is bounded to the north by a rail line (Ballard Terminal Railroad), to the west by 24th Avenue NW, to the south by Salmon Bay, and to the east by a private parking lot and commercial/industrial buildings. The existing use on the site is a vacant restaurant and its parking lot. The pier at the 24th Avenue NW street end is located southwest of the West Portal site, and is owned and maintained by SDOT. Existing uses on adjacent upland properties include a two-story office/warehouse building, a boat repair yard, and a fishery supply store. There is a current development proposal by C.D. Stimson Co. to construct a new five-story office building on the adjacent parcel to the north of the existing vacant restaurant. No construction dates have been identified for this project. Adjacent waterward uses include a private covered marina and several piers for commercial boat moorage, boat repair, and recreational use.

The West Portal site is zoned Industrial General (IG) 1 and IG-2. The SMP designation of the upland portion of the site within 200 feet of the OHWM is UI. The UI designation extends approximately 350 feet waterward of the OHWM where it transitions to the Conservancy Navigation (CN) shoreline environment within the Ship Canal. It appears that the existing 24th Avenue NW pier is located entirely within the UI shoreline environment and does not extend into the CN environment.

7.1.1.3 East Portal

The East Portal would be located on a vacant approximately 0.6-acre City-owned property at the northeast corner of N 35th Street and Interlake Avenue N on a site zoned Commercial 2 – 30 (C-2). Existing uses on the surrounding sites include SPU's North Transfer Station (which reopened in late 2016) to the south, residential uses to the east, commercial/warehouse buildings to the west, and a private school to the north.

7.1.1.4 Drop Shafts

In addition to the drop shafts at the West and East Portals, there are three other, intermediate drop shafts sites described below. The general locations described below are based on preliminary design and are considered conceptual; exact locations may change during detailed design.

11th Avenue NW Drop Shaft. The 11th Avenue NW Drop Shaft would potentially be located in the public right-of-way along NW 45th Street near 11th Avenue NW, in an area zoned IG-2. This location abuts the UI shoreline environment to the south. However, the proposed drop shaft, generator, electrical panel structures, and construction staging area are all located more than 200 feet from the OHWM and outside of shoreline jurisdiction. Construction activity would encompass approximately 40,000 square feet, and may include some adjacent privately owned commercial property.

North 3rd Avenue/174 Drop Shaft. The North 3rd Avenue/174 Drop Shaft would potentially be located in the public right-of-way along NW 36th Street between 3rd Avenue NW and Leary Way NW, in an area zoned Industrial Buffer (IB). This location abuts the UI shoreline environment to the south. However, the proposed drop shaft, generator, electrical panel structures, and construction staging area appear to be located just beyond 200 feet from the OHWM and outside of shoreline jurisdiction. The construction area would encompass approximately 25,000 square feet, including a small area of two abutting parcels to the immediate south, one owned by DNRP and the other by SDOT. Adjacent parcels to the east of this site contain a retail store, warehouse, and parking lot. Other surrounding uses include the Fremont Siphon odor control building (under construction) to the south, miscellaneous commercial uses to the north and west, and the Fremont Canal Park to the east.

South 3rd Avenue Drop Shaft. The South 3rd Avenue Drop Shaft would be located in the parking lot of the City of Seattle's West Ewing Mini Park in an area zoned C-2. This area is within 200 feet of the OHWM and is designated Urban General (UG) shoreline environment. The construction area would encompass approximately 11,000 square feet, and is owned by the City of Seattle Parks and Recreation. Surrounding uses include the DNRP Environmental Lab to the west, Seattle Pacific University facilities to the south, and the extension of West Ewing Mini Park to the east. The Ship Canal abuts the site on the north.

7.1.1.5 Conveyance Facilities

Conveyance facilities would include underground pipes, diversion structures, and associated components to convey flows from the Ballard, Fremont, Wallingford, and Queen Anne CSO areas to the tunnel. In addition, grit removal structures would be located at six locations within the conveyance system. Approximately 3,300 linear feet of gravity conveyance pipelines, and 1,900 feet of force mains, would be constructed, primarily in public rights-of-way. Similar to the storage tunnel, the underground conveyance pipelines would cross many zones and in a few limited cases would be within SMP jurisdiction. The 3rd Avenue West microtunnel crossing under the bed of the Ship Canal is located in a CN shoreline environment. The shoreline environment abutting the CN district on the north side of the Ship Canal is designated UI. The shoreline environment abutting the CN district on the south side of the Ship Canal is designated UG.

7.1.2 Visual Quality

This section describes the existing visual quality and characteristics at the sites for each of the main project components and the surrounding environment. Most of the project's facilities would be constructed below ground and would have no long-term effect on visual quality along the approximately 2.7-mile alignment. The proposed aboveground structures would be located mainly in developed commercial and industrial areas. As described in the 2014 Plan EIS, there are no protected views under the Seattle Municipal Code at any of the project locations.

7.1.2.1 West Portal

The upland portion of the West Portal site is generally graded flat with some grade changes supported by retaining walls and rockery walls. Similar topography is found on adjacent properties. The general visual character of the upland area is dominated by commercial and industrial uses. Street trees line portions of the south side of Shilshole Avenue NW and the east side of 24th Avenue NW near the West Portal site, partially screening views from the street toward the site.

In the immediate vicinity of the 24th Avenue NW pier, the view is dominated by commercial/industrial and recreational maritime uses. Other piers provide commercial and private moorage for small, medium, and large vessels. There is a large commercial dry dock repair facility to the west of the 24th Avenue NW pier and a covered private marina to the east. The Ship Canal waterway in this part of Salmon Bay is heavily used for commercial and recreational boat traffic heading both westbound and eastbound.

7.1.2.2 East Portal

The East Portal site is generally graded flat, with retaining walls supporting the eastern and northern boundaries. Similar topography is found on adjacent properties. **The site is currently in use as leased parking.** The general visual character of this area is mixed-use commercial/residential. However, the bulk and scale of the adjacent transfer station, which occupies a one-block by three-block area, dominates the visual character of the immediate area near the East Portal site.

7.1.2.3 Drop Shafts

11th Avenue NW Drop Shaft. The topography at the 11th Avenue NW Drop Shaft site and in the immediate vicinity is generally flat, with a slight slope down to the south toward the Ship Canal. The visual character of the area is dominated by commercial and industrial uses at all four corners of the intersection of 11th Avenue NW and NW 45th Street. There is very little existing vegetation or street trees in the immediate vicinity.

North 3rd Avenue/174 Drop Shaft. The topography in the North 3rd Avenue/174 Drop Shaft area is generally flat, with a slight slope down to the south toward the Ship Canal. The visual character of the area is dominated by commercial, industrial, and utility uses. There are a few mature street trees along both sides of Leary Way NW in the immediate vicinity. A greenbelt area is located to the south abutting the Ship Canal.

South 3rd Avenue Drop Shaft. The topography in the South 3rd Avenue Drop Shaft area is generally flat, with a slight slope down to the north toward the Ship Canal. The site is within the West Ewing Mini Park adjacent to the south side of the Ship Canal. Other than the paved parking lot, the West Ewing Mini Park is well vegetated with a mixture of trees, shrubs, and grasses.

7.2 How would the project affect land and shoreline use and visual quality?

7.2.1 During Construction

As described in Section 5.9 of the 2014 Plan EIS, potential construction-related impacts are associated with the acquisition of property and/or easements, incompatibility of surrounding land uses, changes to views, and light and glare. This section analyzes the following design and construction changes and additions for potential effects to land and shoreline use and visual quality:

- Pier replacement at the West Portal site;
- Barge use at the West Portal site; and
- Design, construction, and location updates related to the West Portal, East Portal, drop shafts, and conveyance facilities.

7.2.1.1 Acquisition of Easements

Storage Tunnel. The tunnel alignment generally follows paved arterial or secondary streets and attempts to avoid residential street rights-of-way and private property. The alignment would include a “tunnel envelope” that provides a horizontal and vertical offset to protect the tunnel from future surface and subsurface development. This envelope would generally extend 20 feet from the top, bottom, and sides of the tunnel. Permanent easements for the tunnel envelope would be negotiated with private property owners where the envelope extends outside the public right-of-way. This routing was developed to reduce impacts to private property in the unlikely event that a tunnel machine intervention is required during construction.

West Portal. Most of the staging areas necessary to support construction of the storage tunnel would be located at the City-owned West Portal site. Temporary easements may be needed from adjacent landowners for construction. If barging is used to remove spoils, and depending on the final design of the 24th Avenue NW pier, there would be a number of potential temporary property-related impacts that are described below.

- Temporary use of the pier for barge operations may require moorage barges or temporary extension of the reconstructed pier beyond the current SDOT parcel boundary. Approval would be needed from the

Washington State Department of Natural Resources (WDNR), which owns and regulates development on the tidelands waterward of the SDOT parcel.

- Barge use of the reconstructed pier (regardless of whether it is temporarily extended) would likely result in temporary displacement of existing recreational and live-aboard boat moorage at the adjacent pier to the east. It could also temporarily displace boats moored along the pier to the west.

The potential impacts described above would occur for approximately **2.5 years**, the estimated duration for tunneling. The City would follow federal, state, and local requirements for property acquisition, compensation, and relocation for any moorage, including live-aboards displaced during the barging operations.

East Portal. Land for the East Portal site is owned by the City of Seattle (Finance and Administrative Services [FAS]). Negotiations are in progress for SPU to lease the property during construction. After construction, jurisdiction of the property needed for permanent operation of the facility would be transferred to SPU. The property not needed for facility operations would remain in FAS jurisdiction.

Drop Shafts and Conveyance Facilities. A limited number of temporary construction easements would likely be required for construction activities or staging areas associated with construction of the drop shafts and conveyance facilities located outside of public rights-of-way. The duration of the temporary easements would vary from site to site, ranging from approximately 6 months to 24 months.

7.2.1.2 Incompatibility of Adjacent Land Uses

As stated in Section 7.2.1.1, use of the 24th Avenue NW pier for barging near the West Portal would cause conflicts with adjacent mooring piers, requiring temporary displacement or relocation of moorage. The use of tugs and barges would increase the use of the Ship Canal waterway, but this increase in vessel traffic would not be significant (see Chapter 9, Transportation).

Use of both rail and barges to haul materials and spoils is being considered to minimize truck traffic on surface streets in Ballard, Fremont, and Wallingford. Potential impacts of these transport options on nearby recreational uses are described in Chapter 8, Recreation.

7.2.1.3 Changes to Visual Character

As described in Section 5.9 of the 2014 Plan EIS, construction would temporarily affect visual character through short-term changes to views resulting from construction equipment and activities. Additional information is provided below on activities at the West Portal and East Portal sites that were not described in detail in the 2014 Plan EIS.

The West Portal would be the main site for work associated with tunnel construction. To support tunnel construction, material handling facilities (including a conveyor system, rail car, or slurry piping) would be located on the portal site. The West Portal construction staging area would also provide laydown areas for materials, maintenance workshops, storage areas for excavated spoils and precast-concrete segments, along with parking and field offices. The existing vacant restaurant building would be used as the construction office. Security fencing would be installed along the perimeter of the construction site. Construction activities at this site would be conducted over approximately 6 to 7 years, including site preparation, tunneling, and construction of the drop shaft, TEPS, and odor control facilities.

If a conveyor system is used to transport spoils, the temporary use of the reconstructed pier would likely include a closed conveyor structure, secured and placed on top of the pier deck to transport spoils from the tunnel portal to large barges moored at the pier. The height of the conveyor could range between 3 and 15 feet above the top of

the pier deck. The conveyor structure would be removed after the tunnel phase is completed. Given the industrial character in the vicinity of this pier, the temporary presence of the conveyor structure and use of large barges would not be a significant visual impact.

Construction activities at the East Portal site include establishing a staging area; installing fencing; creating new driveways and site access routes; designating contractor parking; and constructing associated buildings and facilities, including a generator, equipment trailers, and a laydown area. Construction of the East Portal would be similar to the West Portal except the construction staging area would be smaller. Most of the approximately 0.5-acre site would be used for construction. Construction would last approximately 9 to 16 months. The proximity of the site to adjacent residences increases the likelihood that noise, dust, and construction-related activities could disrupt some uses.

7.2.1.4 Light and Glare

Nighttime construction could be necessary for project components, resulting in light and glare impacts similar to those described in the 2014 Plan EIS. While the type of temporary impacts would remain unchanged, the anticipated total construction period of 6 to 7 years is longer than that estimated in the 2014 Plan EIS (3.5 years). This would mean that visual impacts would be experienced for a longer period of time, particularly at the West Portal site. Adjacent residences near the East Portal site would increase the potential for light and glare impacts to residences. Temporary lighting impacts during nighttime construction would be reduced by shielding light sources to block direct views from residential areas, and by aiming and shielding light sources to reduce spillover lighting from such areas.

7.2.2 After Construction

Impacts to land use, shoreline use, and visual quality after construction are consistent with Section 6.9 of the 2014 Plan EIS. Additional information is provided below related to design and location updates.

7.2.2.1 Land Conversion or Easement Restrictions

Storage Tunnel. As stated above in Section 7.2.1.1, permanent underground easements for the tunnel envelope would be negotiated with private property owners where the envelope extends outside the public right-of-way. Because most of the 2.7-mile tunnel alignment is within public rights-of-way, it is anticipated that fewer than 20 permanent easements would be required with affected property owners. These easements would have no material impact on the normal use and enjoyment of the affected properties.

West Portal. Following completion of construction activities at the upland portion of West Portal site, any excess land acquired for construction could be surplus or repurposed after construction. The decision to surplus or repurpose would be made following project completion in 2025. The 24th Avenue NW pier would be reopened for public access.

East Portal. Following construction, jurisdiction of a portion of the East Portal site needed for permanent operation of the facility will be transferred from the City of Seattle FAS to SPU (see Figure 2-8, Conceptual East Portal Permanent Facilities, for approximate finished site boundary). The portion of the property that is not needed for permanent facility operation would return to FAS jurisdiction following construction. A small (approximately 15-foot by 35-foot) building will remain at the site following construction. The building will be located inside the fence line. Impacts to land use and the visual environment are not expected to occur.

11th Avenue NW Drop Shaft. Permanent easements may be required to house the standby generator and electrical cabinet for the 11th Avenue NW Drop Shaft. This easement would likely be located at the southeast corner of NW 45th Street and 11th Avenue NW and would not interfere with existing site use or access.

North 3rd Avenue/174 Drop Shaft. A belowground odor control structure would be located south of the North 3rd Avenue/174 Drop Shaft. Permanent easements would likely be required around the odor control structure. These easements would be located on parcels owned by DNRP (Fremont Siphon Facility) and SDOT; both parcels are located on the south side of NW 36th Street, south of the drop shaft. These easements would not interfere with existing site uses and access.

South 3rd Avenue Drop Shaft. No significant impacts to land and shoreline uses are expected at West Ewing Mini Park after construction. The presence of drop shaft facilities would result in a dedicated use of the subsurface area and would restrict certain future uses in the surface area above the facilities. The area is currently used for parking, and there are no plans to redevelop to a different use.

7.2.2.2 Consistency with Seattle’s Comprehensive Plan, Land Use Code, and Shoreline Master Program

The project’s consistency with Seattle’s Comprehensive Plan is the same as stated in the 2014 Plan EIS. The regulatory environment, specifically Seattle’s Land Use Code and SMP described in Section 4.8 of the 2014 Plan EIS, has not substantially changed. However, Ecology approved Seattle’s SMP Update on June 1, 2015 and it became effective on June 15, 2015. There were no substantive changes to standards applicable to utility services and utility lines in the approved SMP Update compared to the version of the SMP Update that was reviewed at the time the 2014 Plan EIS was issued.

Table 7-1 summarizes the zoning and shoreline environment designations in the project area.

| Table 7-1. Zoning and Shoreline Designations and Permitted Uses | | | |
|--|---|------------------------------|---|
| Project Component | Zoning Designation | Shoreline Designation | Allowable Permitted Use? |
| Storage Tunnel (underground) | Industrial: IG-1, IG-2, IB, and IC Commercial: C-2, C-1, NC-3, and NC-2 Residential: Low-rise (LR)-3, LR-2, and Single-family (SF) 5000 | UI | Underground utility service uses are permitted outright in all industrial, commercial, and residential zones. Utility service uses are permitted in the UI shoreline environment if they reasonably require a shoreline location to operate. |
| West Portal | Industrial: IG-1 and IG-2 | UI | Utility service uses (underground and aboveground structures) are permitted outright in the IG-1 and IG-2 zones. Utility service uses are permitted in the UI shoreline environment if they reasonably require a shoreline location to operate. Piers are permitted outright in the UI shoreline environment subject to development standards contained in the SMP. |
| East Portal | Commercial: C-2 | N/A | Utility service uses (underground and aboveground structures) are permitted outright in the C-2 zone. |
| Drop Shaft – 11th Avenue NW | Industrial: IG-2 | N/A | Utility service uses (underground and aboveground structures) are permitted outright in the IG-2 zone. |

Table 7-1. Zoning and Shoreline Designations and Permitted Uses

| Project Component | Zoning Designation | Shoreline Designation | Allowable Permitted Use? |
|--|---------------------------|------------------------------|---|
| Drop Shaft – North 3rd Avenue/174 | Industrial: IB | N/A | Utility service uses (underground and aboveground structures) are permitted outright in the IB zone. |
| Drop Shaft – South 3rd Avenue | Commercial: C-2 | UG | Utility service uses (underground and aboveground structures) are permitted outright in the C-2 zone. Utility service uses are permitted in the UG shoreline district if they reasonably require a shoreline location to operate. |
| Conveyance Facilities | Same as storage tunnel | UI, UG, and CN | Utility lines are permitted outright in all zones. Utility lines are permitted outright in the UI and UG shoreline districts, and permitted as a shoreline special use in the CN shoreline district. |

Generally, utility service uses and utility lines are permitted outright in all zones, except that a City Council Conditional Use approval is required for aboveground utility service uses in Single-Family Residential zones. No aboveground utility service uses are proposed for this project within a Single-Family Residential zone. All aboveground uses and structures, including the TEPS constructed at the West Portal, would be located in Industrial or Commercial zones. According to regulations for siting of public facilities in Chapter 23 of the SMC, underground utility structures and utility lines, such as the storage tunnel, drop shafts, and conveyance facilities, are permitted outright in all zones. A Type II Master Use Permit (MUP) would likely be required for this project. Type II MUP applications are reviewed and approved by the City of Seattle DCI.

Aboveground and underground utility service uses and structures, including the storage tunnel, are permitted in the UI shoreline environment provided they “reasonably require a shoreline location to operate” according to the City’s SMP. Within the shoreline area, a small portion of the tunnel crosses under private property near the Ballard Bridge; otherwise the tunnel alignment located within the City’s shoreline jurisdiction is within public rights-of-way. Construction of the tunnel within these areas would likely require a shoreline substantial development permit and a Type II MUP reviewed and approved by DCI. A new or reconfigured pier used for barging materials is a permitted use in the UI shoreline environment. A shoreline substantial development permit would likely be required to construct a new or reconfigured pier.

The replacement and protection of existing utilities is permitted under the Seattle Land Use Code and would be regulated under Title 15 (Street and Sidewalk Use) of the SMC.

During the permitting process, the City of Seattle DCI would be consulted to ensure that the proposed project is compatible with existing and proposed land uses and plans, and to verify permit requirements.

7.2.2.3 Visual Impacts

The completed facilities would largely be constructed below ground. Aboveground facilities would have minimal visual impacts with the use of appropriate design and screening. The visible, aboveground facilities would include the TEPS building and other facilities at the West Portal and East Portal sites, and other relatively small facilities (generator and electrical control panel in aboveground casing) necessary to support the drop shafts. These facilities would also require air ventilation stacks and access panels set into concrete slabs, which would be visible from the immediate site but would not have substantial visual impacts offsite. Apart from the potential

removal of vegetation and structures at these sites, visual impacts would be minimal. Impacts to visual quality after construction are consistent with 2014 Plan EIS. Additional information is provided below related to design and location updates.

West Portal. Several changes would be noticeable, including the new TEPS building, odor control facility, new driveway and landscaping, and a reconstructed pier at the 24th Avenue NW street end. The TEPS would be housed in a low-rise building, up to 35 feet in height, surrounded by safety fencing. The building would have a footprint of approximately 8,000 square feet and would be designed to blend in with the existing commercial setting. The odor control facility would be fenced. There would be a new driveway from NW 54th Street for SPU vehicles. The Yankee Grill building, which would be used as the construction office, would remain in place to be sold or repurposed. Given the context of a variety of smaller-scale and larger-scale buildings in the immediate area, the TEPS facility is not expected to change the visual character of the area or views of Salmon Bay. The TEPS would include security lighting, which would not adversely affect adjacent properties because it would be shielded and directed downward toward areas that require illumination.

The existing perimeter street trees along 24th Avenue NW and Shilshole Avenue NW would be retained to the greatest extent possible. Other site landscaping would be provided in accordance with permitting requirements.

The reconstructed 24th Avenue NW pier would have a modern, updated appearance. The pier would be consistent with current permitting requirements, including a grated deck that allows light to penetrate to the water surface below.

East Portal. Permanent facilities at the East Portal site would include an underground drop shaft and odor control structures, and an aboveground standby generator and electrical building, approximately 15 feet by 35 feet. There would be security fencing around the perimeter of the site, and reconstructed retaining walls along the northern and eastern edges of the property. Landscaping would be installed along the street frontages. Visual impacts of the permanent facilities would be minor because most facilities would be underground, and the aboveground equipment would be placed in low-profile enclosures.

Drop Shafts. Most of the facilities associated with the drop shafts would be underground. The 11th Avenue NW and North 3rd Avenue/174 Drop Shafts would include an underground odor control structure within a vault in the right-of-way or on private property, and a small aboveground standby generator and electrical control panel located close to the vault. Stormwater runoff from the 11th Avenue NW, North 3rd Avenue/174, and South 3rd Avenue drop shaft sites would remain in the existing rights-of-way through the use of grading and curb-and-gutter to direct flows to existing drainage structures. Runoff reduction strategies for the sites could consist of porous sidewalks in the disturbed area or additional runoff treatment systems (e.g., Filterra™ units or comparable technologies). These aboveground and at-grade ancillary facilities would have little or no impact on visual character at each drop shaft site. At the 11th Avenue NW and North 3rd Avenue/174 Drop Shafts, access lids would be recessed into the pavement of the street. At the South 3rd Avenue Drop Shaft, the access hatch would be recessed into the parking lot of the West Ewing Mini Park.

Conveyance Facilities. Conveyance facilities would be located underground, primarily in public rights-of-way or on existing SPU or DNRP-owned parcels with existing facilities. Once construction is complete, disturbed surface areas would be restored and landscaping installed per SDOT standards.

7.3 What measures would reduce or eliminate potential impacts associated with land and shoreline use and visual quality?

7.3.1 During Construction

Measures to reduce or eliminate impacts to land use, shoreline use, and visual quality would remain as described in the 2014 Plan EIS. In addition, SPU would take the following measures to reduce or eliminate potential impacts:

- Screen construction equipment staging areas to buffer views of construction equipment and materials, where feasible.
- Comply with federal, state, and local regulations regarding property acquisition and relocation assistance, including relocation assistance to moorage facilities affected by barging operations.
- Minimize the size of permanent aboveground facilities and design them to blend with the surroundings.
- Locate and shield light sources to block direct views from residential areas, and aim lighting away from adjacent roadways, residential areas, and the Ship Canal; use the minimum wattage necessary to provide the necessary illumination.

Other chapters discuss specific measures to minimize recreation, air quality, noise, and traffic impacts during construction.

7.3.2 During Operations

Measures to reduce or eliminate impacts to land use, shoreline use, and visual quality would remain as described in the 2014 Plan EIS. At the West Portal site, aboveground facilities would be designed and located to maximize the future potential for reuse of the vacant restaurant building and allow for new development on the rest of the site.

7.4 Unavoidable Significant Adverse Impacts

There would be no unavoidable significant adverse impacts to land and shoreline use or visual quality.

Recreation

8.1 What are the existing recreation conditions in the project area?

The study area for recreation consists of those areas in or adjacent to the project’s aboveground footprint. Within the study area, there are several City of Seattle parks (including West Ewing Mini Park and the Burke-Gilman Trail), several public access sites along the Ship Canal, recreation facilities associated with Seattle Pacific University, streets used for passive recreation such as bicycle riding, and in-water recreation in the Ship Canal. Figures 8-1 and 8-2 show the locations of recreation sites in the project area. The affected environment described in Section 4.9 of the 2014 Plan EIS has not changed; however, additional information is provided for specific recreational facilities and areas that were not described in detail in the 2014 Plan EIS.

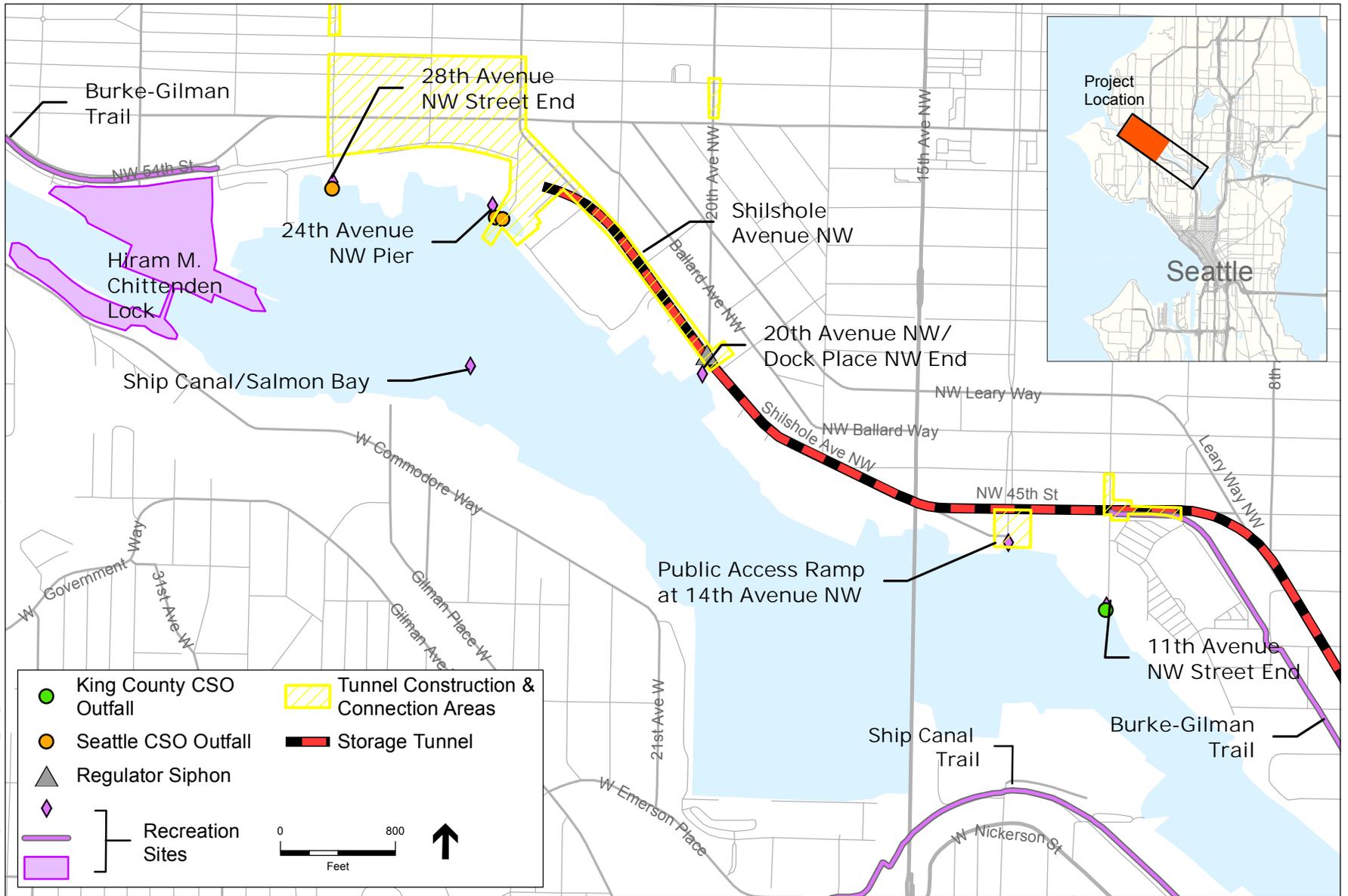
Ship Canal. The Ship Canal, which connects Lake Washington to Puget Sound, is used for in-water recreation by boaters, kayakers, paddle boarders, and others. Many marinas are located along the shores of the Ship Canal in the vicinity of the project.

Hiram M. Chittenden Locks. The Hiram M. Chittenden Locks (Ballard Locks) are operated by the U.S. Army Corps of Engineers to allow boat passage between Lake Washington and Puget Sound and to regulate the water levels in Lake Washington. Recreational boaters travel through the Ballard Locks. The grounds of the Ballard Locks are operated as a park, with walking paths, lawn areas, a visitor’s center, viewing windows to a fish ladder, and the Carl S. English, Jr. botanical gardens. Boat watching is a major visitor use of the Ballard Locks. Visitors can cross the Ballard Locks by foot, and bicyclists and pedestrians often cross the Ballard Locks to travel between Magnolia and Ballard as an alternative to the Ballard Bridge. The Ballard Locks are a major tourist destination for the Ballard neighborhood.

Ship Canal Trail. The Ship Canal Trail is a multi-use trail along the south shore of the Ship Canal from Lake Union to the Ballard Bridge. The trail, used by bicyclists and walkers, runs through West Ewing Mini Park adjacent to the project area. To the east of West Ewing Mini Park, the trail runs between Seattle Pacific University athletic facilities and the Ship Canal. This portion of the trail includes grassy areas and benches facing the Ship Canal.

Recreation Key Findings

- If barging is used to haul spoils, the existing pier at the 24th Avenue NW street end would be inaccessible during construction.
- Construction is anticipated to occur in portions of West Ewing Mini Park (the parking lot) and potentially in Fremont Canal Park. The majority of both parks would be accessible during construction.
- Construction activities would be visible and audible to recreationists at other parks and recreation sites in the vicinity.
- Portions of the Burke-Gilman Trail near the North 3rd Avenue/174 and 11th Avenue NW Drop Shafts could need to be closed or rerouted during construction.
- Construction activities at the West Portal would need to be coordinated with construction of the Burke-Gilman Trail Missing Link project.



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Figure 8-1 Parks and Recreational Facilities - West

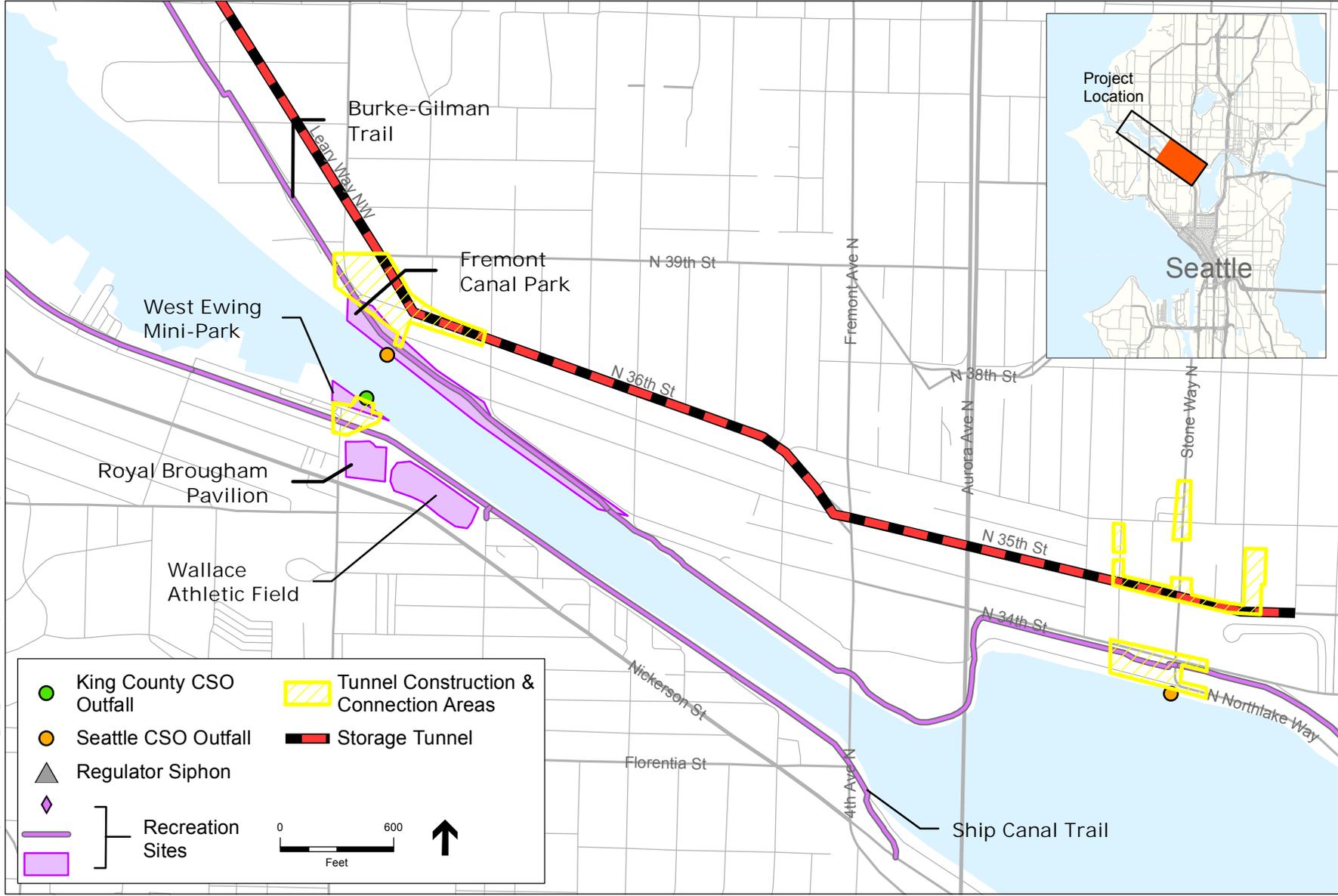


Figure 8-2 Parks and Recreational Facilities - East

Seattle Pacific University Athletic Fields and Facilities. Seattle Pacific University's athletic facilities are located at 3rd Avenue West between Nickerson Street and Ewing Street, directly adjacent to the Ship Canal Trail. The facilities include Wallace Athletic Field, the Royal Brougham Pavilion, and the Crew Dock. The Royal Brougham Pavilion includes a gymnasium used for NCAA Division II basketball games, concerts, and school events; a weight room; a fitness center; and facilities used for intramural and club sports. Wallace Athletic Field features a rubberized track and two softball and flag football fields. The field is open to the public and is used for the school's track and field team and for intramural events. The Crew Dock is located in the Ship Canal at the end of 3rd Avenue West.

West Ewing Mini Park. West Ewing Mini Park, operated by Seattle Parks and Recreation, is a small waterfront park on the south side of the Ship Canal. The park features lawn/open space, an overlook with benches, picnic tables, and the Ship Canal Trail.

Shilshole Avenue NW and Other Streets in the Project Area. Shilshole Avenue NW runs through an industrial area of Ballard along the Ship Canal from 24th Avenue NW to 15th Avenue NW. Shilshole Avenue NW is commonly used by bicyclists and other recreational users despite the lack of a dedicated bicycle lane or sidewalks along the southwest side of the road. Shilshole Avenue NW is one of three potential routes for the proposed Burke-Gilman Trail Extension Project (also known as the "Missing Link" project). Similar to Shilshole Avenue NW, all other streets in the project area are used for informal recreation such as bicycling and walking.

Burke-Gilman Trail. The Burke-Gilman Trail is a 19.8-mile-long multi-use trail used by walkers, runner, cyclists, and skaters. Within the project area, the trail runs from Golden Gardens Park to the Ballard Locks. The trail resumes at NW 45th Street and 11th Avenue NW and runs along the Ship Canal to the University of Washington campus, where it turns north and continues until reaching Bothell. The Burke-Gilman Trail is adjacent to the proposed 11th Avenue NW and North 3rd Avenue/174 Drop Shaft sites and Wallingford conveyance (connection) area. Burke-Gilman Trail users often ride along Shilshole Avenue NW between the 11th Avenue NW and 30th Avenue NW segments of the trail.

Fremont Canal Park. The Fremont Canal Park, operated by Seattle Parks and Recreation, is a small linear park adjacent to the Ship Canal in Fremont. The park features a lawn area/open space, a pedestrian trail, benches, and a viewing platform. The park stretches from Phinney Avenue N to 3rd Avenue NW. Public events such as festivals are held in the park during the summer months.

Ship Canal Access at Street Ends. Street ends throughout the Ballard neighborhood are designated shoreline street ends, which provide public shoreline access and views. Some street ends feature piers or boat ramps, while others simply feature a public space adjacent to the Ship Canal providing views of the water. The SDOT Shoreline Street Ends Project is working to improve shoreline street ends throughout the city, adding more public access and recreational opportunities (SDOT, 2015). Street ends within or near the project area are described below.

- **11th Avenue NW Street End.** The 11th Avenue NW street end features native plantings, a shoreline viewing platform, a bench swing, and birdhouses. These features were installed in spring 2015 through collaboration between SDOT and the University of Washington Landscape Architecture Program.
- **Public Access Ramp at 14th Avenue NW.** The 14th Avenue NW street end in Ballard features a free public boat ramp providing access to the Ship Canal. The site has two piers, two launch ramps, handicap parking spaces, and a portable restroom.
- **20th Avenue NW/Dock Place NW Street End.** Shoreline access is also available at a street end on the Ship Canal side of Shilshole Avenue NW, directly across from the King County Ballard Regulator Station.

- **Pier at 24th Avenue NW Street End.** SDOT owns the existing pier at the 24th Avenue NW street end and it is maintained by Seattle Parks and Recreation. The pier is used by recreationists for water access and shoreline viewing. The pier is also used for public vessel moorage, which is limited to 2 hours. Moorage limits are enforced by the Harbor Patrol. Seattle Parks and Recreation identified this site as the location of a potential new park called the Threading the Needle Park. The Park would include a pedestrian greenway, restored waterfront beach, upgraded dock, and stormwater gardens. The project is not currently scheduled or funded.
- **28th Avenue NW Street End.** SDOT recently improved the 28th Avenue NW street end to enhance recreational opportunities and fish habitat. The 28th Avenue NW street end features native plantings, water access, a kayak launch, and a basketball hoop.

8.2 How would the project affect recreation?

Recreation impacts are consistent with those described in the 2014 Plan EIS in Sections 5.10 (construction) and 6.10 (operation). As described in Section 5.10, construction-related impacts can occur when there is construction within a park, adjacent to a park, or in a right-of-way. Operation impacts discussed in Section 6.10 of the 2014 Plan EIS were limited to permanent facilities constructed in or adjacent to parks and other recreation areas.

The following section analyzes several changes and additions to the proposed project that have been made since the 2014 Plan EIS. These include the following:

- Pier replacement at the West Portal.
- Barge use at the West Portal.
- Design, construction, and location updates related to the West Portal, East Portal, drop shafts, and conveyance facilities.

8.2.1 During Construction

8.2.1.1 Construction within Parks or Recreation Areas

Any construction activities (described below) within City of Seattle parks would constitute a non-park use of park property and, as such, would require approval by Seattle Parks and Recreation through the Revocable Use Permit process.

West Portal. To facilitate the barging of spoils from the West Portal site, the existing pier at the 24th Avenue NW street end would need to be replaced with a new pier to support barging operations. During the approximate 6-month pier construction period and 2.5-year tunneling period, the pier would be unavailable for recreational use. In total, the pier and street end would be closed to recreational use for approximately 3 years. Once tunneling is complete, the pier would be restored to public use.

The Threading the Needle Park project could not begin until the Ship Canal Project is complete and the pier is no longer being used to convey spoils. However, there is currently no funding or schedule for implementation of the Threading the Needle Park project. Therefore, construction of the Ship Canal Project is not expected to delay the park project.

While the pier would be closed to the public for approximately 3 years, shoreline access would be available at other sites in Ballard, including the two public docks at the 14th Avenue NW street end. Public moorage is also available at Union Bay (Belvoir Place) and Lake Union (Fairview, Lake Union Park, and Terry Pettus). Additional

private moorage is available in Salmon Bay at the Ballard Mill Marina and at Nickerson Marina. Because other nearby public docks would remain open, and recreationists would be able to utilize alternate nearby facilities, this impact would not be significant.

Recreational users of the Ship Canal include paddle boarders, kayakers, and recreational boat users. They would likely notice construction noise and activity associated with pier construction and barging activities, but noise and activity levels would be consistent with the types of noise and activity that currently occur along the industrial shoreline.

Drop Shafts and Conveyance Facilities. As described in Chapter 2, as design progresses, the location and design of drop shafts and conveyance facilities will be refined, but are anticipated to be located within the general locations shown on Figures 2-2 through 2-11. Construction of both the 11th Avenue NW and North 3rd Avenue/174 Drop Shafts and associated conveyance pipelines would potentially require temporary closure and rerouting of portions of the Burke-Gilman Trail during construction.

Some construction activities associated with the North 3rd Avenue/174 Drop Shaft could occur within Fremont Canal Park. The actual location of the drop shaft would be determined during final design. If located in the park, construction areas within the park would be fenced, and most of the park would remain available for recreational use.

Construction of the South 3rd Avenue Drop Shaft would potentially require the temporary closure and rerouting of a portion of the Ship Canal Trail during construction. The South 3rd Avenue Drop Shaft is proposed to be constructed in a portion of the paved parking lot of West Ewing Mini Park. During the approximate 6- to 9-month construction period, recreationists using West Ewing Mini Park would still have access to the park, but the construction area would be fenced. Approximately 16 of the 19 parking spaces would be closed for the length of construction. It is likely that users of the Ship Canal Trail use the parking lot in West Ewing Mini Park. Street parking would still be available in the vicinity of the park on West Ewing Street. Park users would still be able to access the overlook, lawn areas, picnic tables, and benches during construction. However, park users would be aware of construction noise, dust, the high visibility of construction activities and fencing, and increased traffic on adjacent roads from construction truck trips. Since West Ewing Mini Park is very small, most of the park would be within 100 feet of construction activities.

8.2.1.2 Construction Adjacent to Parks or Recreation Areas

Drop Shafts and Conveyance Facilities. **Along portions of the Ship Canal Trail and adjacent recreation areas (lawn and benches) that remain available for recreational use during the approximate 6- to 9-month construction period,** trail and park users would be aware of construction noise, dust, the high visibility of construction activities and fencing, and increased traffic on adjacent roads from construction truck trips.

Construction activities for the South 3rd Avenue Drop Shaft would also be located in the vicinity of athletic facilities at Seattle Pacific University. The Royal Brougham Pavilion **and the Crew Dock** would be within 150 feet of construction, and Wallace Athletic Field would be within 300 feet of construction. Construction activities would be visible and potentially audible from Wallace Athletic Field **and the Crew Dock**.

Construction at the North 3rd Avenue/174 Drop Shaft would likely occur adjacent to the Burke-Gilman Trail and Fremont Canal Park. During the approximate 12- to 16-month construction period, construction activities would be visible to trail and park users, and construction noise and dust could be disruptive to recreation on the trail. Construction traffic would not need to cross the Burke-Gilman Trail to access the site.

8.2.1.3 Construction in Rights-of-Way

The 2014 Plan EIS identified the potential for construction in road rights-of-way, which would temporarily interfere with informal recreation opportunities such as bicycle and pedestrian use. For the Ship Canal Project, drop shaft construction and associated conveyance activities could temporarily disrupt bicycle and pedestrian use on streets. Due to the availability of alternate routes, this disruption would not be considered significant.

During construction near the intersection of 11th Avenue NW and NW 45th Street, the Burke-Gilman Trail will be temporarily rerouted. SPU will schedule activities to minimize disruption to trail users to the extent feasible.

A small section of the Ship Canal Trail near the intersection of West Ewing Street and 3rd Avenue West will also be temporarily rerouted during construction, and as described for the Burke-Gilman Trail will be scheduled to reduce trail disruption to the extent feasible.

Ballard conveyance facilities would include construction along Shilshole Avenue NW between 24th Avenue NW and 20th Avenue NW. Shilshole Avenue NW is frequently used by bicyclists and other recreational users despite the lack of a dedicated bicycle lane or sidewalks along the southwest side of the road. Shilshole Avenue NW is used frequently as a connector between the two disconnected segments of the Burke-Gilman Trail. Safety conflicts have been cited by bicyclists and motorists using Shilshole Avenue NW due to the lack of dedicated bicycle lanes and the high volume of industrial traffic entering and exiting driveways and using the street. Additional construction in the right-of-way on Shilshole Avenue NW could aggravate these conditions (see Chapter 9, Transportation for additional discussion).

8.2.1.4 Hauling of Spoils

West Portal

Spoils generated at the West Portal site would be hauled by barges, trucks, and/or trains.

- **Barge:** If spoils are hauled by barge, they would be transferred to the 24th Avenue NW pier by conveyor system then barged through the Ballard Locks. Barges and other commercial boats already use the Ballard Locks and would not be considered an impact to recreational use of the Ballard Locks. Depending on how the pier and barges are configured, the barges could affect recreational use in areas of the canal where barge activity occurs. Barges could also preclude moorage at adjacent privately owned piers. Information on potential barge activity can be found in Chapter 9, Transportation.
- **Train:** Spoils could be hauled by train through use of the BTRR/BNSF rail operations. Information on the frequency of train trips can be found in Chapter 9, Transportation. Train traffic could cause periodic short access delays to the Burke-Gilman Trail and 11th Avenue NW, 14th Avenue NW, and 28th Avenue NW street ends. The BTRR tracks run through the parking lot of the Ballard Locks and could cause periodic short access delays to the Ballard Locks.
- **Truck:** Trucks hauling spoils would exit the West Portal site via a driveway onto Shilshole Avenue NW and travel southeast along Shilshole Avenue NW. Information on the number of truck trips that would be required can be found in Chapter 9, Transportation. Shilshole Avenue NW is already frequently used by bicyclists despite a high number of existing truck trips on the road and entering and exiting driveways. Therefore, bicycle use of Shilshole Avenue NW would likely not be disrupted by truck trips for this project. However, added truck trips could increase potential safety conflicts along Shilshole Avenue NW (see Chapter 9, Transportation for additional discussion).

8.2.2 After Construction

Section 6.10 of the 2014 Plan EIS discusses potential operational impacts of the Ship Canal Project. The project would reduce pollutant loading to the Ship Canal, with potential long-term benefits to water-based recreation. Operational impacts would be limited to those areas where permanent facilities associated with the Ship Canal Project are located in or adjacent to parks at the West Portal location, the South 3rd Avenue Drop Shaft, and the North 3rd Avenue/174 Drop Shaft.

West Portal

Once tunnel construction activities are complete, the 24th Avenue NW pier would be reopened for public access.

The 24th Avenue NW pier and street end shoreline access point would be located directly adjacent to the permanent TEPS facility at the corner of 24th Avenue NW and Shilshole Avenue NW. The facility would be designed to reduce the potential for odors and noise to be noticeable off site (see Chapter 5, Air Quality and Odors and Chapter 10, Noise and Vibration, for additional discussion). SPU employees would access the TEPS facility from 24th Avenue NW and NW 54th Street. SPU estimates that up to five employees could work at the TEPS site and up to one additional truck trip per day would be required after construction is complete. However, these streets are already used for industrial traffic associated with the Pacific Fishermen Shipyard and other uses along NW 54th Street, and increased traffic associated with the TEPS facility would not impact users of the pier.

11th Avenue NW

The 11th Avenue NW sidewalk and Burke-Gilman Trail access would be re-opened once construction is complete. Both pedestrians and cyclists will be rerouted during construction in this area.

For maintenance access to the odor control facilities and electrical room near the intersection of NW 45th Street and 11th Avenue NW, several concrete lift slabs will be permanently fixed in the Burke-Gilman Trail. SPU employees would access lift slabs from either right-of-way or private parcel. SPU estimates accessing the concrete lift slabs no more than once per year for routine and emergency maintenance. While accessing the lift slabs, SPU would reroute cyclist and pedestrian traffic. Regular maintenance will be provided by an access hatch located off the Burke-Gilman Trail in private parcels and rights-of-way.

South 3rd Avenue Drop Shaft

The South 3rd Avenue Drop Shaft would be constructed within the parking lot at West Ewing Mini Park. However, once completed, there would be no aboveground elements and the project site would be restored to previous conditions. Access to the drop shaft would be through an access hatch located in the parking lot that would be located and designated for permanent maintenance access. SPU would require access to the drop shaft an average of once per month for regular maintenance activities.

North 3rd Avenue/174 Drop Shaft

The North 3rd Avenue/174 Drop Shaft would be constructed adjacent to the Burke-Gilman Trail and Fremont Canal Park. SPU would require access to the drop shaft an average of once per month for regular maintenance activities. Maintenance activities would be noticeable to park users but would be minor and unlikely to disrupt recreational activities.

8.3 What measures would reduce or eliminate potential impacts associated with recreation?

Measures to reduce or eliminate construction and operation impacts to recreation are discussed in Section 5.10.5 and Section 6.10.4 of the 2014 Plan EIS, respectively.

During construction, access to all recreational areas except for the 24th Avenue NW pier and portions of Fremont Canal Park and West Ewing Mini Park would be maintained. If barging is used to support construction at the West Portal, SPU would coordinate and provide SDOT with advance notice of the construction period for the 24th Avenue NW pier construction and barging activities.

SPU would provide the Seattle Parks and Recreation with advance notice of times when portions of West Ewing Mini Park and Fremont Canal Park would need to be closed for construction so that festivals and other events could be planned accordingly. Project construction updates would be posted on signs in the project area and mailed, emailed, or hand-delivered to interested parties so that park and trail users could anticipate when construction would occur in the parks and when the trails would be rerouted.

SPU would coordinate with Seattle Pacific University throughout the construction process to reduce potential impacts to recreational facility access and use.

SPU would provide advance notice of trail rerouting for the Burke-Gilman and Ship Canal Trails during construction and operation, to reduce potential for disruption of trail use.

The contractor would be required to provide safe pedestrian and bicycle access to Fremont Canal Park, West Ewing Mini Park, the Burke-Gilman Trail, and the Ship Canal Trail (except for any areas of the parks and trails that are temporarily closed during construction). Measures to ensure pedestrian and bicyclist safety could include the use of signage regarding park access routes and temporary fencing to designate safe walkways through or near construction areas. Construction along portions of the Burke-Gilman Trail will require early coordination and public outreach efforts.

As described above in Section 8.2.1, SPU would coordinate approval for any construction activities within City of Seattle parks through the Revocable Use Permit process.

Transportation impacts would be minimized as discussed in Section 9.3, odors would be minimized as discussed in Section 5.2, and noise would be minimized as discussed in Section 10.3.

8.4 Unavoidable Significant Adverse Impacts

There would be no unavoidable significant adverse impacts to recreation.

Transportation

9.1 What are the existing transportation conditions in the project area?

The study area for the transportation analysis includes all roadways, non-motorized facilities, and transit and marine facilities that could be potentially disturbed by construction or operation of the project elements. The affected environment described in the 2014 Plan EIS has not changed; however, more detailed information is provided for the specific transportation facilities that would be affected by the project elements and were not described in the 2014 Plan EIS.

This section describes the different facilities and services that constitute the transportation system in the study area, their operational characteristics, and any constraints they currently have. Surface transportation facilities and services include streets and intersections, alleys, driveways, parking lots and spaces, sidewalks and other pedestrian facilities such as crosswalks, bus routes and stops, and railroad facilities. More detailed descriptions of the surface transportation characteristics within the study area for each project element are provided in Tables B-1 through B-6 in Appendix B. Marine facilities needed to accommodate potential construction-generated barges are also considered.

9.1.1 Roadway System

Roadways in the transportation study area are designated with one of the following classifications (City of Seattle, 2005), consistent with those previously described in the 2014 Plan EIS:

- **Principal Arterials** serve as primary routes for moving traffic through the city, connecting urban centers and urban villages to one another or to the regional transportation network.
- **Minor Arterials** distribute traffic from principal arterials to collector arterials and local access streets.
- **Collector Arterials** collect and distribute traffic from principal and minor arterials to local access streets and/or provide direct access to destinations.
- **Local Access Streets** directly serve residential, commercial, and industrial land uses and provide localized traffic circulation.
- **Alleys** provide access to the rear of residences and businesses and are not intended for the movement of through trips.

Transportation Key Findings

- Transportation impacts during construction would include temporary roadway lane and sidewalk narrowings or closures adjacent to construction activities. Some closures could require temporary detours of vehicular, transit, or non-motorized traffic.
- Parking availability could be reduced in some neighborhoods.
- If Ballard conveyance facilities were constructed via NW 54th Street, transportation impacts would be considered significant and unavoidable if adequate measures cannot be identified to maintain access to the businesses that use this segment of NW 54th Street.
- Construction-generated truck trips would not significantly affect roadway operations but would be noticeable. Use of barge or rail to support construction activities where feasible would reduce truck trips.
- Increases in train traffic during construction may require measures to minimize the potential conflict with other vehicular or non-motorized traffic.

These functional classifications represent varying levels of emphasis on mobility and access. Higher classes (e.g., arterials) provide greater mobility and have more limited access to adjacent land uses while accommodating higher traffic volumes at higher speeds. Lower classes (e.g., local access streets and alleys) provide a high degree of access to adjacent land and are not intended to serve through-traffic, and thus carry lower traffic volumes at lower speeds. Collector arterials generally provide a more balanced emphasis on traffic mobility and access to land uses.

The study area roadways provide varying levels of access to adjacent properties and include numerous intersections with alleys and driveways. Some industrial and commercial properties have access along large portions of their frontages without delineated driveways.

Average Weekday Daily Traffic (AWDT) counts within the transportation study area were conducted by Idax Data Solutions in June 2015. Observed AWDT volumes on arterials ranged from about 6,000 vehicles per day on a collector roadway to 32,000 vehicles per day on a principal arterial roadway. Most local access streets carried fewer than 1,500 vehicles per day, but some carried higher volumes with ranges observed between 3,000 and 7,000 vehicles.

In the transportation study area, public parking is typically provided on-street. In busy commercial areas, parking may be restricted to 2-hour time limits. In the Ballard and Fremont portions of the study area, some streets have metered parking with pay stations where drivers are required to pay for parking between 8:00 a.m. and 8:00 p.m. Metered parking in the transportation study area typically has time limits of 2 to 4 hours (or 3 minutes to 30 minutes in loading zones). On-street parking is prohibited on some arterials during peak periods so that the lanes can accommodate additional vehicle traffic.

Private parking for residential, commercial, industrial, and institutional development is typically provided in off-street surface lots or garages. There is typically no charge to park in private off-street lots that directly serve businesses in the transportation study area, but privately owned and managed surface lots or garages (e.g., pay lots) typically charge for general parking.

Table 9-1 summarizes the major roadway characteristics in the transportation study area. See Figures 2-2 through 2-11 for locations of study area roadways.

Table 9-1. Summary of Existing Roadway Characteristics in Project Areas

| Project Area | Roadway Characteristics |
|--|--|
| West Portal & Ballard Conveyance Facilities | <p>The major street through the study area is Shilshole Avenue NW, a 2-lane Minor Arterial that carries 14,000 vehicles per day.</p> <p>The study area for the Ballard conveyance facilities includes NW Market Street, a 4-lane Minor Arterial that carries 14,900 vehicles per day, and 24th Avenue NW, a 3-lane Minor Arterial that carries 12,300 vehicles per day.</p> <p>All other streets in the study area, including NW 54th Street, NW 56th Street, and 28th Avenue NW, are 2-lane local access, carrying fewer than 1,300 vehicles per day.</p> <p>On-street parking is provided along both sides of most study area streets.</p> |
| Ballard East - 11th Avenue NW Drop Shaft & Associated Conveyance Facilities | <p>Both study area streets, 11th Avenue NW and NW 45th Street, are local access but carry higher traffic volumes than most typical local access streets of 3,000 to 7,000 vehicles per day.</p> <p>On-street parking is provided along both sides of most study area streets.</p> |
| Fremont - North 3rd Avenue/174 Drop Shaft & Associated Conveyance Facilities | <p>The major street through the study area is Leary Way NW/N 36th Street, a 5-lane Principal Arterial that carries 31,500 vehicles per day.</p> <p>3rd Avenue NW, north of Leary Way NW, is a 2-lane Collector Arterial that carries 3,500 vehicles per day.</p> <p>All other streets in the study area, including 2nd Avenue NW and 3rd Avenue NW/NW 36th Street (south of Leary Way NW), are local access, carrying fewer than 500 vehicles per day.</p> <p>On-street parking is provided along one or both sides of most study area streets.</p> |
| Queen Anne - South 3rd Avenue Drop Shaft & Associated Conveyance Facilities | <p>Both study area streets, W Ewing Street and 3rd Avenue W, are local access streets and carry fewer than 1,400 vehicles per day.</p> <p>On-street parking is provided along both sides of both study area streets, and a 19-space parking lot that serves the West Ewing Mini Park is located to the east of the 3rd Avenue W/W Ewing Street intersection.</p> |
| East Portal & Wallingford Conveyance Facilities | <p>The major streets through the study area are Stone Way N, a 3-lane Minor Arterial that carries 12,400 vehicles per day, and N 34th Street. To the east of Fremont Avenue N, N 34th Street is a 2-lane Principal Arterial that carries 17,500 vehicles per weekday. To the west, it is a local access street.</p> <p>N 35th Street is a 2-lane Collector Arterial that carries 5,700 vehicles per day.</p> <p>All other streets in the study area, including Interlake Avenue N, N 36th Street, Woodlawn Avenue N, and N Northlake Way, are local access streets that typically carry fewer than 1,500 vehicles per day.</p> <p>On-street parking is provided along one or both sides of the study area streets.</p> |

9.1.2 Transit

King County Metro Transit (Metro) provides bus service in the transportation study area (King County Metro Transit, 2015). Table 9-2 summarizes transit characteristics in the study area. It is noted that transit service is continually changing as routes are added, changed, or eliminated; the data in the table reflect service as of September 2016. Prior to construction, SPU would coordinate with Metro to confirm the current bus routes that could potentially be affected.

Table 9-2. Summary of Existing Transit Characteristics in the Project Area

| Project Area | Transit Characteristics |
|--|--|
| West Portal & Ballard Conveyance Facilities | Metro Routes 17, 18, 29, 40 and 44 operate in the study area (NW Market Street); one bus stop in each direction is located in the study area serving Routes 17, 29, and 44. Electric overhead trolley lines are located on each side of NW Market Street. Metro Routes 18 and 40 operate in the study area near NW 56th Street; no bus stops are located in the study area. |
| Ballard East –11th Avenue NW Drop Shaft & Associated Conveyance Facilities | No transit routes. |
| Fremont – North 3rd Avenue/174 Drop Shaft & Associated Conveyance Facilities | Metro Routes 28 and 40 operate in the study area; one eastbound stop and two westbound stops are located in the study area serving Route 40. |
| Queen Anne – South 3rd Avenue Drop Shaft & Associated Conveyance Facilities | No transit routes. |
| East Portal & Wallingford Conveyance Facilities | Metro Routes 31, 32 and 62 operate in the study area; two northbound stops and three southbound stops are located in the study area. |

9.1.3 Non-motorized Facilities

Streets in the Ballard, Fremont, Wallingford, and north Queen Anne neighborhoods generally have completed sidewalk networks. Signalized intersections typically include marked crosswalks with pedestrian signals. Marked crosswalks are provided at some stop-controlled intersections and mid-block locations. Intersections without marked crosswalks are also considered legal pedestrian crossings.

In addition to sidewalks, non-motorized facilities include painted on-street bicycle lanes and roadway lanes that are marked with sharrows (a shared-lane pavement marking that is placed in the roadway lane) indicating that motorists and bicyclists should share the road. Some roadways without bicycle pavement markings are still identified by the City as bicycle routes that may be either signed or unsigned (City of Seattle, 2015a).

Two major multi-use trails traverse the study area:

The **South Ship Canal Trail** is a 1.5-mile trail adjacent to the south side of the Ship Canal between the Ballard Bridge (15th Avenue NW) and the Fremont Bridge.

The **Burke-Gilman Trail** is about 19.8 miles in length, with a west section adjacent to Elliott Bay between Golden Gardens Park and the Hiram M. Chittenden Locks, and an east section that connects Ballard, Fremont, and the University of Washington, and then continues adjacent to Lake Washington from Seattle's Ravenna neighborhood, through north Seattle, Lake Forest Park, and Bothell. In Bothell, it becomes the Sammamish River Trail, continuing for another 10 miles east to Marymoor Park in Redmond.

The *Burke-Gilman Trail Extension (Missing Link) Project*, currently in the planning process, would connect the existing east and west portions of the Burke-Gilman Trail through the Ballard neighborhood to complete the regional trail. Three alternatives have been defined, located primarily along NW Leary Way, NW Ballard Way, and Shilshole Avenue NW, and also including segments of NW 54th Street, NW Market Street, NW 56th Street, and

28th Avenue NW. Portions of all three alternatives are located in the transportation study area (City of Seattle, 2015b).

Table 9-3 summarizes non-motorized characteristics in the transportation study area.

| Table 9-3. Summary of Existing Non-Motorized Characteristics in the Project Area | |
|---|--|
| Project Area | Non-Motorized Characteristics |
| West Portal & Ballard Conveyance Facilities | <p>Sidewalks are located on one or both sides of all arterials and most local access streets, including Shilshole Avenue NW, NW Market Street, NW 56th Street, 24th Avenue NW, and 28th Avenue NW north of NW Market Street. There are no sidewalks on NW 54th Street or 28th Avenue NW south of NW Market Street.</p> <p>There are no marked bicycle facilities, but the City has identified unsigned bicycle routes on 24th Avenue NW, 28th Avenue NW, and NW Market Street.</p> <p>Most of the study area streets are included in one or more alternatives of the Burke-Gilman Trail Extension Project.</p> |
| Ballard East – 11th Avenue NW Drop Shaft & Associated Conveyance Facilities | <p>Sidewalks are located on the east side of 11th Avenue NW, and along the portion of NW 45th Street between 9th and 11th Avenues NW.</p> <p>The Burke-Gilman Trail is adjacent to NW 45th Street between 9th and 11th Avenues NW, with the western terminus of the east portion of the trail at 11th Avenue NW.</p> <p>A two-way bike lane is located on NW 45th Street between 11th and 14th Avenues NW.</p> <p>Most of the study area streets are included in one or more alternatives of the Burke-Gilman Trail Extension Project.</p> |
| Fremont – North 3rd Avenue/174 Drop Shaft & Associated Conveyance Facilities | <p>Sidewalks are located on both sides of all study area streets except 3rd Avenue NW/NW 36th Street.</p> <p>There are no marked bicycle facilities, but the City has identified an unsigned bicycle route on 3rd Avenue NW.</p> <p>The Burke-Gilman Trail is adjacent to the central portion of 3rd Avenue NW/NW 36th Street.</p> |
| Queen Anne – South 3rd Avenue Drop Shaft & Associated Conveyance Facilities | <p>Sidewalks are located on both sides of 3rd Avenue W, and along portion of the north section of W Ewing Street.</p> <p>The South Ship Canal Trail is located in-between the north and south sections of W Ewing Street, and crosses 3rd Avenue W.</p> |
| East Portal & Wallingford Conveyance Facilities | <p>Sidewalks are located along both sides of all streets in the study area.</p> <p>On Stone Way N, north of N 34th Street, sharrows are located on the west side of the street and a bike lane is located on the east side.</p> <p>Bike lanes are located on both sides of N 34th Street.</p> <p>The Burke-Gilman Trail is adjacent to the south side of N 34th Street in the study area.</p> <p>Stone Way N crosses the Burke-Gilman Trail on the south side of N 34th Street.</p> |

9.1.4 Freight Movement

Freight movement in the study area occurs by truck, rail, and barge. The City designates some of Seattle's arterial streets as Major Truck Streets (City of Seattle, 2005), which accommodate substantial freight movement through the city and connect to major freight traffic generators. Roadway characteristics and potential issues for major truck streets would be similar to those of any other arterial roadway, but the streets likely carry a higher proportion of truck traffic. In areas with no designated Major Truck Streets, trucks are generally directed to travel on arterial roadways, which are designed to carry higher traffic volumes and heavier vehicles than local access streets.

The Ballard Terminal Railroad (BTRR) Company rail line operates a Class III (short line terminal) rail line that is about 3 miles in length between the Shilshole area (east of Seaview Avenue NW at about Ray's Boathouse restaurant) and NW 40th Street west of Leary Way, shown on Figure 9-1. The line is just south of and adjacent to Shilshole Avenue NW, between the roadway and the project site. BNSF Railway services BTRR out of the Interbay yard. The interchange of rail cars between BTRR and BNSF (called Ballard Junction) is located to the north of NW 68th Street. Current BTRR operations in the study area include the following (BTRR, 2016):

- Salmon Bay Sand & Gravel (SBSG), located on Shilshole Avenue NW, typically generates four rail cars per week. The BTRR operates one to three trains per week in support of SBSG. The quantity and length of trains varies from one 4-rail car train to two or three 1- to 3- rail car trains. To serve this site, the locomotive starts at the Locomotive Pen, picks up empty cars at the SBSG Siding Track, and then pulls the rail cars southeast to the Bright Street Yard. There, the locomotive is moved to the other end of the train so that it can pull the cars northwest to the BTRR/BNSF interchange at Ballard Junction (HDR, 2016).
- The BTRR tracks between the Bright Street Yard and the end of the BTRR track at NW 40th Avenue are used for rail car storage. BTRR leases space to industrial customers to store rail cars during times of the year with lower construction activity and associated rail demand. The storage demand primarily occurs in winter but can happen at other times of year as well—it has typically ranged between 5 and 25 rail cars. BTRR allows push operation for moving rail cars to and from storage locations (BTRR, 2016).

In previous years, BTRR operation has also included the following:

- The BTRR has used the Bright Street Yard and the end of the BTRR track at NW 40th Avenue for trans-load of materials between rail cars and trucks. For this operation, rail cars loaded with different materials are interchanged from the BNSF to BTRR at Ballard Junction. BTRR pulls the rail cars from Ballard Junction to the Bright Street Yard, where the contents are transferred to trucks that then transported to their ultimate destinations. The Bright Street Yard has been previously used for the transfer of flour, which generated 1 to 2 rail cars per month (12 to 24 rail cars per year).
- The Western Pioneer Yard has been previously used to transfer frozen fish from Western Pioneer to refrigerated rail cars. This operation was performed with a heavy forklift that crossed the tracks (BTRR, 2016).

There is one signalized railroad crossing of the BTRR tracks at Seaview Avenue NW, at about NW 60th Street; all other crossings are unsignalized. With the current low frequency of train operation, vehicles are sometimes parked illegally on the BTRR tracks during periods of peak parking activity in the Ballard neighborhood. BTRR typically has these illegally parked vehicles impounded only when the tracks are needed for train operation (BTRR, 2016).

Although no marine freight traffic is currently generated in the study area, barges could directly access a portion of the project site via the pier in at the 24th Avenue NW street end (see Figure 2-5). Barges are required to adhere to the rules of marine navigation established by the U.S. Coast Guard and the U.S. Army Corps of Engineers.

Table 9-4 summarizes freight characteristics in the project area.

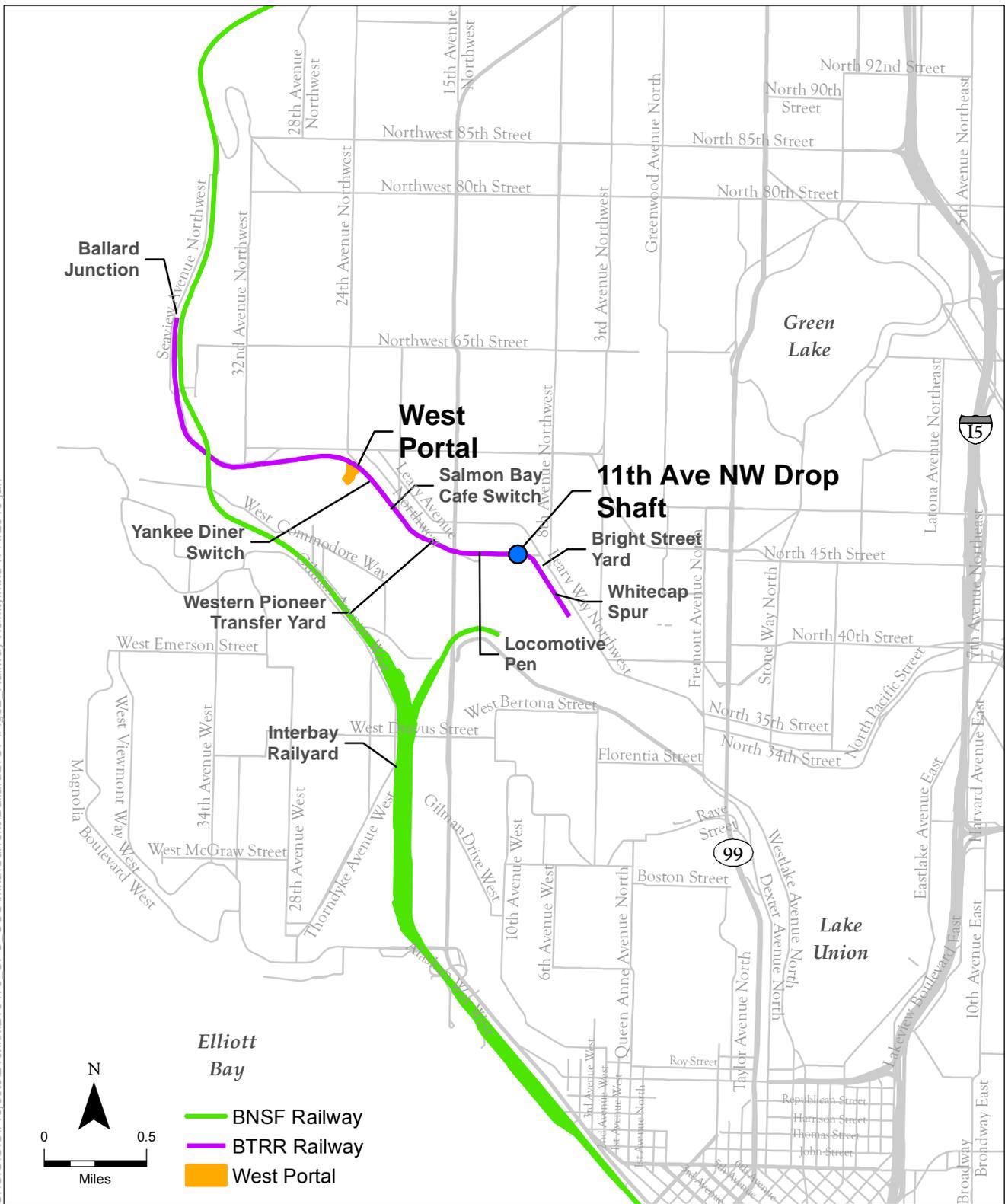
Table 9-4. Summary of Existing Freight System Characteristics in Project Areas

| Project Area | Freight Characteristics |
|--|--|
| West Portal & Ballard Conveyance Facilities | <p>Shilshole Avenue N is designated as a Major Truck Street.</p> <p>BTRR tracks are located adjacent to the south side of Shilshole Avenue N, and cross 24th Avenue NW.</p> <p>BTRR tracks are located adjacent to the south side of NW 54th Street. Truck loading docks and parking are located adjacent to the entire lengths of study area streets on both sides.</p> <p>The Salmon Bay marine dock is located at the south end of 24th Avenue NW.</p> <p>Weekday daily traffic volumes in study area include truck percentages between 5 and 16 percent.</p> |
| Ballard East - 11th Avenue NW Drop Shaft & Associated Conveyance Facilities | <p>BTRR tracks are located in the center of NW 45th Street, and cross 11th Avenue NW.</p> <p>Truck traffic constitutes between 4 and 18 percent of weekday daily traffic volumes in this portion of the study area.</p> |
| Fremont - North 3rd Avenue/174 Drop Shaft & Associated Conveyance Facilities | <p>No designated truck streets or rail facilities in this portion of the study area.</p> <p>Truck traffic constitutes between 4 and 10 percent of weekday daily traffic volumes in this portion of the study area.</p> |
| Queen Anne - South 3rd Avenue Drop Shaft & Associated Conveyance Facilities | <p>No designated truck streets or rail facilities are located in this portion of the study area.</p> <p>Truck traffic constitutes between 5 and 11 percent of weekday daily traffic volumes in this portion of the study area.</p> |
| East Portal & Wallingford Conveyance Facilities | <p>Stone Way N is designated as a Major Truck Street.</p> <p>Truck traffic constitutes between 3 and 6 percent of weekday daily traffic volumes in this portion of the study area.</p> |

9.1.5 Marine Traffic

Salmon Bay is located on the south side of the transportation study area, connecting Shilshole Bay to the west to the Lake Washington Ship Canal to the east. Numerous marine vessels dock in Salmon Bay; most are commercial vessels that support adjacent marine businesses, but some residential vessels also dock in Salmon Bay. Marine traffic through Salmon Bay includes a mix of commercial, recreational, and Tribal fishing vessels that travel between Lake Washington/Lake Union and Puget Sound (via Shilshole Bay). All marine vessels that travel between these water bodies must pass through the Hiram M. Chittenden Locks (Ballard Locks). Operated by the U.S. Army Corps of Engineers, the Ballard Locks and associated facilities are operated to maintain the water level of the fresh water Lake Washington/Lake Union above sea level, to prevent the mixing of sea water from Puget Sound with the fresh water of the lakes, and to move boats between the water level of the lakes to the water level of Puget Sound (U.S. Army Corps of Engineers, 2015b). The Ballard Locks accommodate vessel traffic 24 hours per day, 7 days per week.

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SOURCE: OpenStreetMaps 2014, BTRR 2016, ESA 2014

SPU CSO . D210475.02
Figure 9-1
Rail Facilities in Project Vicinity

9.2 How would the project affect transportation?

The impacts on transportation from the Ship Canal Project are consistent with those described in Sections 5.12 and 6.12 of the 2014 Plan EIS. As described in those sections, most impacts would be construction-related, including disruption to vehicular and non-motorized traffic at roadways, sidewalks and trails where construction occurs, displacement of parking, and potential increases in vehicular traffic generated by construction activities. These types of disruptions would increase travel delay to varying levels depending on the day of week and time of day, which in turn may add inconvenience for travelers, but are considered significant only if they would prohibit access to residences, businesses or services, or prohibit or substantially restrict travel through a major arterial corridor. When constructed, the Ship Canal Project facilities would be mostly underground and physically separated from transportation infrastructure and services. A small number of operational trips would be generated to support operation and maintenance.

This section provides more information about the impacts to specific transportation facilities affected by the Ship Canal Project.

9.2.1 During Construction

This section presents the transportation impacts during project construction. Transportation system elements potentially affected by construction of each project element are described in detail in Tables B-6 through B-10 in Appendix B. Without measures to reduce or eliminate impacts, transportation impacts could be significant. Section 9.3 describes the measures that would reduce or eliminate the impacts identified in this section.

The 2014 Plan EIS describes the following impacts that are expected with all project elements, which are briefly summarized below:

- **Roadway Capacity Restrictions.** Construction of the project elements and associated conveyance in facilities in the road right-of-way would require temporary lane closures where construction occurs. In addition to reducing the vehicle capacity of the street, some disrupted lanes could include marked bicycle lanes or sharrows, or eliminate on-street parking.
- **Sidewalk Impacts.** Construction of each project element could require that sidewalks or multi-use trails adjacent to the segment under construction be narrowed or closed during construction. If sidewalks are present on both sides of the affected street, pedestrians would likely be detoured to the sidewalk across the street. Special accommodations would be needed to retain pedestrian access to businesses along the construction route if the sidewalk is closed.
- **Bicycle Impacts** – Where roadway lanes with marked bicycle facilities (bicycle lanes or sharrows) or multi-use trails would be narrowed or closed during construction, bicyclists would need to be detoured to a roadway lane or sidewalk where they could travel safely.
- **On-street Parking Removal** – Construction within the road right-of-way would temporarily eliminate some public on-street parking adjacent to construction activities. Additional parking demand could also be generated by construction employees who work at the sites.
- **Rail Operations** – BTRR operations could be temporarily disrupted during construction, for up to 1 week.

9.2.1.1 Disruption of Traffic on Arterials

Construction of the conveyance facilities could require trenching on, along, or across roadways designated as Principal or Minor Arterials, some of which are also designated as Major Truck Streets, and/or Major or Minor

Transit Streets. Arterials provide a major mobility function for higher traffic volumes. Lane closures would increase travel delay to varying levels depending on the day of week and time of day; lane closures during peak travel times could potentially result in long queues and increased levels of delay for vehicles traveling on the road.

If the project restricts construction activities to off-peak periods, a lower level of impact (e.g. shorter potential vehicle queues, lower vehicle delay) would result, but it would occur over a longer duration. Depending on the level of restriction applied (e.g. construction allowed during weekday off-peak periods, or restricted to nights and weekends), construction activity time restrictions could increase the duration of construction by a factor of two or more.

Specific conveyance routes will be identified during detailed design. Two project elements—the *11th Avenue NW Drop Shaft and Conveyance* and the *South 3rd Avenue Drop Shaft and Conveyance*—are expected to disrupt only local access streets. Disruption could occur on all or part of the following Principal or Minor Arterials (depending on the final conveyance routes) for the other project elements.

West Portal and Ballard Conveyance Facilities

All Conveyance Options

- Shilshole Avenue NW (NW Market Street to NW Dock Place) – Minor Arterial, Major Truck Street
- 24th Avenue NW (NW Market Street to the West Portal) – Minor Arterial, Minor Transit Street

Option 1: Conveyance via NW 54th Street

- NW Market Street (crossing at 28th Avenue NW) – Minor Arterial, Major Transit Street

Option 2: Conveyance via NW Market Street

- NW Market Street (24th Avenue NW to 28th Avenue NW) – Minor Arterial, Major Transit Street

Option 3: Conveyance via NW 56th Street

- NW Market Street (crossing at 24th Avenue NW) – Minor Arterial, Major Transit Street
- 24th Avenue NW (NW Market Street to NW 56th Street) – Minor Arterial, Minor Transit Street

As described in Chapter 2, for each Ballard conveyance option, a portion is proposed to be constructed by microtunneling instead of open cut methods that would involve trenching. While microtunneling would cause disruption at the portals, the street above the tunneled section between the portals would not be affected, resulting in a lower level of transportation impact.

North 3rd Avenue/174 Drop Shaft – Fremont and Associated Conveyance Facilities

- Leary Way NW (NW 41st Street to NW 36th Street/2nd Avenue NW) – Principal Arterial, Major Truck Street, Minor Transit Street

East Portal and Wallingford Conveyance Facilities

- Stone Way N (N 38th Street to N Northlake Way) – Minor Arterial, Minor Transit Street, and a one-block segment is a Major Truck Street
- N 34th Street (Evanston Avenue N to Stone Way N) – Principal Arterial, Major Truck Street, Minor Transit Street

9.2.1.2 Unique Commercial Access Considerations

West Portal and Ballard Conveyance Facilities

Although vehicle volumes on NW 54th Street are very low, the potential conveyance segment via NW 54th Street between 24th and 28th Avenues NW has unique characteristics that would highly constrain the ability to maintain commercial access during construction. The roadway is narrow with BTRR tracks adjacent to its south side. Access needs are continuous along both sides of the segment, and with NW Market Street located to the north of adjacent properties and Salmon Bay to the south, there are no secondary access options for the businesses that use this street. Businesses that use NW 54th Street for access include a number of light industrial businesses, boat dock and repair, and other water-related businesses. As described in Chapter 2, a portion of the NW 54th Street conveyance option is proposed be constructed by microtunneling instead of open cut, which would reduce the amount of trenching and associated access disturbance. In addition to microtunneling along sections where trenching would leave no access options, a very high level of coordination with business owners would be required to identify other measures to maintain access to these properties during construction. If adequate measures cannot be identified to maintain access to the businesses that use this segment of NW 54th Street, the transportation impact of this option would be considered significant and unavoidable.

9.2.1.3 Disruption at Roadway Intersections

Trenching through an intersection would disrupt intersection operations. In addition, some signalized intersections have in-pavement induction loops that control traffic operations. Excavation of the pavement at these locations would destroy the existing induction loops. Specific intersections potentially impacted by each project element are summarized in Tables B-6 through B-10 of Appendix B. With implementation of the manual traffic control described in Section 9.3, the increase in travel delay could be eliminated or reduced, depending on the day of week, time of day, and level roadway capacity reduction that would also occur at the intersection as part of construction.

9.2.1.4 Disruption at Alleys and Driveways

Trenching across a driveway or alley would disrupt property access at that location. Driveways located along the conveyance routes must be passable during construction unless there is an alternative driveway serving a property that can accommodate vehicles if one driveway is closed. The numbers of alleys and driveways potentially impacted by each project element are summarized in Tables B-6 through B-10 of Appendix B. With implementation of the measures to reduce or eliminate impacts that are described in Section 9.3, access to alleys and driveways would be maintained.

9.2.1.5 Disruptions at Loading Zones

Trenching across or near a commercial loading zone would disrupt property access at that location. For locations with commercial loading zones that would be disrupted by project construction, SPU would work closely with business owners to ensure that access is maintained not only for their customers, but for the delivery of goods and services needed to maintain their operations.

9.2.1.6 Bus Stop Closure or Relocation

Construction on arterials could require temporary closure or moving of bus stops. The walking distance to the nearest alternative bus stop would typically be between one and three blocks, which would increase the time needed to walk to the stop but would still maintain reasonable access to transit service. The following describes the bus stops that may need to be closed or relocated during construction of the project elements. It is noted that transit service is continually changing as routes are added, changed, or eliminated; the routes listed reflect

service as of September 2016. Prior to construction, SPU would coordinate with Metro to confirm the current bus routes that could potentially be affected.

West Portal and Ballard Conveyance Facilities

- Up to two bus stops (serving Metro Routes 17, 29, and 44)

Ballard East – 11th Avenue NW Drop Shaft and Associated Conveyance Facilities

- Up to three bus stops (serving Metro Routes 28 and 40)

East Portal and Wallingford Conveyance Facilities

- Up to three bus stops (serving Metro Routes 26, 31, and 32)

9.2.1.7 Disruption of Bus Trolley Power Lines

West Portal and Ballard Conveyance Facilities

If construction equipment clearances are required, it could be necessary to either temporarily relocate or deactivate the trolley lines on NW Market Street during construction. This would have the greatest impact along about 4 blocks of NW Market Street, between 24th Avenue NW and 28th Avenue NW, if the NW Market Street alignment is selected for the final conveyance route. For the NW 54th Street or NW 56th Street conveyance route options, this impact would potentially occur where the project crosses NW Market Street—at 28th Avenue NW or at 24th Avenue NE. With the implementation of measures to reduce or eliminate impacts described in Section 9.3, transit service could still be provided. Additionally, for sections along or across NW Market Street where the conveyance would be constructed by microtunneling instead of trenching, disruption to bus trolley power lines may be avoided.

9.2.1.8 Increased Train Volumes on BTRR Tracks

West Portal and Ballard Conveyance Facilities

Use of rail to haul materials and equipment to and from the West Portal site would increase train volumes on the BTRR tracks. If rail is used to support construction activities, a range of approximately 513 to 695 total trains would be expected, depending on the final diameter tunnel (14- to 18-feet). This would reflect an increase of up to four to eight trains per week during periods in which rail-supported activities take place (two to four trains inbound, and two to four trains outbound) over the anticipated West Portal and tunnel construction period. In addition to increased activity between the West Portal and the Ballard Junction interchange facility to the west, where trains would be transferred to and from BNSF Railway operation, storing and staging of rail cars could increase train activity to the east of the West Portal. Much of the existing BTRR track is adjacent to existing roadways, and sections are also adjacent to the Burke-Gilman Trail. It has one signalized crossing of Seaview Avenue NW near its west end. All other crossings along its length are at-grade and unsignalized, including crossings of roadways and driveways, and one crossing of the Burke-Gilman Trail near its east end. Because existing train volumes on the BTRR tracks are currently very low (typically two to six trains per week), drivers, pedestrians and trail users are unlikely to be on alert that train traffic could occur, increasing the potential for safety conflicts. However, with implementation of the rail safety and improvement measures described in Section 9.3, safety at railroad crossings could be maintained with increased train volumes. Increased parking enforcement may also be needed to ensure that no vehicles are illegally parked on the railroad tracks.

Ballard East - 11th Avenue NW Drop Shaft and Associated Conveyance Facilities

The impacts of increased train volumes to support construction of the 11th Avenue NW Drop Shaft would be the same as described for construction of the West Portal and Ballard conveyance facilities. If rail is used to support construction activities, an increase of up to two trains per week (one train inbound, and one train outbound) could occur over the anticipated construction period.

9.2.1.9 Increased Delay at BTRR Track Crossings

West Portal and Ballard Conveyance Facilities

If rail is used to support construction activities, each train generated by construction is expected to typically be eight or fewer rail cars in length. Each train would be expected to typically delay vehicular and non-motorized traffic for 45 to 60 seconds at each unsignalized roadway, bikeway, or walkway crossing located between construction activities and the Ballard Junction interchange facility, where trains would be transferred to and from BNSF Railway operation. Delays of 75 to 90 seconds would be expected at the one signalized crossing (BTRR, 2015). These delays would occur with each train crossing, which are anticipated 4 to 8 times per week (once every day or two) during periods in which rail supported activities would take place (two to four trains inbound, and two to four trains outbound) over the tunnel construction period (CH2M Hill, 2015).

Ballard East – 11th Avenue NW Drop Shaft and Associated Conveyance Facilities

The potential type of impact of increased delay at BTRR crossings to support construction of the 11th Avenue NW Drop Shaft would be the same as described for construction of the West Port and Ballard conveyance facilities. If rail is used to support construction activities, increased delay would occur for up to two trains per week (one train inbound, and one train outbound) over the anticipated construction period.

9.2.1.10 Disruption to BTRR Tracks

West Portal and Ballard Conveyance Facilities

Ballard conveyance along Shilshole Avenue NW would be constructed parallel to the BTRR main track for approximately the full length of the SBSG siding. Construction would require trench support located as close as 1 foot from the end of the ties of the BTRR main tracks. Without measures to reduce impacts, trenching adjacent to the tracks may disrupt train service at that location. **Close coordination with BTRR and limits to the length of time and physical length of railroad disruption are expected to allow BTRR operations to be largely maintained during construction.** The tracks would be fully operational after construction of the conveyance facilities is complete.

Ballard East – 11th Avenue NW Drop Shaft and Associated Conveyance Facilities

Construction of the 11th Avenue NW Drop Shaft at the NW 45th Street/11th Avenue NW intersection could disrupt the existing BTRR tracks at that location. However, the drop shaft has been relocated to reduce disruption of the BTRR tracks, allowing BTRR to continuously operate during construction. The design has been developed to ensure that BTRR operations (including locomotive turnaround, access to BTRR tracks for leased rail car storage, and access to the Bright Street Yard) will be maintained throughout construction, although some disruptions may still occur.

As described in Chapter 2, the construction duration for the 11th Avenue NW Drop Shaft is anticipated to be 12 to 16 months. Within this time frame, there may be short term (approximately one–two weeks) disruptions due to construction staging or other factors, but these will be coordinated with BTRR to minimize impacts to operations.

9.2.1.11 Increased Barge Traffic

West Portal and Ballard Conveyance Facilities

Use of barges to haul excavated materials from the West Portal site would increase tug/barge traffic volumes in Salmon Bay. The volume of barge traffic generated by tunnel construction would depend on the size and capacity of the barges used, which will be determined by the contractor. Using a range of possible barge sizes (from 500- to 5,000-ton capacity), the project would generate approximately 55 to 535 total barges (for a 14-foot diameter tunnel), or approximately 85 to 830 total barge trips (for an 18-foot diameter tunnel). This would equate to an average of from 3 large barge trips to 31 small barge trips generated per week during tunnel excavation. At the upper end of this estimate, the volume of barge traffic generated by the project reflects an increase of less than 3 percent of typical marine vessel traffic through the Ballard Locks on an annual basis (U.S. Army Corps of Engineers, 2015a). Because tugs/barges are required to adhere to the rules of marine navigation established by the U.S. Coast Guard and the Corps of Engineers, increased barge traffic would not interfere with commercial and recreational navigation but may disturb tribal fishing activities.

Depending on the final design of the 24th Avenue NW pier, there would be potential temporary impacts to adjacent moorage facilities. Barge use of the reconstructed pier would likely result in temporary displacement of existing recreational and live-aboard boat moorage at the adjacent privately owned pier to the east, and potentially, temporary displacement of commercial use of the pier to the west. As described in Chapter 7, Land & Shoreline Use, the City would follow federal, state and local requirements for property acquisition, compensation and relocation for any moorage, including live-aboards displaced during the barging operations.

9.2.1.12 Removal of Surface Lot Parking Spaces During Construction

Queen Anne – South 3rd Avenue Drop Shaft and Associated Conveyance Facilities

Construction activities for the South 3rd Avenue Drop Shaft would be located in the 19-space surface lot that serves the West Ewing Mini Park. It is expected that 16 parking spaces would be displaced during construction, leaving 3 spaces available for park users. Parking in the lot has a 2-hour time limit. Field counts conducted in June and July 2015 indicated a typical midday utilization of 4 or 5 spaces, and a typical summer weekend day use of 9 or 10 spaces. Reduction in available capacity of this lot would limit vehicle access to the park during the expected 6- to 9-month construction period, and some park users who access by vehicle might need to park elsewhere in the vicinity. Additionally, people who park in the lot to access the Ship Canal Trail may choose to park near other trail access points during the construction period. If construction occurred outside the summer months, a lower total demand would be expected, and fewer users would be impacted. Pedestrian access to the park would still be available during construction, and the project would be required to maintain safe pedestrian detours around construction activities if pedestrian pathways are disrupted. The parking lot and pedestrian paths would be fully restored after construction is completed. Additional site-specific evaluations would be conducted during project design as needed to comply with the permitting process.

9.2.1.13 Increase in Vehicle Traffic Due to Construction-Generated Trips

Table 9-5 summarizes the total, average, and peak trips expected to occur with construction of each project element, if no construction activities are supported by rail or barge. Table 9-6 summarizes the trips expected to occur if rail and barge were used to support activities where feasible at the West Portal site, and rail used to support activities where feasible at the 11th Avenue NW Drop Shaft (Ballard East). Table 9-7 summarizes the trips expected to occur if only barge were used to support activities where feasible at the West Portal site. As shown, the use of rail and barge could substantially reduce the total number of truck trips generated by the

project, with reductions of up to 66 to 72 percent (depending on the final tunnel diameter) if rail and barge are used to the fullest extent feasible.

Table 9-5. Summary of Construction-Generated Trips without Use of Rail or Barge

| Project Area | Total Estimated Truck Trips ¹ | Peak Truck Trips Per Day ¹ | Peak Commute Trips Per Day ² |
|--|--|---------------------------------------|---|
| West Portal & Ballard Conveyance Facilities ³ | 40,940 – 51,980 | 180 – 232 | 150 |
| Ballard East – 11th Avenue NW Drop Shaft & Associated Conveyance Facilities | 2,230 | 100 | 80 |
| Fremont – North 3rd Avenue/174 Drop Shaft & Associated Conveyance Facilities | 2,520 | 100 | 80 |
| Queen Anne – South 3rd Avenue Drop Shaft & Associated Conveyance Facilities | 980 | 100 | 80 |
| East Portal & Wallingford Conveyance Facilities | 2,360 | 100 | 80 |

Source: CH2M Hill, 2015.

1. Reflects total one-way inbound and outbound truck trips.
2. Reflects total one-way inbound and outbound commute trips for all estimated construction workers. With measures in place to reduce or eliminate impacts, a large share of workers would be expected to commute alternative modes such as carpool, transit, or shuttle.
3. Lower end of range reflects estimate for a 14-foot diameter tunnel, and higher end of range reflects estimate for an approximate 18-foot diameter tunnel.

Table 9-6. Summary of Construction-Generated Trips with Use of Rail-Only or Rail/Barge

| Project Area | Total Estimated Truck Trips ¹ | Peak Truck Trips Per Day ¹ | Peak Commute Trips Per Day ² |
|--|--|---------------------------------------|---|
| West Portal & Ballard Conveyance Facilities ³ | 9,920 | 40 | 150 |
| Ballard East – 11th Avenue NW Drop Shaft & Associated Conveyance Facilities | 1,040 | 84 | 80 |
| Fremont – North 3rd Avenue/174 Drop Shaft & Associated Conveyance Facilities | 2,520 | 100 | 80 |
| Queen Anne – South 3rd Avenue Drop Shaft & Associated Conveyance Facilities | 980 | 100 | 80 |
| East Portal & Wallingford Conveyance Facilities | 2,360 | 100 | 80 |

Source: CH2M Hill, 2015.

1. Reflects total one-way inbound and outbound truck trips.
2. Reflects total one-way inbound and outbound commute trips for all estimated construction workers. With measures in place to reduce or eliminate impacts, a large share of workers would be expected to commute alternative modes such as carpool, transit, or shuttle.
3. With full use of rail-only or a rail/barge combination, the estimate of truck trips is the same for a 14-foot or 18-foot diameter tunnel.

Table 9-7. Summary of Construction-Generated Trips with Use of Barge-Only

| Project Area | Total Estimated Truck Trips ^{1,2} | Peak Truck Trips Per Day ^{1,2} | Peak Commute Trips Per Day ^{1,2,3} |
|--|--|---|---|
| West Portal & Ballard Conveyance Facilities ³ | 23,940 | 72 | 150 |
| Ballard East – 11th Avenue NW Drop Shaft & Associated Conveyance Facilities | 2,230 | 100 | 80 |
| Fremont – North 3rd Avenue/174 Drop Shaft & Associated Conveyance Facilities | 2,520 | 100 | 80 |
| Queen Anne – South 3rd Avenue Drop Shaft & Associated Conveyance Facilities | 980 | 100 | 80 |
| East Portal & Wallingford Conveyance Facilities | 2,360 | 100 | 80 |

Source: CH2M Hill, 2015.

1. Reflects total one-way inbound and outbound truck trips.
2. Reflects total one-way inbound and outbound commute trips for all estimated construction workers. With measures in place to reduce or eliminate impacts, a large share of workers would be expected to commute alternative modes such as carpool, transit, or shuttle.
3. With full use of barge-only, the estimate of truck trips is the same for a 14-foot or 18-foot diameter tunnel.

Roadway operational analysis previously conducted along the potential truck haul routes indicated that truck trips generated by construction activities, with or without barge and rail, would have very little effect on peak hour roadway operations. This is because with trips spread out over a multi-year construction period, and across 8- to 20-hour workdays, the proportion of project-generated trips to total trips through the intersections would be small, even during periods of peak construction activity (Heffron Transportation et al., 2014).

However, the projected hourly volumes of truck trips with the “All Trucks” scenarios would be noticeable to residents and businesses located near the project work sites and along the truck haul routes. Use of rail or barge could reduce the frequency of trucks to an extent that would likely be perceptible to adjacent residents and businesses.

The estimates of construction worker commute trips reflect one-way trips (inbound and outbound). With implementation of measures described in Section 9.3 to reduce or eliminate impacts, a large share of workers would be expected to commute with alternative modes such as carpool, transit, or shuttle.

9.2.1.14 Utility Replacement Projects

It is possible that opportunities for additional improvements to utility infrastructure would be identified in the vicinity of the project construction activities that would reduce the need for additional future construction in the project area. The majority of utility replacement work would be concentrated around the drop shaft locations, but could potentially occur at other locations along the tunnel alignment. Although the exact locations of potential improvement opportunities are not known, they would be expected to result in similar potential construction impacts to roadways, transit, bicycles and pedestrians as those identified for the other project elements, or if located within an area already disturbed by construction, could lengthen the duration of the construction period.

9.2.2 After Construction

Operational impacts on transportation are expected to be similar to those described in the 2014 Plan EIS. When constructed, the tunnel facilities would be located mostly underground and physically separated from

transportation infrastructure and services. Transportation infrastructure disrupted during construction would be restored, and streets disturbed during construction would be repaved. The following additional construction impacts have been identified through project-level assessment.

9.2.2.1 Operational Vehicle Trips

A small number of trips related to operation and maintenance would be generated by the completed facility, summarized as follows:

- One truck round-trip per day would be generated at each of the two tunnel portals.
- The pump station at the West Portal would have up to five permanent employees, generating up to ten employee commute trips per day (five inbound, five outbound), plus a few ancillary midday trips (e.g. for lunch or errands).

On-site parking would be provided at each portal site to accommodate these vehicles, so no parking overflow is anticipated to result from the project.

SPU would conduct quarterly maintenance at the 11th Avenue NW Drop Shaft site, where a 1-day partial street closure would be necessary for personnel to access the underground flow meter vault.

SPU would also conduct annual maintenance at each of the facilities, generating up to 10 truck trips per day of maintenance activities, and requiring 1 or 2-day partial closure of streets near the facility access points. Grit removal facilities would be serviced every 6 months, and would require 1-day partial street closures at their access points. This is consistent with routine maintenance that SPU performs at other facilities throughout the city, with traffic managed around maintenance access points according to SPU procedures.

The frequency and number of operational vehicles trips represent a very small portion of the overall traffic in the project vicinity, and would not affect roadway operations. Therefore, no long-term impacts on transportation are expected to result from the Ship Canal Project.

9.3 What measures would reduce or eliminate potential transportation impacts?

Measures to reduce or eliminate potential construction impacts are discussed in Section 5.12 of the 2014 Plan EIS, including general measures to avoid or reduce vehicle queues and delay near construction activity; maintaining vehicular and non-motorized access along roadways disrupted by construction, as well as to adjacent businesses and residences; coordinating with agencies with jurisdiction over the transportation facilities; and coordinating with affected community members.

The following describes additional or more detailed measures to avoid or reduce impacts based on the project-level assessment. These measures would be applied as part of the Street Use Permit process, unless determined by SDOT as not needed.

Barging and/or Rail Transport. The use of barging and/or rail transport of construction materials and spoils, described above, would significantly reduce truck trips. Because these measures also result in impacts, they are described in the Impacts section, but both barge and rail transport were developed to mitigate truck trips on surface streets.

Coordination with BTRR. SPU will coordinate closely with BTRR prior to and during construction to minimize the potential for disruption of BTRR operations.

Maintenance of Traffic Plans. The contractor would be required to prepare maintenance of traffic plans for any work within the public right-of-way that affects vehicular, transit, bicycle, or pedestrian traffic. These plans must show the location of traffic cones, traffic control personnel, and signs; note if bus stops are to be closed or relocated; and indicate special treatments for pedestrian and bicycle access.

Haul Routes. Figure 9-2 shows potential truck haul routes for the different project elements. Based on typical requirements, haul routes generally would be on Major Truck Streets and arterial streets through commercial areas, and consist of the most direct path to and from the state highway system. In general, construction-generated truck traffic would be prohibited during weekday peak periods (6:00 to 9:00 a.m. and 3:00 to 6:00 p.m.). However, confirmation of haul routes, as well as the appropriate times of travel for construction-generated truck traffic, would be provided by the City as part of the project permitting process.

Construction Employee Parking Restriction. The project would prohibit construction employees from parking on public streets within 12 blocks of the project site in the contractor specifications. Any parking for construction employees that could not be directly accommodated on the construction site would need to be in paid lots and garages at market rates. This restriction would be expected to encourage a higher use of alternative transportation modes (which could potentially include carpool, transit, walk/bike, or a shuttle provided by the contractor) by construction employees.

Construction through an Intersection. Manual traffic control would be needed when construction occurs through an intersection. Work in a signalized intersection (or within 50 feet of a signalized intersection) would require police officer control; work in an unsignalized intersection would be performed with certified flaggers.

Construction across Driveways and Alleys. When trenching across a driveway or alley, the work can usually be done in two parts: trench across one-half of the driveway and then plate it for driving before trenching the other half. At major driveways, flagger control may be needed to facilitate alternating enter and exit traffic. Special treatment would be needed for developments that have split driveways (with one driveway serving entering traffic and one serving exiting traffic) if traffic cannot easily be shifted to the other driveway for two-way operation. Driveway and alleyway locations potentially affected by each project element are listed in Tables B-6 through B-10 in Appendix B. The contractor would be required to coordinate with property owners when driveways or alleys are affected by construction, and access to residences and businesses, including delivery loading and garbage pick-up, would need to be maintained at all times.

Loading Zone Accommodation. For locations with commercial loading zones that would be disrupted by project construction, SPU would work closely with business owners to ensure that access is maintained not only for their customers, but for the delivery of goods and services needed to maintain their operations.

Signal Detection Disruption. Some intersections in Seattle have in-pavement induction loops that control traffic signal operations. Prior to trenching through these intersections, alternative detection equipment (e.g., camera detectors) might need to be installed to maintain proper signal function. Loops or permanent cameras would need to be installed as part of restoration.

On-street Parking Removal. The contractor would be required to obtain a Street Use Permit wherever on-street parking would be affected during project construction. Compensation would be required for lost parking revenue from any paid on-street parking taken out of service during construction. Permits are issued by SDOT.

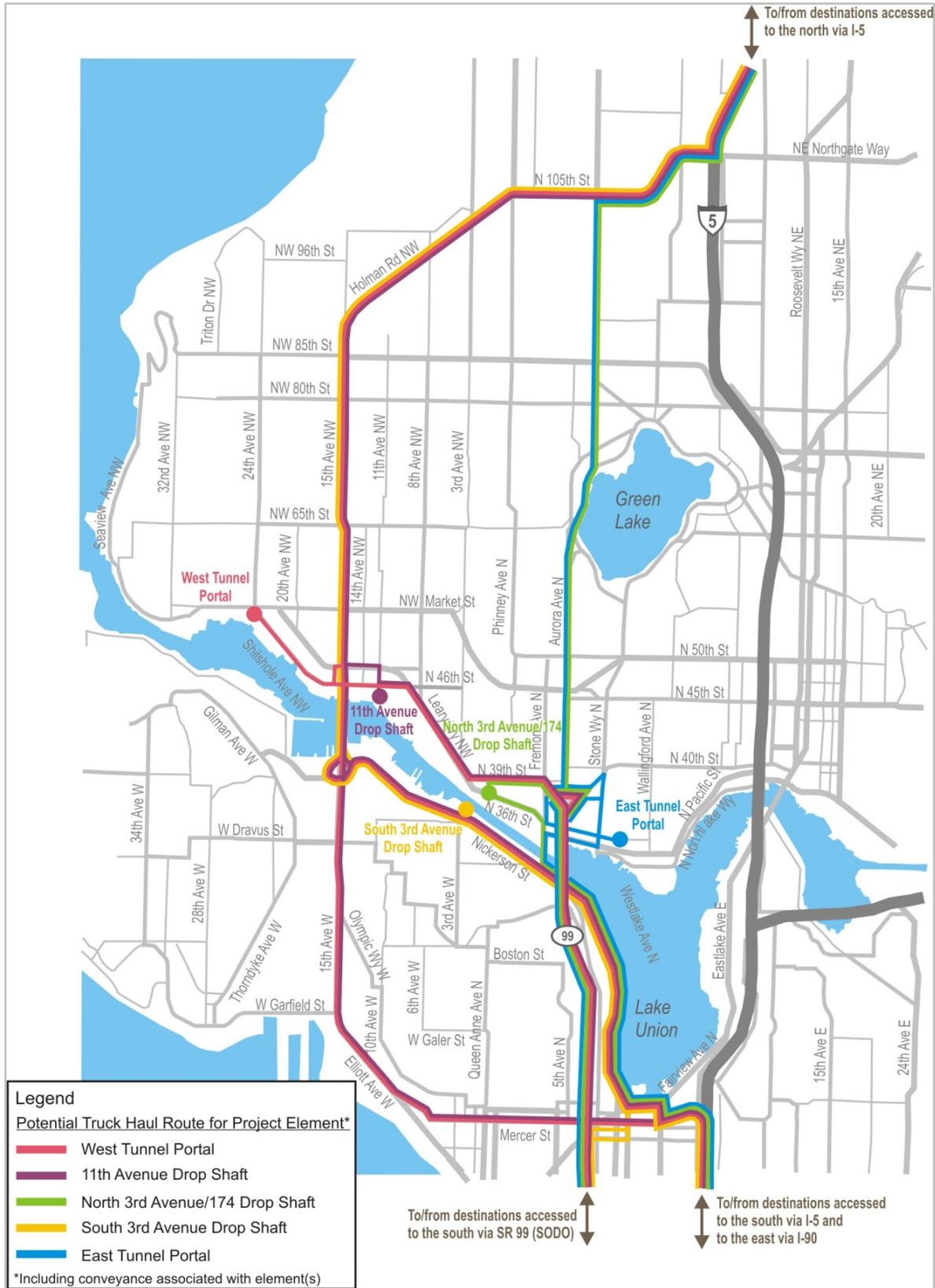


Figure 9-2. Potential Truck Haul Routes

Bus Stop Closure or Relocation. Some bus stops might need to be closed or relocated during construction. The contractor would be required to coordinate with Metro to close or relocate a bus stop.

Coordination with Other Construction Projects. Through its Street Use Permit process and consistent with SMC 15.32.050, the Capital Projects and Roadway Structures Division of SDOT would coordinate the construction needs and impacts of this project with the other infrastructure and development projects in the study area. SPU would participate in any construction coordination processes that SDOT establishes for major projects.

Education and Outreach. A public involvement program would be implemented prior to project construction to provide information about the purpose and importance of the Ship Canal Project, detailed information about the types and locations of expected construction impacts, and the measures that would be implemented to minimize those impacts. SPU would establish a construction outreach team, which would work closely with affected residents and business owners to minimize construction-related impacts throughout the duration of construction. A contact person would be identified whom community members can contact to address specific concerns both prior to and during project construction.

Full or Partial Street Closure at Night and/or on Weekends. To avoid creating long vehicle queues and high vehicle delays on Principal and Minor Arterials during weekdays when traffic volumes and transit ridership are highest, off-peak, nighttime and/or weekend construction may be required to reduce weekday traffic closures on arterials listed under Section 9.2.1.1, Disruption of Traffic on Arterials. Appropriate restrictions at each arterial would be coordinated with SDOT, and may be required for the duration of construction depending on the project element under construction.

Temporary Closure of Railroad Tracks Near Conveyance Construction. To minimize the impact of railroad track closures during construction of Ballard conveyance facilities along Shilshole Avenue NW, SPU would coordinate with BTRR to determine an appropriate period when the tracks are not used for railroad operation to implement construction closures. SPU would coordinate with BTRR to identify the periods for temporary closures with the least disruption to rail operation. SPU would coordinate with BTRR to identify and implement the appropriate measures to mitigate project construction impacts to rail operation at this location (HDR, 2016).

Maintenance of Rail Operation During 11th Avenue NW Drop Shaft Construction. SPU has refined the project design to reduce disruption of BTRR operation when project construction is in the vicinity of the mainline tracks at 11th Avenue NW/NW 45th Street. In addition, the following measures will be considered:

- Use of design and contracting approaches to reduce impacts to BTRR operations during construction, such as siting facilities in areas that minimize construction/post construction impacts, and/or stipulating construction methods that reduce excavation or other construction conflicts.
- Temporary or permanent realignment of the main track between 9th Avenue NW and 11th Avenue NW to avoid conflicts with construction activities.
- Rehabilitation of the BTRR main track between the Yankee Diner Switch and Salmon Bay Switch to enable its use for rail car storage and locomotive turnaround operation. Additional signage and enforcement of parking prohibition would be required at all times to replace rail car storage capacity.
- Rehabilitation of the Western Pioneer Transfer Yard, including track rehabilitation and one new turnaround to enable its use for rail car storage, locomotive turnaround operation, and potentially, trans-load operations. Additional signage and enforcement of parking prohibition would be required at all times to replace rail car storage capacity (HDR, 2016).

SPU would coordinate with BTRR to identify and implement the appropriate measures to reduce project construction impacts to rail operation at this location.

Rail Operating Safety and Improvement Measures During Construction. If using rail to carry materials to or from the project work sites, additional signage, and/or flaggers would be provided at key crossing locations to minimize the potential conflict with other vehicular or non-motorized traffic. In addition, some new equipment and/or improvements may be required to facilitate the loading and unloading of rail cars at the project work sites. Additional signage may also be needed to warn drivers that parking on the railroad tracks is illegal and violators will be towed. Enforcement of parking prohibition and towing of vehicles off the tracks would be required before a train could operate. Appropriate measures would be coordinated with SDOT, the agency with jurisdiction over streets and sidewalks affected by increased train traffic, **and with BTRR, operating the tracks under a franchise agreement with the City.**

Safety Measures for Work Near Rail Tracks. For construction activities near the BTRR tracks, the contractor would be subject to safety regulations set forth by the Federal Railroad Administration (FRA) and BTRR. These safety measures would include:

- Advance notice to BTRR prior to commencement of any work within 25 feet of the tracks.
- Provision of a flagger and/or implementation of special protective or safety measures identified as necessary by BTRR.
- Minimum safety requirements, including clothing and personal protective equipment, needed to comply with the Code of Federal Regulations (49 CFR 213 and 49 CFR 214), and completion of railroad safety training.
- Aside from the coordination and mitigation described above, conduct construction activities so as not to interfere with the continuous and uninterrupted use and operation of the railroad tracks and property, or with a scheduled, temporal pattern of interference. These measures would include separating the construction machinery and materials at least 50 feet from the track centerline (HDR, 2016).

Construction Below Bus Trolley Power Lines. For construction along or across NW Market Street, if construction equipment clearances require, the contractor would work with King County Metro Power Distribution to either temporarily relocate or deactivate the trolley lines during construction. SPU would need to work closely with Metro to avoid or minimize disruption to trolley buses. It may be possible to put non-trolley or hybrid (trolley buses with short-range batteries that could be used through the construction area) buses on some routes if a disruption were expected to occur. Otherwise, if sufficient numbers of non-trolley buses were not available, it could be necessary to limit construction activities to off-peak periods.

9.4 Unavoidable Significant Adverse Impacts

If Ballard conveyance is provided via the NW 54th Street routing option, a very high level of coordination with business owners would be required to identify the measures that would adequately maintain access to the properties abutting NW 54th Street during construction, in combination with microtunneling along sections where trenching would leave no access options. If adequate measures cannot be identified, the transportation impact of this option would be considered significant and unavoidable.

With measures to reduce or eliminate impacts in place, no unavoidable significant adverse impacts to transportation are anticipated from either construction or operation of the Ship Canal Project.

Noise and Vibration

The study area for the analysis of noise and vibration consists of those areas in or adjacent to the project's aboveground project footprint and along the proposed tunnel alignment. The affected environment described in Section 4.7 of the 2014 Plan EIS has not changed. This chapter provides additional information for specific regulatory requirements, sensitive receptors, and potentially affected areas that were not described in detail in the 2014 Plan EIS. This analysis summarizes the results of noise monitoring and modeling to identify potential impacts and describes measures to avoid, minimize, or mitigate those impacts.

10.1 What are the characteristics of noise?

Noise is defined as unwanted sound. The response to noise is subjective and varies from listener to listener. The human ear processes small fluctuations in air pressure differently, depending on the amplitude (loudness or softness), pitch (high or low frequency), and variability (how noise changes over time). Sound is typically measured in terms of sound pressure level expressed in decibels. Decibel (dB) levels are a form of shorthand that characterizes, with a convenient numerical scale, the auditory response to the broad range of perceptible pressure intensities. The decibel scale is logarithmic. For example, a doubling or halving of energy causes the sound level to change by 10 dB; it does not double or halve the original level.

10.1.1 Measuring Noise

The overall decibel level does not address the varying human sensitivity to sound at different frequencies, overall loudness, or variability that might be experienced. The human ear is optimized for speech frequencies and is less sensitive at low frequencies and very high frequencies. To provide a measurement meaningful to humans, a weighting system was developed that reduces contributions of these higher and lower frequency sounds, to approximate human perception of sound. Measurements taken with this "A-weighted" filter are referred to as "dBA." Because most applicable regulatory criteria (including the Seattle Noise Ordinance) are written using A-weighting, that is the format used for sound levels presented in this chapter.

Noise and Vibration Key Findings

- Noise impacts during construction at specific properties would vary depending on the type and location of construction equipment being used.
- Residential areas near the Ballard conveyance facilities and the Wallingford conveyance facilities have the greatest potential for experiencing intermittent noise impacts.
- Construction activities at the West Portal are expected to exceed SMC nighttime sound level limits. A noise variance would be required from the City. Daytime construction activities are not expected to exceed daytime sound level limits at any of the project work sites.
- If rail is used during construction, increases in train traffic could increase noise levels along the BTRR tracks.
- Vibration impacts such as minor cosmetic damage to structures or annoyance of occupants may occur during concrete demolition and shaft construction.

10.1.2 Evaluating Noise Impacts

Environmental sound levels vary in magnitude over time, often significantly. To account for this, descriptors have been developed to simplify sound pressure levels that vary over time into single numbers. Two common descriptors used for assessing environmental impacts are defined as follows:

- **Equivalent sound level or L_{eq}** - Steady sound level that represents the same sound energy as varying sound levels over a specified time period (typically 1 hour or 24 hours).
- **Maximum sound level or L_{max}** - The maximum recorded root mean square (rms) A-weighted sound level for a given time interval or event. L_{max} “fast” is defined as a 125-millisecond time-weighted maximum, while L_{max} “slow” corresponds to a 1-second time-weighted maximum.

10.2 What are the characteristics of vibration?

Vibrations can result during construction using large equipment, excavation, pile driving, and tunneling operations. Ground-borne vibration can be a concern for occupants of nearby buildings during construction activities. The effects of ground-borne vibration at high levels can include the perceptible movement of building floors, rattling of windows, shaking of items on shelves or hanging on walls, rumbling sounds, and building damage.

Vibration can be quantified in terms of mechanical motion of the medium (e.g., floor or soil) through which it is perceived. The magnitude of vibration is typically reported in velocity or acceleration. For a vibrating floor, velocity represents the speed of the floor movement; acceleration represents the rate at which the speed changes. As vibration transmits through the ground it attenuates (lessens) with distance. The attenuation rate varies depending on the medium through which the vibration travels. Vibration is measured in terms of peak particle velocity (PPV), which is expressed in inches per second, and the vibration decibel (VdB), which is logarithmic and similar to the decibel scale.

10.3 What is the regulatory setting for noise and vibration?

10.3.1 Noise

10.3.1.1 Sound Level Limits

Section 25.08 of the SMC establishes limits on the levels of noise crossing property boundaries. SMC 25.08.410 defines allowable exterior sound level limits based on land use zoning, as shown in Table 10-1.

| <i>Table 10-1. Exterior Sound Level Limits: Average Noise Levels, dBA</i> | | | |
|---|------------------------------------|------------|------------|
| Type of Noise Source | Type of Receiving Property | | |
| | Residential Day/Night ¹ | Commercial | Industrial |
| Residential | 55 / 45 | 57 | 60 |
| Commercial | 57 / 47 | 60 | 65 |
| Industrial | 60 / 50 | 65 | 70 |

Source: SMC 25.08.410 Exterior Sound Level Limits

1. Nighttime is defined as 10:00 p.m. to 7:00 a.m. on weekdays, but extends to 9:00 a.m. on Saturdays, Sundays, and legal holidays according to SMC 25.08.420.

In addition, maximum sound levels (L_{max}) may exceed the exterior sound level limits defined in Table 10-1 by no more than 15 dBA (SMC 25.08.410.B).

The City also imposes the following limitations on maximum permissible sound levels (SMC 25.08.420):

- Between 10:00 p.m. and 7:00 a.m. during weekdays, and between 10:00 p.m. and 9:00 a.m. on weekends and legal holidays, the exterior sound level limits established by SMC 25.08.410 are reduced by 10 dBA where the receiving property lies within a residential district of the city.
- For any source of sound (other than an electrical substation) that has a pure tone component, the exterior sound level limits established under SMC 25.08.410 are reduced by 5 dBA.
- For any source of sound that is impulsive and not measured with an impulse sound level meter, the exterior sound level limits established under SMC 25.08.410 are reduced by 5 dBA.

10.3.1.2 Construction Noise Criteria

Modifications to the permissible exterior sound level limits set forth in Table 10-1 are allowed for construction activities. Daytime construction is subject to SMC 25.08.425 for non-impact construction activities. Sound generated from construction activities is allowed to exceed these maximum permissible sound levels by up to 25 dBA between 7:00 a.m. and 10:00 p.m. on weekdays and 9:00 a.m. and 10:00 p.m. on weekends and legal holidays. These higher sound levels from construction equipment are defined as occurring at adjacent property lines or 50 feet from the sound generating equipment, whichever is greater.

For impact types of equipment, including pavement breakers, pile drivers, jackhammers, or other types of equipment that create impulse sound or impact sound, the sound level limits established by SMC 25.08.425 may, under certain conditions, be exceeded in any 1-hour period between 8:00 a.m. and 5:00 p.m. on weekdays and 9:00 a.m. and 5:00 p.m. on weekends and legal holidays. However, sound levels associated with impact construction equipment are not allowed to exceed the values set forth in Table 10-2. These values are defined at the adjacent property line or 50 feet from the equipment, whichever is greater.

| Activity During 1-Hour Period | Sound Level, dBA |
|--------------------------------------|-------------------------|
| Continuous | 90 |
| 30 Minutes | 93 |
| 15 Minutes | 96 |
| 7.5 Minutes | 99 |

Source: SMC 25.08.425 Sound Created by Construction and Maintenance Equipment

Sound levels for all types of construction equipment are measured at the property line of the receiver or at a distance of 50 feet from the equipment making the sound, whichever is greater. Furthermore, any type of noise that exceeds the exterior sound level limits when measured from the interior of buildings within a commercial district is prohibited between 8:00 a.m. and 5:00 p.m.

In instances where sound levels generated during construction are predicted to exceed the maximum SMC sound level limits (Table 10-1. and 10-2), the project must obtain a noise variance from the City of Seattle. The City of Seattle DCI Director's Rule 3-2009 defines four types of noise variances: Temporary Noise Variance, Technical Noise Variance, Economic Noise Variance, and Major Public Project Construction Variance. The Director's Rule

states that a project may apply for a Major Public Project Construction Variance (MPPCV) if the project meets all of the following criteria:

- Project is for a public facility as defined in the Land Use Code (SMC Chapter 23.84A);
- Project will last at least 6 months; and
- Project will have a substantial impact on the provision of public services (such as transportation) and public health, safety, and welfare.

Other factors that influence whether a project is eligible for an MPPCV include the following:

- Expected size, duration, complexity, and cost of construction;
- Magnitude of the expected impacts on traffic and transportation; and
- Degree of impact on the provision of public services during construction.

10.3.2 Vibration

Vibration levels are not regulated by the City of Seattle. Assessment of vibration impacts from construction activities is commonly based on guidelines within the Federal Transit Administration's 2006 *Transit Noise and Vibration Impact Assessment Manual* (FTA Manual) (FTA, 2006). While the FTA Manual is intended for use on federally funded transportation projects (busses, light rail, heavy rail, and subway), the manual provides guidelines for construction vibration impact assessments that are applicable for other project types, such as the Ship Canal Project. The FTA Manual divides construction vibration impact assessment criteria into two classes: building damage and occupant annoyance. Table 10-3 presents the FTA building damage criteria, which are determined from the construction type of nearby buildings. The PPV metric is used for damage criteria vibration limits.

| Building Category | Construction Description of Building | PPV Limit, inches/second |
|--------------------------|--|---------------------------------|
| I | Reinforced-concrete, steel, or timber (no plaster). | 0.5 |
| II | Engineered concrete and masonry (no plaster). | 0.3 |
| III | Non-engineered timber and masonry buildings. | 0.2 |
| IV | Buildings extremely susceptible to vibration damage. | 0.12 |

Source: FTA, 2006.

Table 10-4 presents the general annoyance criteria for vibration events inside nearby buildings. The annoyance criteria are based on land use categories and use the VdB metric. The threshold for human perception of vibration is approximately 65 VdB, but annoyance does not usually occur unless the vibration level exceeds 70 VdB. More sensitive receptors, such as vibration-sensitive electron microscopes, can have lower interference thresholds. At 90 VdB, vibration can cause difficulty with tasks such as reading computer monitors. The threshold for cosmetic building damage is between 90 VdB and 100 VdB depending on the building construction. The land use categories defined in the FTA Manual are as follows (Table 10-4):

- Category 1 – Buildings where vibration would interfere with interior operations.
- Category 2 – Residences and buildings where people normally sleep.
- Category 3 – Institutional land uses with primarily daytime use.

Table 10-4. General Annoyance Criteria, VdB

| Land Use Category | Receiving Property | | |
|-------------------|------------------------------|--------------------------------|--------------------------------|
| | Frequent Events ¹ | Occasional Events ² | Infrequent Events ³ |
| Category 1 | 65 | 65 | 65 |
| Category 2 | 72 | 75 | 80 |
| Category 3 | 75 | 78 | 83 |

Source: FTA, 2006.

1. "Frequent Events" are defined as more than 70 vibration events of the same source per day.
2. "Occasional Events" are defined as between 30 and 70 vibration events of the same source per day.
3. "Infrequent Events" are defined as fewer than 30 vibration events of the same source per day.

10.4 What methods were used to assess noise and vibration levels in the project area?

10.4.1 Noise

The primary method used for predicting noise impacts of the project was computer noise modeling using acoustic modeling software Cadna/A. The model accounts for the effects of distance, topography, and surface reflections on sound levels predicted for modeled activities during the project's construction and operation.

Computer noise models were created for each surface construction location and the pump station, which will be constructed after the tunnel has been completed. These models were used to predict sound levels at nearby receptors. Predicted sound levels were compared to existing ambient sound levels and SMC sound level limits to determine whether noise impacts are expected.

10.4.2 Vibration

Vibration impacts were assessed using guidance provided in the FTA Manual. The distances required for vibration from a source to attenuate to below the FTA building damage and annoyance criteria were calculated. This screening distance was used to determine the properties that may be affected by vibration produced from construction activities. Reference vibration velocities from construction equipment (included in Appendix C) were used to make the evaluations. The results will be refined during final design by determining site-specific soil vibration propagation characteristics. Building damage and annoyance impacts were assessed separately.

Calculations for general building damage were based on PPV vibration levels, and distance between the equipment and the nearby receptor. FTA damage criteria indicate the threshold for minor cosmetic damage. Distances between construction activities and the different building construction categories were calculated to determine the minimum distances needed to prevent building damage. Additional information is included in Appendix C.

General annoyance was calculated based on vibration levels and distance between the equipment and the receptor and represents the threshold for occupant annoyance. The annoyance criteria use the VdB metric and

are based on land use. Distances between construction activities and the different building use annoyance criteria were calculated to determine the minimum distances required to prevent occupant annoyance. Additional information on these calculations is included in Appendix C.

10.5 What sensitive noise or vibration receptors are located in the project area?

Receptors or land uses in the project area that are considered sensitive to noise and vibration are described below. Sensitive receptors are defined as those building occupants and uses that are most susceptible to noise, such as residences, hospitals, and schools, as well as those sensitive to vibration such as scientific facilities.

10.5.1 Ship Canal Tunnel

Vibration sensitive receptors include Swedish Medical Center in Ballard and IcoGenex, a biomedical facility in Fremont that may use vibration sensitive equipment.

10.5.2 West Portal

Properties located near the West Portal site are primarily commercial and industrial. A residential building is located near the northwest corner of 24th Avenue NW and NW Market Street.

10.5.3 East Portal

The East Portal would be located at the northeast corner of N 35th Street and Interlake Avenue N in Wallingford. Noise and vibration sensitive receptors include the Fremont Community School, located directly north of the East Portal site, as well as residences to the east and north of the East Portal.

10.5.4 Drop Shafts and Associated Conveyance Facilities

Drop shafts would be located near the intersection of NW 45th Street and 11th Avenue NW (11th Avenue NW Drop Shaft), the southwest corner of Leary Way and 3rd Avenue NW (North 3rd Avenue/174 Drop Shaft), and northeast of West Ewing Street and 3rd Avenue West (South 3rd Avenue Drop Shaft) near the Seattle Pacific University campus.

Properties near the 11th Avenue NW Drop Shaft are commercial and industrial. No noise or vibration sensitive receptors are currently located in this area.

Noise and vibration sensitive receptors located near the North 3rd Avenue/174 Drop Shaft include residences to the north of Leary Way and Our Beginning daycare facility located to the southeast of the drop shaft.

Seattle Pacific University's Otto Miller Hall is the closest noise and vibration sensitive receptor to the South 3rd Avenue Drop Shaft. **Otto Miller Hall houses the University's Physics and Electrical Engineering program and** contains vibration sensitive equipment. An additional vibration sensitive receptor may include the King County Environmental Laboratory, which may also house vibration sensitive equipment. No residential properties are currently located in the vicinity.

10.5.5 Ballard Conveyance Facilities

Conveyance construction in Ballard is expected to take place along roads within the general construction area shown on Figure 2-2. Noise and vibration sensitive receptors located in these areas include a residential

neighborhood north of NW Market Street and the future Nordic Heritage Museum at the southeast corner of NW Market Street and 28th Avenue NW.

10.5.6 Wallingford Conveyance Facilities

Conveyance construction in Wallingford is expected to take place along roads within the general construction area shown on Figure 2-7. Noise and vibration sensitive receptors include a group home located at the northwest corner of Woodland Park Avenue N and N 35th Street, as well as residential properties in the vicinity of construction.

10.6 What are the existing noise and vibration conditions in the project area?

The Ship Canal Project is located in a primarily commercial and industrial setting as discussed in Chapter 7. The predominant noise sources include traffic, aircraft, and construction noise from nearby projects.

To characterize existing noise and vibration conditions, the project team measured outdoor sound and vibration levels at 10 locations. These locations were near noise and vibration sensitive receptors in areas where surface work is anticipated to occur during construction, where future above grade structures will be located, and at vibration sensitive receptors near the tunnel alignment (including Swedish Medical Center in Ballard and IcoGenex, a biomedical research company in Fremont). Monitoring locations are shown in Figure 10-1 and Figure 10-2. These measurements were conducted between May 20, 2015, and June 24, 2015. The measurements took place during weekdays for at least 48 hours at each location.

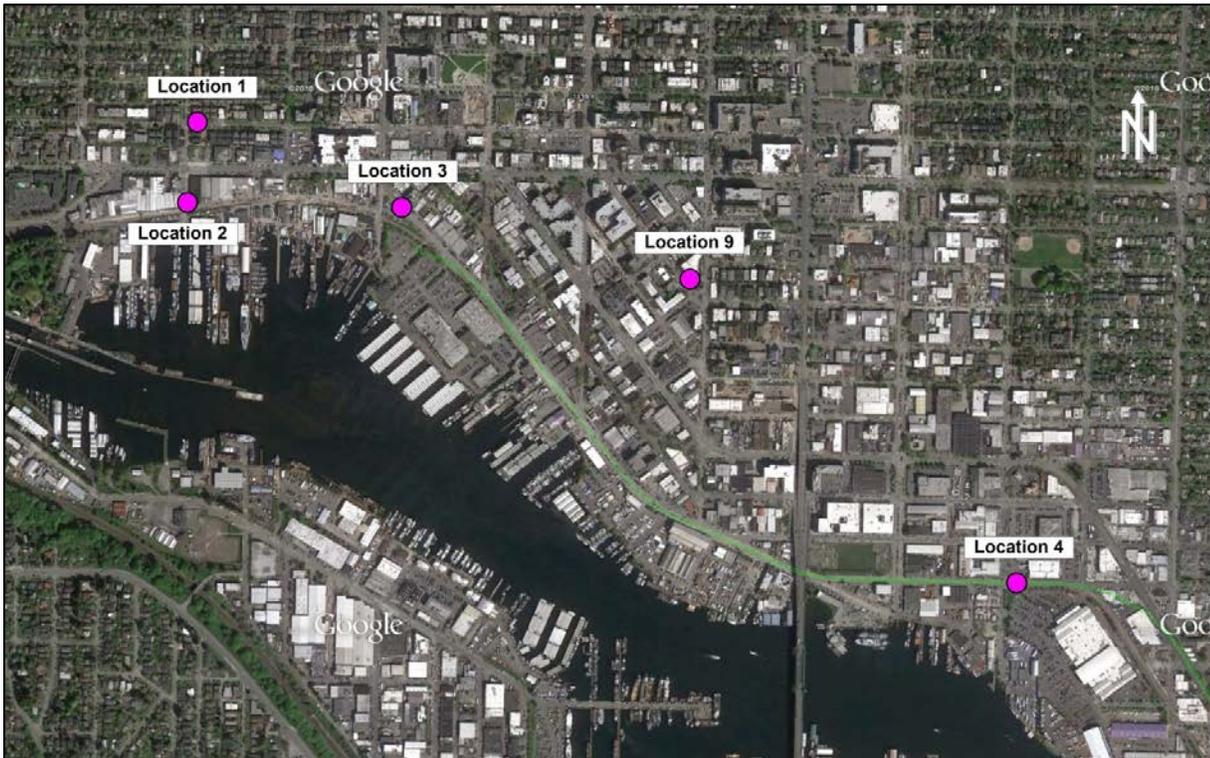


Figure 10-1. West Ambient Noise and Vibration Measurement Locations

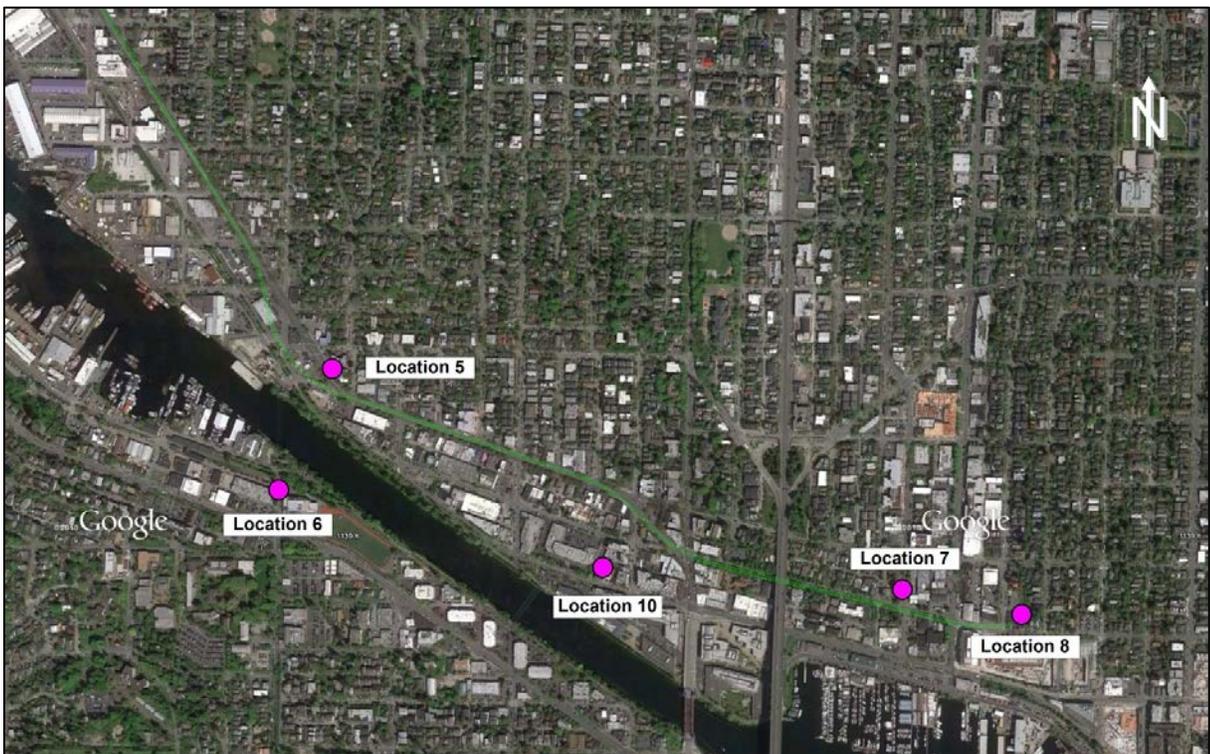


Figure 10-2. East Ambient Noise and Vibration Measurement Locations

Table 10-5 summarizes the noise and vibration levels measured at each location. The hourly L_{eq} sound level for the sites ranged from a low of 50 dBA L_{eq} at night to 73 dBA L_{eq} during the day. Daytime and nighttime vibration levels ranged between 42 VdB and 66 VdB. These existing sound and vibration levels reflect the urban roadway traffic in the area, aircraft noise, and nature sounds typically found in the area.

Four of the measurement locations (Locations 1, 5, 6, and 8) were near active construction sites. Construction activities at these locations took place during daytime hours. Daytime sound levels at these locations will likely decrease when construction activities are complete. The types of construction activities at these locations are typical of the rapidly developing Ballard and Fremont neighborhoods. In addition to increasing sound levels, construction activities also influence vibration levels.

In addition to the construction effects on measured vibration levels, the Ballard Terminal Railroad ran trains past Location 4 during the evening of June 11, 2015. Measured vibration levels during the train runs reached as high as 89 VdB.

| Location | Project Area | Sound Level, dBA | | Vibration Level, VdB |
|---|---|------------------|-----------|----------------------|
| | | Daytime | Nighttime | |
| Location 1 – NE corner 28th Ave NW and NW 56th St | Ballard Conveyance | 59 | 50 | 52 |
| Location 2 – SE corner of 28th Ave NW and NW 54th St | Ballard Conveyance | 62 | 57 | 50 |
| Location 3 – NE of the West Portal on the south side of Shilshole Ave NW | West Portal | 68 | 63 | 56 |
| Location 4 – NE corner of NW 45th St and 11th Ave NW | 11th Avenue NW Drop Shaft | 61 | 60 | 49 |
| Location 5 – NW corner of Leary Way NW and NW 36th St | North 3rd Avenue/ 174 Drop Shaft | 73 | 67 | 57 |
| Location 6 – SW corner of W Ewing St and 3rd Ave W | South 3rd Avenue Drop Shaft | 63 | 54 | 66 |
| Location 7 – NW corner of N 35th St and Woodland Park Ave | Wallingford Conveyance | 62 | 56 | 66 |
| Location 8 – SE corner of property at NE corner of Interlake Ave N and N 35th St | East Portal | 55 | 47 | 42 |
| Location 9 – NW corner of Tallman Ave NW and NW Lone Pl near Swedish Medical Center | Vibration sensitive receptor near Ship Canal Tunnel | 62 | 54 | 47 |
| Location 10 – NW corner of IcoGenex near NW corner of Evanston Ave N and N 34th St | Vibration sensitive receptor near Ship Canal Tunnel | 59 | 56 | 53 |

10.7 What are the potential noise impacts of the project?

As described in Section 5.8 of the 2014 Plan EIS, noise generated by construction equipment and activities would have the potential to impact residential areas and sensitive receptors. Section 6.8 of the 2014 Plan EIS described operational noise impacts from pump stations, odor control facilities, maintenance, and other noise-generating equipment associated with permanent facilities. Noise impacts described in this section are consistent with those described in the 2014 Plan EIS, with additional analysis related to design changes and additions, including design, construction, and location updates.

To determine the impact to the community, this analysis relies on guidelines presented by EPA Region 10 in its 1973 document entitled *Environmental Impact Statement Guidelines* (EPA, 1973). In the published document, increases in noise are described in relation to expected community response to the introduced noise source. The responses are described as follows:

- Up to 5 dBA increase – few complaints if gradual increase.
- 5 to 10 dBA increase – more complaints, especially during sleeping hours.
- Over 10 dBA increase – substantial number of complaints.

The EPA guidelines are not standards, but they do serve as useful indicators for potential noise impacts of projects undergoing evaluation. The 1973 document does not indicate either the time interval (e.g., hourly or daily) or the noise metric (e.g., L_{eq} , L_{max} , etc.) to which these impact/mitigation thresholds should be applied. The following discussion applies the EPA guidelines to the average hourly (L_{eq}) sound levels.

10.7.1 During Construction

Multiple projects, public and private, will be under construction concurrent with the Ship Canal Project. Potential impacts from construction noise will depend on the type of construction activity on a given day, the equipment used, the distance between construction activities and the nearest sensitive land use, and the existing ambient sound levels near the receptor.

Table 10-6 lists the typical construction equipment used for this type of project and the corresponding maximum noise levels that would be produced when measured at 50 feet from the sources under normal use, based on information from the Federal Highway Administration (FHWA) Construction Noise Control Specification 721.560. The amount of time when each type of equipment is predicted to be used (percent of an hour or acoustical usage factor) is also shown in Table 10-6.

Hourly L_{eq} sound levels for the construction equipment identified for the Ship Canal Project were calculated using the maximum (L_{max}) sound data and acoustical usage factors in Table 10-6. The resulting L_{eq} sound levels were used to predict sound levels from construction activities. The resulting predicted sound levels are likely conservative. All equipment included in Table 10-6, except for impact devices, generates maximum sound levels below the maximum sound levels defined in the SMC. Therefore, compliance with City of Seattle L_{eq} sound levels will also result in compliance with the City's L_{max} levels.

| Table 10-6. Construction Equipment Sound Levels, L_{max}¹ | | | |
|--|-------------------------|---|-----------------------------------|
| Equipment | Sound Level, dBA | Acoustical Usage Factor, %² | Impact Device?³ |
| Backhoe | 80 | 40 | No |
| Compressor | 80 | 40 | No |
| Concrete Mixer Truck | 85 | 40 | No |
| Concrete Pump Truck | 82 | 20 | No |
| Concrete Saw | 90 | 20 | No |
| Conveyer | 85 | 50 | No |
| Crane | 85 | 16 | No |
| Dozer | 85 | 40 | No |
| Drill Rig | 85 | 20 | No |
| Excavator | 80 | 40 | No |
| Gantry Crane | 85 | 50 | No |
| Generator | 82 | 50 | No |
| Grout Plant | 83 | 15 | No |
| Haul Truck | 84 | 40 | No |
| Hoe Ram | 90 | 20 | Yes |
| Light Plant | 82 | 50 | No |
| Loader | 80 | 40 | No |
| Pile Driver | 95 | 20 | Yes |
| Pump | 77 | 50 | No |
| Pump Truck | 84 | 40 | No |
| Transformer | 32 | 80 | No |
| Tunnel Vent Fan | 85 | 100 | No |

Source: FHWA Specifications 721.560.

1. At a distance of 50 feet from the equipment, "slow" time weighting.
2. Percent of time each hour equipment typically generates sound.
3. Creates impact sound subject to additional limits delineated in SMC 25.08.425.

Actual construction equipment, locations, and staging of activities will be at the discretion of the contractor and will be determined during contracting. For mobile equipment, sound pressure levels at nearby properties will vary depending upon the actual location of the equipment at any given time. For this analysis, equipment was placed at locations that yield conservative or worst-case predictions, given the likely site layout and staging.

The following sections describe predicted sound levels for the anticipated construction activities without any noise reduction measures.

10.7.1.1 Ship Canal Tunnel

Noise impacts from construction are anticipated to be localized to surface work areas. Construction of the tunnel would primarily take place below grade. Noise impacts from below-grade tunnel construction activities are not expected. The types of construction equipment anticipated at each location are described in Appendix C.

10.7.1.2 West Portal

Construction activities at the West Portal site would consist of mobilization, tunnel pit excavation, tunneling, and construction of the pump station. During the 6- to 7-year construction period, most activities would occur during daytime hours, with the exception of tunneling, which is anticipated to occur during daytime and nighttime hours. However, as stated above, belowground tunnel construction is unlikely to generate noise impacts.

Use of barges, rail, and trucks to haul spoils and deliver materials would generate noise during tunneling. The addition of 180 to 232 one-way peak truck trips per day (without use of rail or barges) may generate minor to moderate noise impacts. However, the West Portal site is located in a predominantly industrial area, and traffic volumes along haul routes would need to double from current levels to generate a 3 dBA change in noise levels. If rail and barge are used to the fullest extent feasible, the addition of 40 one-way peak truck trips per day could generate minor noise impacts. Ballard Terminal Railroad (BTRR) currently operates trains during nighttime hours and is not heavily used. Additional trains on the BTRR may generate minor noise impacts at nearby properties, particularly those properties west of the West Portal site near the BTRR tracks.

Of the three options to remove spoils, barges are expected to produce the lowest noise impacts at surrounding properties. Loading barges would occur at the pier located at the southwest side of the construction site on 24th Avenue NW. Spoils would be removed through the West Portal site using enclosed or covered conveyors to move spoils to barges for transport to a disposal site. Additional noise would be generated by the conveyor, but removal of spoils would take place in an industrial zone. Barges are not expected to generate noise impacts while in transit.

Predicted sound levels from onsite construction activities at the West Portal site without noise reduction measures at the ambient measurement location (Location 3) as well as properties adjacent to the construction site are provided in Table 10-7. The equipment included in the noise analysis for construction activities at the West Portal site is described in Appendix C.

| Table 10-7. Predicted Average Sound Levels from West Portal Construction Activities, Hourly L_{eq} | | | | | | |
|--|---|---------------------------|------------------------------|------------------|----------------------------------|--|
| Receiving Property | Existing Ambient Level (day/night) | Construction Phase | | | | SMC Sound Level Limit (day/night) |
| | | Mobilization | Tunnel Pit Excavation | Tunneling | Pump Station Construction | |
| Location 3 | 68/63 | 75 | 76 | 81 | 76 | 95/70 |
| Commercial Zones | 68/63 ¹ | 52 – 72 | 54 – 70 | 59 – 74 | 54 – 68 | 90/65 |
| Industrial Zones | | 61 – 81 | 62 – 75 | 69 – 78 | 59 – 72 | 95/70 |

1. Ambient sound levels are assumed to be similar to ambient measurement location.

Ambient sound levels are expected to increase by up to 13 dBA during the day and by up to 18 dBA at night. Noise impacts at specific properties would vary depending on the type and location of construction equipment being used. At times, the increase in sound levels would be noticeable at nearby residential use properties and may result in noise impacts. The implementation of noise control measures, such as those listed in Section 10.9.1, may reduce noise impacts at nearby properties during construction. Construction activities at the West Portal site are expected to exceed nighttime SMC sound level limits by up to 9 dBA. A noise variance would be required from the City. Daytime construction activities are not expected to exceed daytime SMC sound level limits.

Noise from impact equipment expected to be used at the West Portal site would be below the daytime sound level limits at a distance of 50 feet, with the exception of the impact pile driver. To comply with sound level limits in SMC 25.08.425.C, the impact pile driver must operate for less than 15 minutes in any 1-hour period or operate 100 feet from the nearest property line. This applies to all types of properties, including commercial, residential, and industrial properties.

In addition to the potential airborne noise impacts described above, there are also potential underwater noise impacts from pile driving associated with pier replacement. Vibratory and impact hammers will be used intermittently over several months. During impact hammer use, there is a potential for elevated underwater sound levels to adversely affect aquatic life (see discussion of biological resources in Chapter 6).

10.7.1.3 East Portal

Construction activities at the East Portal would consist of tunnel pit excavation, removal of the tunnel boring machine, and site restoration. These activities would occur during daytime hours over an approximate 9 to 16-month construction period.

Table 10-8 provides predicted sound levels from construction activities at East Portal site and adjacent properties, without measures to reduce or eliminate noise impacts. The equipment included in the noise analysis for construction activities at the East Portal is described in Appendix C.

| Receiving Property | Existing Ambient Level | Construction Phase | | | SMC Sound Level Limit |
|--------------------|------------------------|--------------------------|-----------------|------------------|-----------------------|
| | | Retrieval Pit Excavation | TBM Removal | Site Restoration | |
| Location 8 | 55 | 87 ² | 86 ² | 86 ² | 85 ² |
| Commercial Zones | 55 ¹ | 66 – 77 | 66 – 77 | 64 – 76 | 85 |
| Industrial Zones | | 68 – 79 | 68 – 79 | 66 – 80 | 90 |
| Residential Zones | | 62 – 82 | 62 – 81 | 60 – 81 | 82 |

1. Ambient sound levels are assumed to be similar to ambient measurement location.
2. Location 8 is positioned on the East Portal construction site. SMC sound level limits are defined at receiving property lines and do not apply within the construction site boundaries.

Daytime construction activities without noise reduction measures at the East Portal site are expected to comply with SMC daytime sound level limits. However, daytime ambient sound levels are expected to increase by up to 27 dBA. While daytime construction activities at the East Portal are expected to comply with SMC daytime sound level limits, the increase above existing sound levels would result in noticeable and potentially bothersome noise

impacts at nearby residential properties. Measures discussed in Section 10.9 could be used to reduce noise impacts.

10.7.1.4 Drop Shafts and Associated Conveyance

Construction activities at the 11th Avenue NW Drop Shaft and North 3rd Avenue/174 Drop Shaft are anticipated to take place over a period of approximately 12 to 16 months, while construction at the South 3rd Avenue Drop Shaft is anticipated to occur approximately 6 to 9 months. Major construction activities would consist of excavation and construction of the drop shaft structure, including site restoration. Construction activities would take place during daytime hours.

Predicted sound levels from construction at the drop shafts are provided in Table 10-9 at the ambient measurement locations as well as properties adjacent to the construction sites.

| Table 10-9. Predicted Average Sound Levels from Drop Shaft Construction Activities, Hourly, L_{eq} | | | | |
|--|-------------------------------------|---------------------------|-----------------------------|------------------------------|
| Receiving Property | Existing Ambient Sound Level | Construction Phase | | SMC Sound Level Limit |
| | | Excavation | Drop Shaft Structure | |
| 11th Avenue NW Drop Shaft | | | | |
| Location 4 | 61 | 88 | 88 | 95 |
| Industrial Zones | 61 ¹ | 62 – 87 | 60 – 86 | 95 |
| North 3rd Avenue/174 Drop Shaft | | | | |
| Location 5 | 73 | 79 | 77 | 90 |
| Commercial Zones | 73 ¹ | 65 – 78 | 64 – 77 | 90 |
| Industrial Zones | | 59 – 76 | 58 – 76 | 95 |
| Residential Zones | | 49 – 74 | 49 – 73 | 85 |
| South 3rd Avenue Drop Shaft | | | | |
| Location 6 | 63 | 72 | 72 | 85 |
| Commercial | 63 ¹ | 73 – 76 | 72 – 75 | 85 |
| Industrial | | 64 – 70 | 63 – 70 | 90 |

1. Ambient sound levels are assumed to be similar to ambient measurement location.

Daytime construction activities at the drop shaft sites are expected to comply with daytime SMC sound level limits. During excavation, ambient sound levels are expected to increase by up to 27 dBA at the 11th Avenue NW Drop Shaft, 5 dBA at the North 3rd Avenue/174 Drop Shaft, and 13 dBA at the South 3rd Avenue Drop Shaft. Noise impacts at specific properties would vary depending on the type and location of construction equipment being used. The increase in daytime sound levels during construction of the North 3rd Avenue/174 Drop Shaft and the South 3rd Avenue Drop Shaft may result in noise impacts at nearby sensitive receptors. Haul trucks and delivery vehicles traveling on 3rd Avenue W near Seattle Pacific University's Otto Miller Hall are expected to produce the highest impacts. Noise sensitive receptors are located near the 11th Avenue NW Drop Shaft and the increased sound levels in the area are not expected to result in noise impacts.

10.7.1.5 Ballard Conveyance Facilities

Conveyance construction in Ballard is expected to take place along roads within the general construction area shown on Figure 2-2. Construction is anticipated to occur over approximately 24 months, and it is assumed that construction activities would take place during daytime hours.

Predicted sound levels from conveyance construction are provided in Table 10-10 at the ambient measurement location (Location 1) as well as properties adjacent to construction activities.

| Receiving Property | Existing Ambient Level | Predicted Sound Level | SMC Sound Level Limit ² |
|--------------------|------------------------|-----------------------|------------------------------------|
| Location 1 | 59 | 78 | 90 |
| Residential Zones | 59 ¹ | 68 – 85 | 90 |
| Industrial Zones | | 59 – 73 | 90 |

1. Ambient sound levels are assumed to be similar to ambient measurement location.
2. SMC 25.08.425 exterior sound level limits from impact construction equipment during a 1-hour period.

Daytime construction activities are expected to increase existing ambient sound levels by up to 26 dBA. Concrete demolition with a hoe ram is anticipated to generate the loudest sound levels during construction. Hoe rams are impact devices and are allowed to exceed the exterior sound level limits in any 1-hour period between 8:00 a.m. and 5:00 p.m. on weekdays and 9:00 a.m. and 5:00 p.m. on weekends and legal holidays (SMC 25.08.425). Concrete demolition activities would only occur over short periods. Once demolition activities are completed, the predicted sound levels from the remaining construction activities are predicted to comply with SMC sound level limits.

Noise impacts at specific properties would depend on the location and type of construction equipment being used. However, the residential neighborhood north of NW Market Street has the greatest potential for experiencing intermittent noise impacts.

10.7.1.6 Wallingford Conveyance Facilities

Conveyance construction in Wallingford is expected to take place along roads within the general construction area shown on Figure 2-7. Construction is anticipated to take approximately 12 months and it is assumed to occur during daytime hours.

Predicted sound levels from conveyance construction are provided in Table 10-11 at the ambient measurement location (Location 7) as well as properties adjacent to construction activities.

| Receiving Property | Existing Ambient Level | Predicted Sound Level | SMC Sound Level Limit |
|--------------------|------------------------|-----------------------|-----------------------|
| Location 7 | 62 | 59 | 90 |
| Commercial Zones | 62 ¹ | 66 – 72 | 90 |
| Industrial Zones | | 71 – 84 | 95 |
| Residential Zones | | 66 – 68 | 85 |

1. Ambient sound levels are assumed to be similar to ambient measurement location.

Daytime construction activities are not expected to exceed SMC sound level limits during construction. However, ambient sound levels are expected to increase by up to 22 dBA during concrete demolition. Concrete demolition is anticipated to occur over a short period during daytime hours. Noise impacts would depend on the location and type of construction equipment being used and the land use and zoning of the properties located near the equipment. Residential properties are located near the western extent of the conveyance construction and have the greatest potential for intermittent noise impacts resulting from construction activities.

10.7.2 After Construction

Once construction is complete, a pump station would operate at the West Portal site and passive odor control systems would operate at the drop shaft locations and the East Portal site. Generators at each of the portal and drop shaft locations would be tested for 1 hour each month.

The operation of the completed facilities must comply with the SMC sound level limits provided in Table 10-1 at adjacent property lines. SMC 25.08.530 exempts sounds generated by emergency equipment and applies to generator testing as long as reasonable noise mitigation is used.

10.7.2.1 Ship Canal Tunnel

Once constructed, the Ship Canal Tunnel would serve as storage for combined sewage. No noise impacts are expected from the completed Ship Canal Tunnel.

10.7.2.2 West Portal

A pump station at the West Portal site would include an above-grade structure housing a generator, variable frequency drives, and an odor control fan. Figure 10-3 provides the predicted sound contours from the pump station. The pumps would be installed underground inside the pump station's dry well. The odor control system would consist of an indoor fan and a carbon vessel located outside the structure in a partially recessed space surrounded by a screening wall extending up to 10 feet above grade. A generator inside the pump station would be tested for 1 hour every month.

The pump station is required to comply with SMC sound level limits during normal operations, except the generator, which is exempt during testing periods. Existing daytime ambient sound levels are 3 dBA higher than SMC limits at commercial properties and 2 dBA lower than SMC limits at industrial properties. Nighttime ambient levels are 2 dBA lower than SMC limits at commercial properties and 7 dBA lower at industrial properties.

The closest noise sensitive receptor is located approximately 500 feet northwest of the pump station. Based on predicted sound levels, no noise impacts are anticipated from the operation of the pump station.



Figure 10-3. Predicted Sound Levels from Pump Station Operation

10.7.2.3 Drop Shafts and East Portal

Once the tunnel is complete, passive odor control systems and generators would be installed at the drop shafts and East Portal site. Although the odor control system is passive, the design includes provisions for future fan installation. These odor control systems would be located underground. Generators would be installed above grade and inside weather-proof sound enclosures.

Generator testing would occur for 1 hour every month and is exempt from SMC sound level limits. However, the City expects a reasonable effort to mitigate sound produced during testing. Normal operations at these sites must comply with SMC sound level limits.

Equipment operating at the 11th Avenue NW Drop Shaft could increase sound levels by 10 dBA during daytime and nighttime hours while remaining below SMC limits. Properties near the drop shaft are zoned industrial, and no residential properties are located in the area. As a result, no noise impacts are anticipated from the operation of the 11th Avenue NW Drop Shaft.

The North 3rd Avenue/174 Drop Shaft can operate at 3 dBA above existing nighttime sound levels in industrial areas and still comply with SMC limits. The resulting nighttime sound levels in these areas could increase by up to 5 dBA with the addition of the North 3rd Avenue/174 Drop Shaft equipment to the existing ambient sound levels. Measured ambient sound levels were higher than SMC sound level limits at all nearby noise sensitive receptors.

Therefore, no noise impacts are anticipated as a result of the normal operation of the North 3rd Avenue/174 Drop Shaft.

Sound levels near the South 3rd Avenue Drop Shaft could increase by up to 4 dBA in industrial zones during daytime hours and 11 dBA during nighttime hours, while nighttime sound levels in commercial zones could increase by up to 7 dBA while remaining below SMC limits. Because no nighttime noise sensitive receptors are located in the area, no noise impacts are anticipated as a result of operating the South 3rd Avenue Drop Shaft.

Residential zones near the East Portal site could experience an increase of 4 dBA during daytime hours and 3 dBA at night while remaining below SMC limits. Sound levels at commercial properties in the East Portal area could increase by 6 dBA during the day and 13 dBA at night, while sound levels at industrial properties could increase by 10 dBA during the day and 18 dBA at night. Nighttime SMC sound level limits are the same as the measured nighttime ambient sound levels. The addition of the East Portal would increase the sound levels in the area by 3 dBA during nighttime hours. This increase is characterized by FHWA as “barely perceptible” (FHWA, 2011) and therefore no noise impacts near the East Portal are anticipated.

10.7.2.4 Conveyance Facilities

The completed conveyance facilities in Ballard and Wallingford would consist of underground pipes used to transport wastewater to the portal and drop shaft locations. No noise impacts are anticipated from the completed conveyance facilities.

10.8 What are the potential vibration impacts of the project?

10.8.1 During Construction

The types of construction activities likely to produce the highest levels of ground-borne vibration include impact devices such as hoe rams for concrete demolition and impact pile drivers for installing pier piles. Other equipment proposed for this project (including drill rigs for drilling tunnel shafts, vibratory compactors to compact backfill, and the tunnel boring machine) also produce ground-borne vibration. Impacts are characterized consistent with FTA guidelines described in Section 10.3.2, which include two construction vibration assessment criteria classes: building damage and occupant annoyance. Predicted vibration levels described in the sections below are based on conceptual design. Locations chosen for the vibration analysis are representative of geographic locations. Actual construction locations will be determined during final design.

10.8.1.1 Ship Canal Tunnel

Vibration Analysis Assumptions. A tunnel boring machine would be used to create an approximately 14- to 18-foot-diameter tunnel between the West Portal in Ballard and the East Portal in Wallingford. This analysis addresses two potential depths for the tunnel. Based on the current preliminary design, the tunnel boring machine would operate at a depth of approximately 100 to 120 feet below grade during the entire alignment. A tunnel design option is being considered that could reduce the depth of the tunnel to a range of 50 to 90 feet below grade. For both potential tunnel depths, the tunnel boring machine would operate for a period of approximately 2.5 years.

Muck cars may be used to transport soils from the tunnel boring machine to the West Portal before removal from the site. Muck cars may create vibration impacts when they pass over uneven rail joints. This analysis assumes that if muck cars are used, the rails are welded and maintained to minimize vibration produced by the muck cars.

The tunnel walls would be constructed from curved, interlocking concrete segments. Vibration impacts may occur as the segments drop into place. The analysis assumes that the installation of these segments is performed using methods to minimize vibration.

Vibration impacts were determined by calculating the horizontal distance required between the tunnel alignment and the different FTA damage and annoyance criteria. Any buildings within these distances are associated with a predicted impact from the tunnel boring machine.

Vibration Impacts

For the deep tunnel option (approximately 100 to 120 feet below grade), building damage is not anticipated due to the depth of the tunnel. The horizontal distances required for vibration produced by the tunnel boring machine to fall below the FTA annoyance criteria were calculated. Based on currently available data for the tunnel boring machine, vibration source levels, and soil conditions, the resulting vibration levels produced by tunneling are not anticipated to exceed the FTA annoyance criteria. However, FTA annoyance criteria could be exceeded if site-specific soil conditions allow for efficient movement of vibration through the ground, or if vibration levels generated by the tunnel boring machine are higher than those used in this analysis. In this case, the following receptors (properties) could be affected by vibration during tunneling:

- Category 1 receptors within 140 feet of the tunnel (horizontal distance).
- Category 2 receptors within 105 feet of the tunnel.

Based on currently available data, no building damage is anticipated if the tunnel depth is reduced (approximately 50 to 90 feet below grade). If site-specific soil conditions allow for efficient vibration propagation, receptors within the following horizontal distances of the shallower tunnel may exceed the FTA annoyance criteria and be affected by vibration as the tunnel boring machine passes:

- Category 1 receptors within 180 feet of the tunnel.
- Category 2 receptors within 155 feet of the tunnel.
- Category 3 receptors within 80 feet of the tunnel.

With the shallower tunnel option, vibration impacts may be experienced at a greater number of properties than would occur with the deeper tunnel option. The distances shown in Figure 10-4 are considered the maximum distances from the tunnel construction where vibration impacts may occur. Annoyance impacts are expected to occur only while the tunnel boring machine passes below these properties. After the boring machine travels beyond the distances shown in Figure 10-4, no further vibration impacts are anticipated.

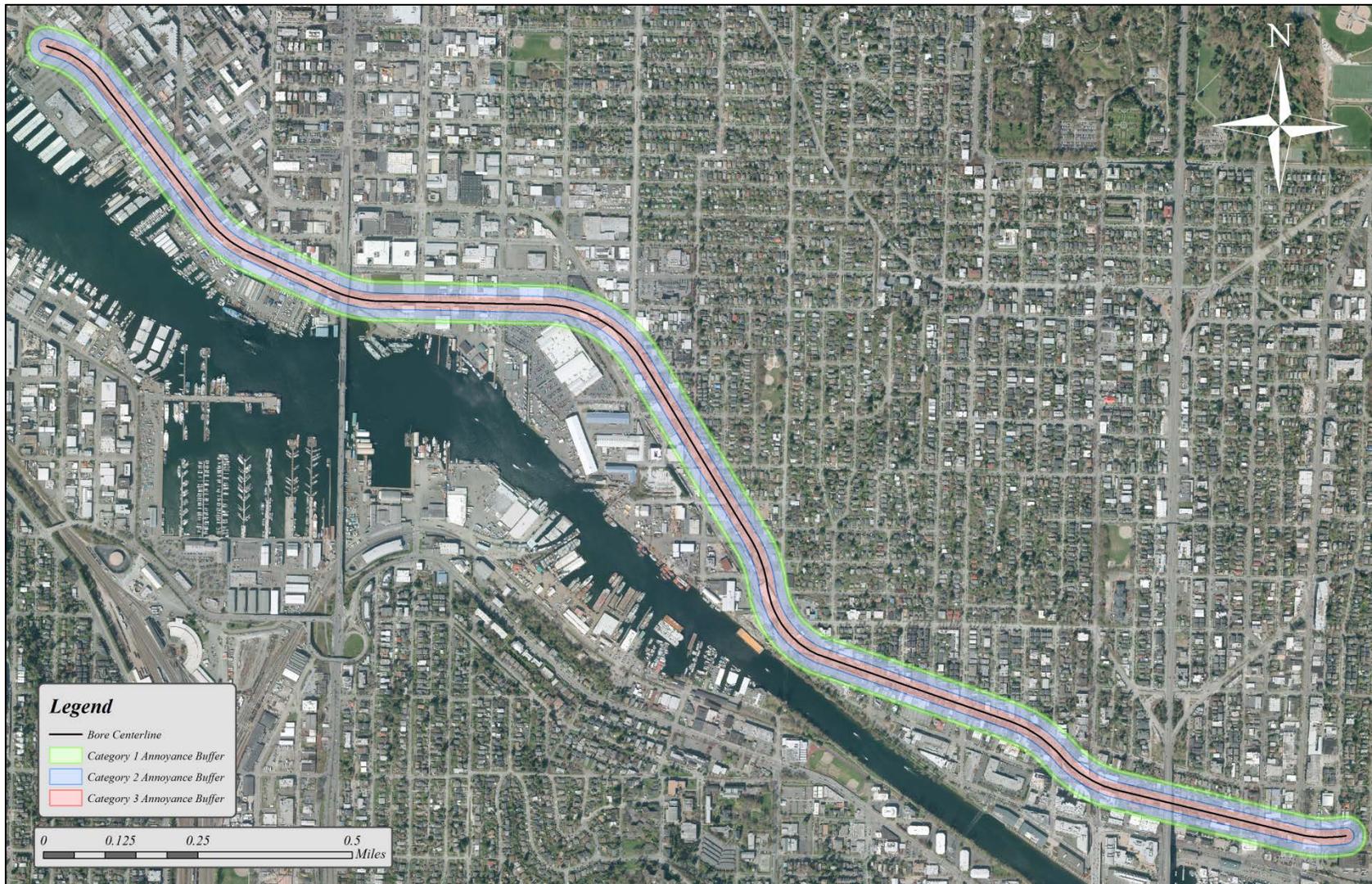


Figure 10-4. Areas Potentially Affected by Vibration during Construction (based on the Shallower Tunnel)

10.8.1.2 West Portal

West Portal construction is likely to produce the highest vibration levels during impact pile driving as part of the pier replacement and as part of drilling operations during construction of the shafts.

Table 10-12 provides the distances from impact pile driving and drilling where building damage criteria and annoyance criteria would be met. Figure 10-5 illustrates the distances to FTA damage and annoyance criteria levels. Buildings located within these distances may experience vibration impacts during pile driving and drilling activities, such as minor cosmetic damage or perceptible vibration resulting in occupant annoyance. These impacts would vary depending on the building construction and use of the receiving properties. No vibration impacts are anticipated after pile driving and drilling are completed.

Table 10-12. Distance to Damage and Annoyance Criteria at the West Portal Site (Feet)

| Equipment | Damage Criteria | | | | Annoyance Criteria | | |
|--------------------|-----------------|----|-----|----|--------------------|------------|------------|
| | I | II | III | IV | Category 1 | Category 2 | Category 3 |
| Impact Pile Driver | 30 | 42 | 55 | 77 | 315 | 270 | 146 |
| Drill Rig | 8 | 11 | 15 | 20 | 85 | 73 | 40 |

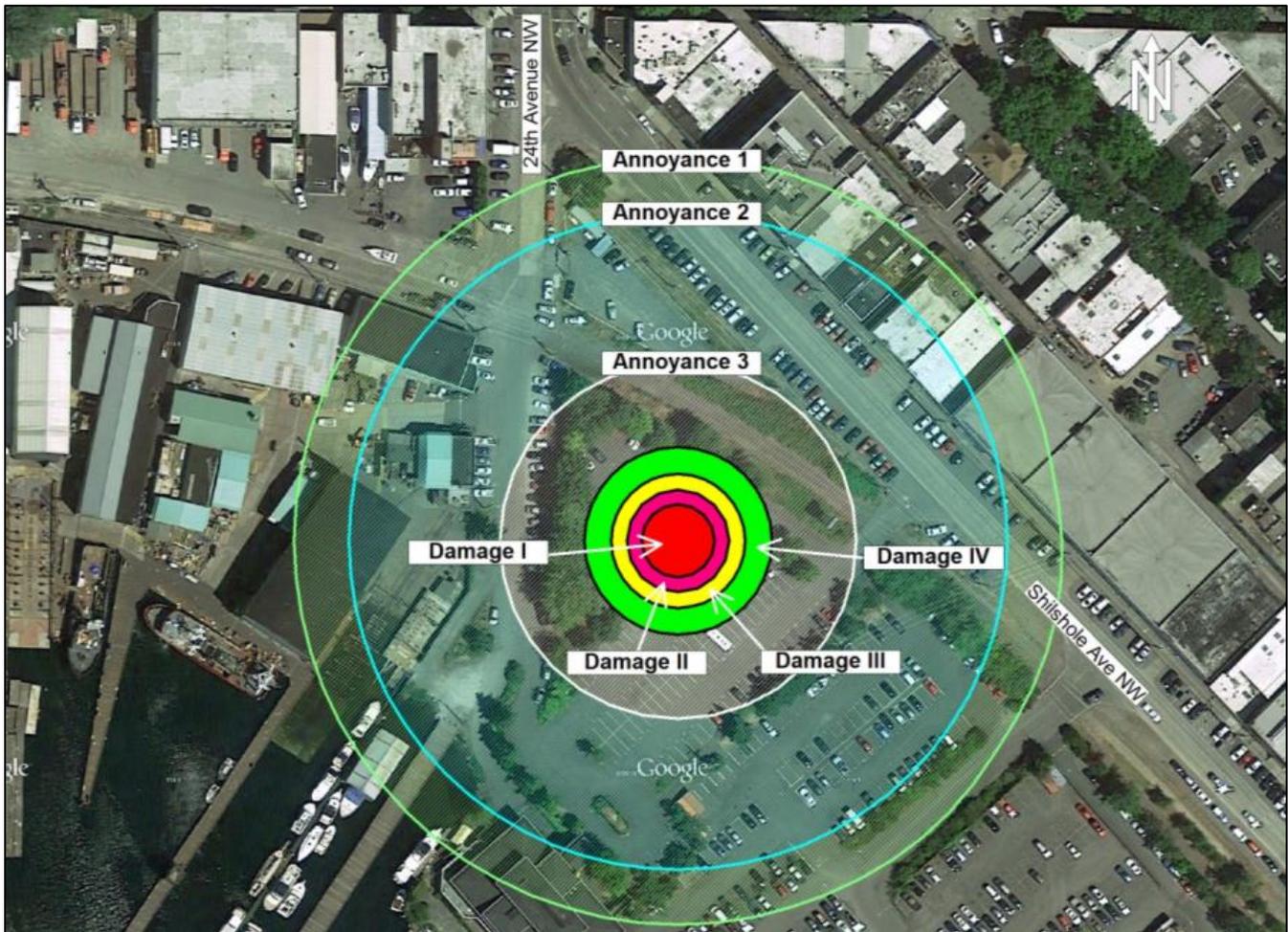


Figure 10-5. Distance where Damage and Annoyance Criteria would be met at the West Portal

Use of rail and trucks to haul spoils and deliver materials may also generate vibration during tunneling activities. The addition of 30 to 40 haul trucks per day is unlikely to generate vibration impacts. Additional trains on the BTRR tracks may generate vibration impacts at nearby properties because the rail line is currently not heavily used and only operates during nighttime hours. If trains will be used to deliver and haul materials, additional vibration analysis may be needed at nearby vibration sensitive properties, such as the future Nordic Heritage Museum and C.D. Stimson office building.

10.8.1.3 East Portal

Drilling operations to construct the tunnel boring machine retrieval pit at the East Portal site are anticipated to produce the highest vibration levels of 0.089 inches per second (PPV) and 87 VdB at a distance of 25 feet from the equipment. These levels are would occur over a 6-month period. Removal of spoils and construction of the East Portal structure are anticipated to generate lower levels of vibration and would occur over a 9- to 12-month duration. Vibratory compaction of backfill may also produce short term vibration impacts at nearby properties; however, this activity would occur over a short duration of time.

Table 10-13 provides the distances to buildings where impacts could occur, based on the FTA damage and annoyance criteria. Figure 10-6 illustrates distances to FTA damage and annoyance criteria levels, based on a representative location. Final alignments will be refined during final design. Buildings located within these distances may experience vibration impacts. Based on current land use, vibration impacts may occur at residential properties located west of the site during drilling operations. These impacts would depend on the particular type and location of the construction equipment.

| Equipment | Damage Criteria | | | | Annoyance Criteria | | |
|-----------|-----------------|----|-----|----|--------------------|------------|------------|
| | I | II | III | IV | Category 1 | Category 2 | Category 3 |
| Drill Rig | 8 | 11 | 15 | 20 | 85 | 73 | 40 |

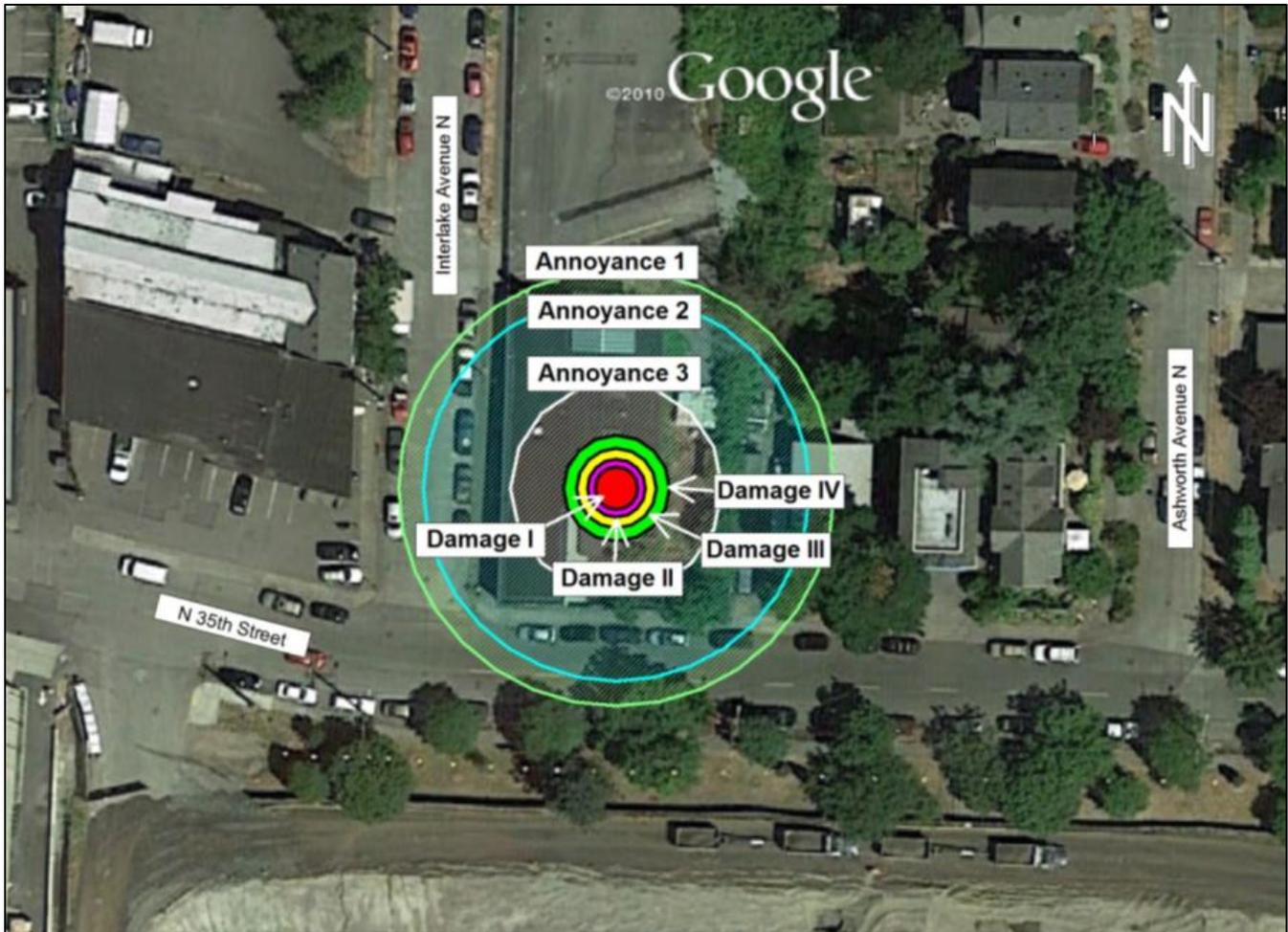


Figure 10-6. Distance where Damage and Annoyance Criteria would be met at the East Portal

10.8.1.4 Drop Shafts and Associated Conveyance

During construction of the drop shafts, drill rigs would likely produce the highest vibration levels, expected to be in use from 4 to 6 months. Removal of spoils and construction of the drop shaft structure are anticipated to produce lower vibration levels, up to 0.076 inches per second (PPV) and 86 VdB at a distance of 25 feet. Vibratory compaction of backfill may also produce short-term vibration impacts at nearby properties; however, this activity would occur over a short duration of time.

Table 10-14 presents the distances where building damage and annoyance criteria would be met for vibration generated from drilling operations. Buildings located within these distances may experience vibration impacts such as minor cosmetic damage to buildings, occupant annoyance, or the inability to operate vibration sensitive instruments. Figure 10-7 illustrates the distances to FTA damage and annoyance criteria, based on a representative location. Final locations will be refined during final design. Figure 10-8 provides these same distances at the generalized location for the South 3rd Avenue Drop Shaft.

Table 10-14. Distance to Meet Damage and Annoyance Criteria at the Drop Shafts (Feet)

| Equipment | Damage Criteria | | | | Annoyance Criteria | | |
|-----------|-----------------|----|-----|----|--------------------|------------|------------|
| | I | II | III | IV | Category 1 | Category 2 | Category 3 |
| Drill Rig | 8 | 11 | 15 | 20 | 85 | 73 | 40 |



Figure 10-7. Distance where Damage and Annoyance Criteria would be met at the North 3rd Avenue Drop Shaft

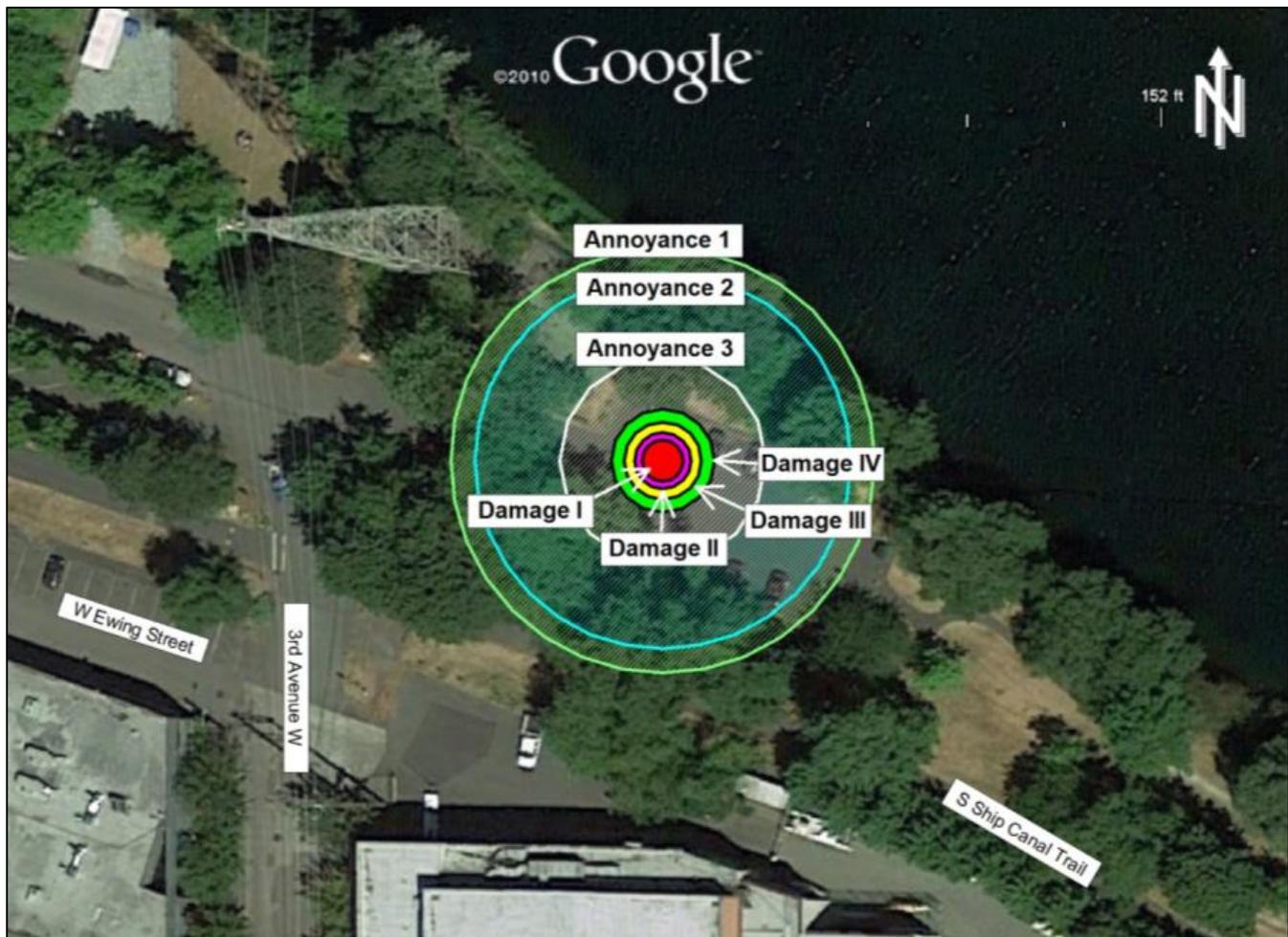


Figure 10-8. Distance to FTA Damage and Annoyance Criteria at the South 3rd Avenue Drop Shaft

10.8.1.5 Ballard Conveyance Facilities

Concrete demolition would likely generate the highest vibration levels during construction of the conveyance facilities in Ballard. Equipment used during concrete demolition may include impact devices such as hoe rams. The most vibration sensitive properties are the residences located north of NW Market Street. These activities are expected to be limited to a couple of hours during the day and may occur over several months. No further impact equipment should be necessary once concrete has been removed.

Table 10-15 provides the distances where building damage and annoyance criteria would be met. Figure 10-9 illustrates these distances from a representative location based on conceptual design. Actual locations will be determined during final design. Properties located within these distances may experience vibration impacts for short durations during construction. These impacts would vary depending on the exact location and type of equipment being used as well as the use of the receiving properties.

Table 10-15. Distance to Meet Damage and Annoyance Criteria at Ballard Conveyance (Feet)

| Equipment | Damage Criteria | | | | Annoyance Criteria | | |
|-----------|-----------------|----|-----|----|--------------------|------------|------------|
| | I | II | III | IV | Category 1 | Category 2 | Category 3 |
| Hoe Ram | 8 | 11 | 15 | 20 | 85 | 73 | 40 |



Figure 10-9. Distance where Damage and Annoyance Criteria would be met at Ballard Conveyance Facilities

10.8.1.6 Wallingford Conveyance Facilities

Concrete demolition would likely generate the highest vibration levels during construction of the conveyance facilities in Wallingford. Equipment used during concrete demolition may include impact devices such as hoe rams. Demolition activities would likely take place in stages and would not occur in the same area for a prolonged period of time. These activities are expected to be limited to a couple of hours during the day at a particular location and may last several months. No further impact equipment should be necessary once concrete has been removed.

Table 10-16 provides the distances where building damage criteria and annoyance criteria would be met. Figure 10-10 illustrates these distances from a representative location based on conceptual design. Actual locations will be determined during final design. Buildings located within these distances may experience vibration impacts such as minor cosmetic damage, or occupant annoyance during concrete demolition. These impacts would vary

depending on the specific type and location of construction equipment and the building construction and land use of receiving properties. Prolonged periods of occupant annoyance are not anticipated.

Table 10-16. Distance to Damage and Annoyance Criteria at Wallingford Conveyance (Feet)

| Equipment | Damage Criteria | | | | Annoyance Criteria | | |
|-----------|-----------------|----|-----|----|--------------------|------------|------------|
| | I | II | III | IV | Category 1 | Category 2 | Category 3 |
| Hoe Ram | 8 | 11 | 15 | 20 | 85 | 73 | 40 |



Figure 10-10. Distance where Damage and Annoyance Criteria would be met at Wallingford Conveyance Facilities

10.8.2 After Construction

Vibration impacts are not anticipated after the project is completed. Equipment installed at the pump station, drop shafts, and portal locations is not anticipated to generate vibration levels high enough to cause impacts at nearby receptors.

10.9 What measures would reduce or eliminate potential impacts associated with noise and vibration?

Below are potential measures that could be used to reduce the impact of noise and vibration produced during the project's construction and operation.

10.9.1 Noise

Construction of the Ship Canal Project may require nighttime construction activities at the West Portal; therefore, a nighttime noise variance may be required from DCI. Because of the magnitude of the project, a Major Public Project Construction Noise Variance would most likely be required. In coordination with DCI, measures to reduce the impact of noise would be developed and specified in the noise variance. To reduce construction noise at nearby receptors, SPU would consider incorporating measures such as the following into construction plans, specifications, and variance requirements. Final measures will be determined as part of permitting during final design.

- Establish daytime and nighttime sound level limits at nearby noise sensitive receptors (this may be required during the procurement of a Noise Variance).
- Develop a Noise Control Plan that includes predicted construction sound levels for the contractor's proposed means, methods, and equipment as well as any measures that would be required to satisfy noise limits.
- Monitor sound levels during construction.
- Line truck beds with rubber bed liners, or keep 1 foot of dirt in the bottom of the trucks to reduce impact noise from loading materials.
- Change backup warning devices to the least intrusive broadband type, or use backup observers as permitted by law.
- Direct generators, compressors, and other stationary equipment away from noise sensitive receptors.
- Remove debris spilled on pavement by hand and do not use scraping type equipment where practical.
- Use rubber tired equipment in lieu of track type equipment whenever possible and safe to do so.
- Limit engine idling to not more than 5 minutes when the vehicle or equipment is not directly engaged in work activity, such as on-site pickup trucks and waiting haul trucks.
- Fit equipment with high-grade engine exhaust silencers and/or engine shrouds to reduce noise emissions.
- Enclose stationary equipment such as generators, pumps, and compressors, or use noise curtains when barriers are infeasible.
- Use electric equipment in lieu of pneumatic or diesel equipment, where feasible.
- Install noise barriers to reduce or block line-of-sight to neighboring noise sensitive receptors.
- Limit the use of impact equipment to daytime hours.

The following measures would be considered by SPU to reduce operational noise impacts and may be required to meet SMC sound level limits and worker safety requirements after the project has been completed:

- Install sound traps on all odor control fan air discharges.

- Size the odor control fan discharge duct to prevent discharge airflow from exceeding 300 feet per second.
- If duct work is installed outside of a structure, use either double-walled duct or round duct.
- Install acoustical louvers on all air intakes and discharges or install sound traps as close to the wall penetrations as possible.
- Install insulated metal doors with adjustable neoprene seals on all external doors.
- Use the quietest equipment available, where feasible.
- Install acoustical panels, acoustical decking, or spray-on acoustical treatments inside structures containing loud equipment.
- Develop noise limits based on site-specific sound criteria during final design.
- Conduct additional noise analysis and identify additional measures to reduce noise as appropriate during final design.

10.9.2 Vibration

Below are possible measures that SPU would consider to reduce vibration impacts produced during construction activities. Final measures used will be determined as part of the permitting conditions established during final design.

- As needed, conduct further investigation and analysis during final design to determine the site-specific soil vibration propagation characteristics.
- Develop site-specific vibration limits during final design.
- Monitor vibration levels at receiving properties during construction.
- Develop a Vibration Control Plan including predicted vibration levels from the contractor's proposed methods and equipment, as well as any mitigation measures to satisfy the project's vibration limits.
- Offer to temporarily relocate residents during activities expected to generate prolonged vibration impacts.
- Limit the distances between vibration generating equipment and sensitive vibration receiving properties.
- Locate stationary vibration generating equipment away from vibration sensitive receptors.
- Develop site-specific vibration mitigation measures during final design.
- Conduct vibration generating activities during periods when nearby occupants may not be present (e.g., during the middle of the day near residences).

The measures provided below may reduce vibration impacts after the project has been completed.

- Assess vibration produced by equipment during final design.
- Install vibration isolation on fans, pumps, and generators, where feasible.

10.10 Unavoidable Significant Adverse Impacts

There would be no unavoidable significant impacts with regard to construction-related or operational noise or vibration. The degree of impact from nighttime construction activity at the West Portal site would depend on the duration and intensity of nighttime noise. Significant impacts could result if high noise-generating activities such as the use of impact equipment were necessary within 500 feet of residences or other sensitive uses. It has not

been determined that any such high nighttime noise activity near sensitive uses would be necessary. SPU would be required to apply for and obtain a noise variance and demonstrate what measures would be taken to minimize such impacts in its final design of the project.

Energy and Climate Change

11.1 What are the existing energy and climate change conditions in the project area?

11.1.1 Energy

The regulatory setting for energy is described in Section 4.5.1 of the 2014 Plan EIS and has not changed. Federal, state, and local regulations apply to energy consumption by buildings and infrastructure. Most of these regulations apply to occupied buildings and would not be applicable to CSO control or stormwater facilities.

Energy that powers the project area is supplied by Seattle City Light (electricity) and Puget Sound Energy (natural gas). Energy consumption by CSO control and stormwater facilities is described in Section 4.5.2.1 of the 2014 Plan EIS.

11.1.2 Climate Change

Global climate change refers to changes in average climatic conditions on Earth as a whole, including changes in temperature, wind patterns, precipitation, and storms. Gases that trap heat in the atmosphere are often called “greenhouse gases.” These gases are emitted by both natural processes and human activities.

The accumulation of greenhouse gases in the atmosphere regulates the Earth’s temperature. Emissions from human activities, such as electricity production and vehicle use, have elevated the concentration of these gases in the atmosphere, leading to higher ambient temperatures. Carbon dioxide is the most abundant greenhouse gas and the primary one emitted by the combustion of fossil fuels.

Risks from climate change are described in Section 4.5.3.1 of the 2014 Plan EIS and have not changed.

11.2 How would the project affect energy and climate change?

Energy use and greenhouse gas emissions were previously described in Sections 5.6 and 6.6 of the 2014 Plan EIS. Greenhouse gas calculations were estimated for each Long Term Control Plan option, which included numerous storage projects throughout the city. Estimated greenhouse gas emissions for the Ship Canal Project are described below.

Energy and Climate Change Key Findings

- Construction and operation of the Ship Canal Project would require the use of diesel and gasoline vehicles and equipment, which would produce greenhouse gases.
- Construction of the Ship Canal Project would produce greenhouse gas associated with embodied energy.
- Construction and operation of the Ship Canal Project would require electrical energy.
- The greenhouse gas emissions and energy consumption of the project represent a small portion of regional emissions and consumption.

11.2.1 During Construction

Construction of the Ship Canal Project would produce greenhouse gases, which contribute to climate change. Greenhouse gas production would primarily be associated with emissions from construction equipment and commuter vehicles, as well as embodied energy. “Embodied energy” is the energy necessary for the entire product lifecycle, beginning with raw material extraction and ending with deconstruction or decomposition. Construction of the Ship Canal Project would require operation of diesel-fueled equipment such as heavy trucks, bulldozers, excavators, drill rigs, cranes, and asphalt pavers, in addition to on-site diesel generators. Construction worker personal vehicles would primarily be fueled by gasoline. Both diesel and gasoline would contribute to carbon emissions, measured as carbon dioxide (CO₂) equivalents (CO₂e). CO₂e provides a universal standard of measurement against which the impacts of releasing different greenhouse gases can be evaluated.

As shown in Appendix D, during the 6- to 7-year construction period, diesel-fueled construction equipment would require an estimated 812,608 gallons of diesel fuel. Construction worker personal vehicles would consume an estimated 640,000 gallons of gasoline. The total greenhouse gas emissions from consumption of fuels during project construction would be approximately 9,786 metric tons of CO₂e. The embodied energy required for the project would add approximately 18,842 metric tons of CO₂e. Together, the total greenhouse gas emissions during construction would be an estimated approximately 35,692 metric tons of CO₂e. This impact is considered to be minor considering the total CO₂e emissions in Seattle in 2012 were 3,728,000 metric tons of CO₂e (City of Seattle, 2014). Therefore, construction of the Ship Canal Project would contribute less than 1 percent of Seattle’s annual total greenhouse gas emissions.

An estimated 35,873,760 kilowatt hours (kWh) of electricity would be required for operation of the tunnel boring machine, tunnel lighting and fans, yard lighting, and other construction equipment. This electricity use would be spread across the 2.5-year construction period of the tunnel, and the daily electric use would be a small percentage of the overall energy consumption in the region. Therefore, the impact would not be significant.

11.2.2 After Construction

Greenhouse gas emissions would be produced by SPU operations and maintenance staff vehicles and stand-by generators. The associated annual greenhouse gas emissions are an estimated 32 metric tons, which is considered minor.

Operation of the Ship Canal Project would also use electric power to run pumps and ventilation equipment. Operation of equipment could be energy intensive, but the equipment would operate infrequently, only during and after storm events. The anticipated annual electricity consumed would be approximately 2,000,000 kWh, an amount not considered significant when compared to energy use in the City of Seattle as a whole.

DNRP’s West Point Treatment Plant would receive additional sewage flows that previously were discharged to receiving water bodies. The effort to convey and treat these additional flows is expected to increase energy consumption at pump stations and the treatment plant by less than 1 percent.

The project energy requirements represent a small portion of the overall regional demand.

11.3 What measures would reduce or eliminate potential impacts associated with energy and climate change?

SPU would undertake the following measures to reduce or eliminate energy and climate change impacts:

- Incorporate specifications into construction contracts that encourage the use of fuel-efficient construction equipment.
- Minimize engine idling during construction.
- Reduce greenhouse gas emissions associated with increases in traffic congestion and idling near the construction site by moving materials via barge and rail when possible.
- Incorporate specifications into construction contracts that require use of well-maintained or newer construction vehicles to reduce vehicle emissions.
- Encourage contractors to offer carpooling options for employees.
- Comply with state and City requirements related to energy efficiency of the new CSO facilities.
- Where feasible, specify particular mixes of concrete that reduce greenhouse gas emissions.
- During design, where feasible, engineer systems that use gravity flows for stormwater conveyance in lieu of energy-intensive pumping stations.
- Design systems that minimize energy use throughout the life-cycle of the project.
- Where feasible, specify the use of more bio-degradable and biologically non-reactive chemicals as part of the tunnel boring operation.

11.4 Unavoidable Significant Adverse Impacts

There would be no unavoidable significant adverse impacts to energy or climate change.

CHAPTER 12

Cultural Resources

12.1 What are cultural resources?

Cultural resources include aboveground resources such as historic buildings and historic structures (for example, piers, canals, or bridges) and underground resources such as archaeological sites. To be considered a historic or cultural resource, a property (building, structure, or site) generally must meet minimum age requirements. However, cultural resources are not defined solely by their age but also by criteria related to their historic or cultural importance; this is known as “significance.” Significant cultural resources represent important themes, cultures, or patterns in our past. The significance of a property may be on the national, state, or local level. For this project, the criteria for evaluating the significance of a cultural resource are established by the City of Seattle’s Landmarks Preservation Ordinance (SMC 25.12).

Because construction of the proposed Ship Canal Project is expected to be underway in 2017 and continue to 2024, SPU has chosen to evaluate existing buildings in the cultural resources study area based on what their age will be in 2024. Different historic registers use different age thresholds for considering a property to be historic. Thus, properties in the study area qualifying for consideration to the National Register of Historic Places (NRHP) and Washington Heritage Register (WHR) include those constructed during or before 1974, making them 50 years old or older in 2024. Properties in the study area qualifying for consideration as a Seattle Landmark would include those buildings constructed during or before 1999, making them 25 years or older in 2024.

Cultural Resources Key Findings

The project study area is located in the Ballard, Fremont, Wallingford, and north Queen Anne neighborhoods of Seattle. The aboveground study area includes dozens of historic-age properties; two of these are considered eligible to be included on the National Register of Historic Places. The project study area is adjacent to, and overlaps, portions of three historic districts. No archaeological sites have been recorded within the study area; however, no surveys have been conducted. Archaeological monitoring is recommended for excavation in intact Holocene strata properties.

12.2 What is the project study area for cultural resources?

The Ship Canal Project is located in the Ballard, Fremont, Wallingford, and north Queen Anne neighborhoods of Seattle. The affected environment described in the 2014 Plan EIS has not changed; however, additional information is provided for portions of the project area that were not described in the 2014 Plan EIS. Two study areas for cultural resources were considered: an aboveground cultural resources study area, and a study area for archaeological resources. The study area for aboveground cultural resources includes the location of the TEPS at the West Portal site, the generator building at the East Portal site, and associated open cut excavations at each end of the storage tunnel. The study area for archaeological cultural resources is the footprint of the tunnel portals, conveyance facilities, and other near-surface impacts plus each adjacent parcel. The study area also includes the conceptual locations of the drop shafts. The storage tunnel alignment is not included in the archaeological or aboveground study areas because the proposed depth of the tunnel is within Pleistocene soils

and therefore predates human occupation of the Puget Sound region. Figures 12-1 through 12-3 illustrate the location of the study areas for cultural resources.

12.3 What is the history of the area?

Section 4.10.2 of the 2014 Plan EIS describes the history of the project vicinity. Important local historic events include the long-term Coast Salish occupation of the Salmon Bay/Lake Washington area, and the Euro-American settlement of Seattle. Archaeological sites and ethnographic records identify the project vicinity as an important location for the Duwamish, Muckleshoot, Suquamish, Tulalip, and Snoqualmie people. Local Native American place names highlight the significance of Salmon Bay, Lake Union, and associated water bodies.

Early in Seattle's history, the Lake Washington Ship Canal was an important feature of the local economy. The canal was first conceived in the 1850s by Thomas Mercer as a means to transport logs from Lake Washington to Portage Bay on Lake Union. The timber industry was central to Seattle's economy at this time. Subsequent improvements continued to widen and deepen the channel through the late 1800s. Hiram M. Chittenden advocated for further improvements to the canal in the early 1900s. Construction of the Ship Canal began in 1911, and the canal was open to boat traffic in 1917. The development of adjacent neighborhoods was concurrent with development of the canal. The growth of railroads in the 1890s, local access to water transportation, and the construction of the Lake Washington Ship Canal accelerated the area's industrial development. Early local industries included shingle mills, fishing, and ship building.

12.4 What methods were used to identify cultural resources in the project area and assess potential impacts to them?

Cultural resources analyses included a desktop review of readily available sources to identify known resources in the project area and assess the potential for encountering undocumented cultural resources. In 2014, a cultural resource reconnaissance was completed during geotechnical testing in the project area (Kelly and Amell, 2014). This reconnaissance included a review of historic properties in the vicinity of planned geotechnical tests and archaeological screening of soil sampled from geotechnical bores; no archaeological materials were identified. In 2016, archaeologists monitored additional geotechnical bores completed for the project and prepared a cultural resources assessment that included the recording of several historic-aged properties near the West and East Portals; no archaeological materials were identified (Valentino et al., in progress).

12.4.1 Historic

The analysis of historic aboveground resources focused on two datasets: (1) buildings currently listed on a historic register, and (2) buildings that meet minimum age thresholds to be considered for listing but have not yet been documented and/or evaluated for inclusion on a historic register. These datasets provide a context for aboveground resources and identify research gaps in the cultural resources study area.

Data sources included the Washington Information System for Architectural and Archaeological Records Data (WISAARD), the City of Seattle Landmarks Registry, and the King County Department of Assessment. Many historic-age properties have been identified in the vicinity of the study area, but few of the properties have been evaluated for their eligibility for inclusion on a historic register. Tax parcel records were used to identify gaps in previous cultural resources surveys. Potential impacts to previously recorded historic properties were determined through a review of project plans in relation to the location of historic-aged properties. Potential impacts were also assessed using information provided in Chapter 10, Noise and Vibration.

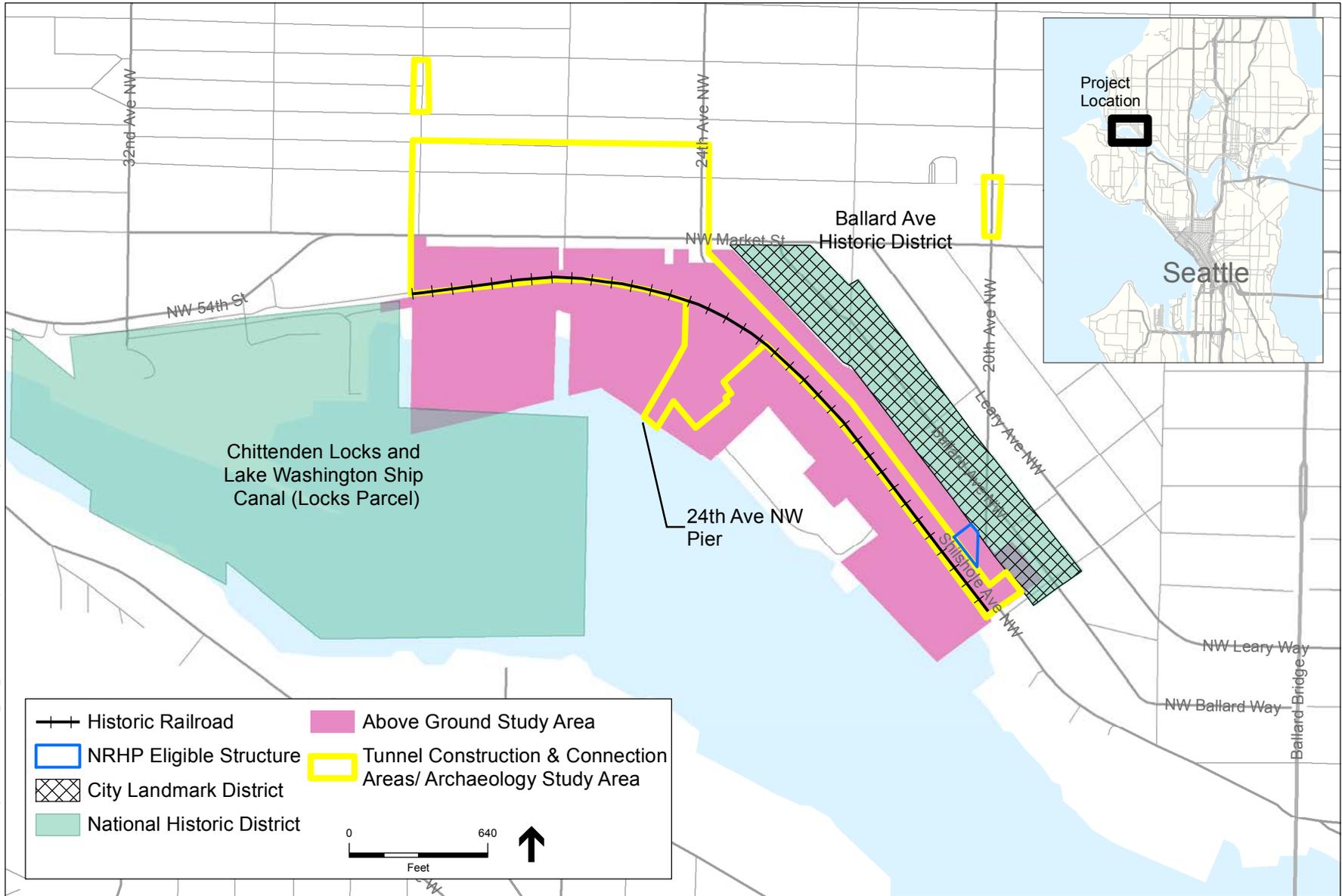


Figure 12-1 West Portal and Ballard Conveyance Study Area

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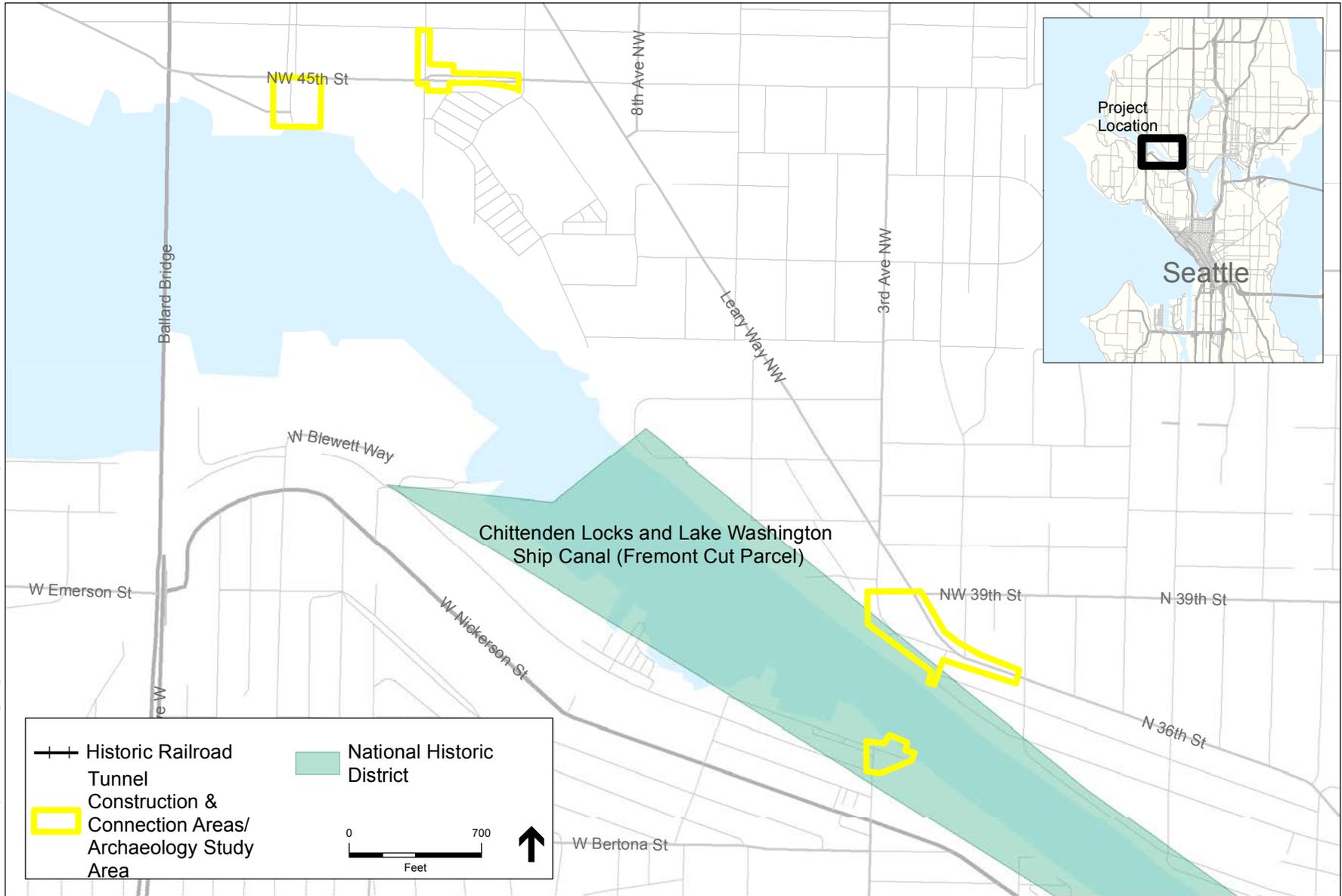


Figure 12-2 Drop Shafts and Associated Conveyance Study Area

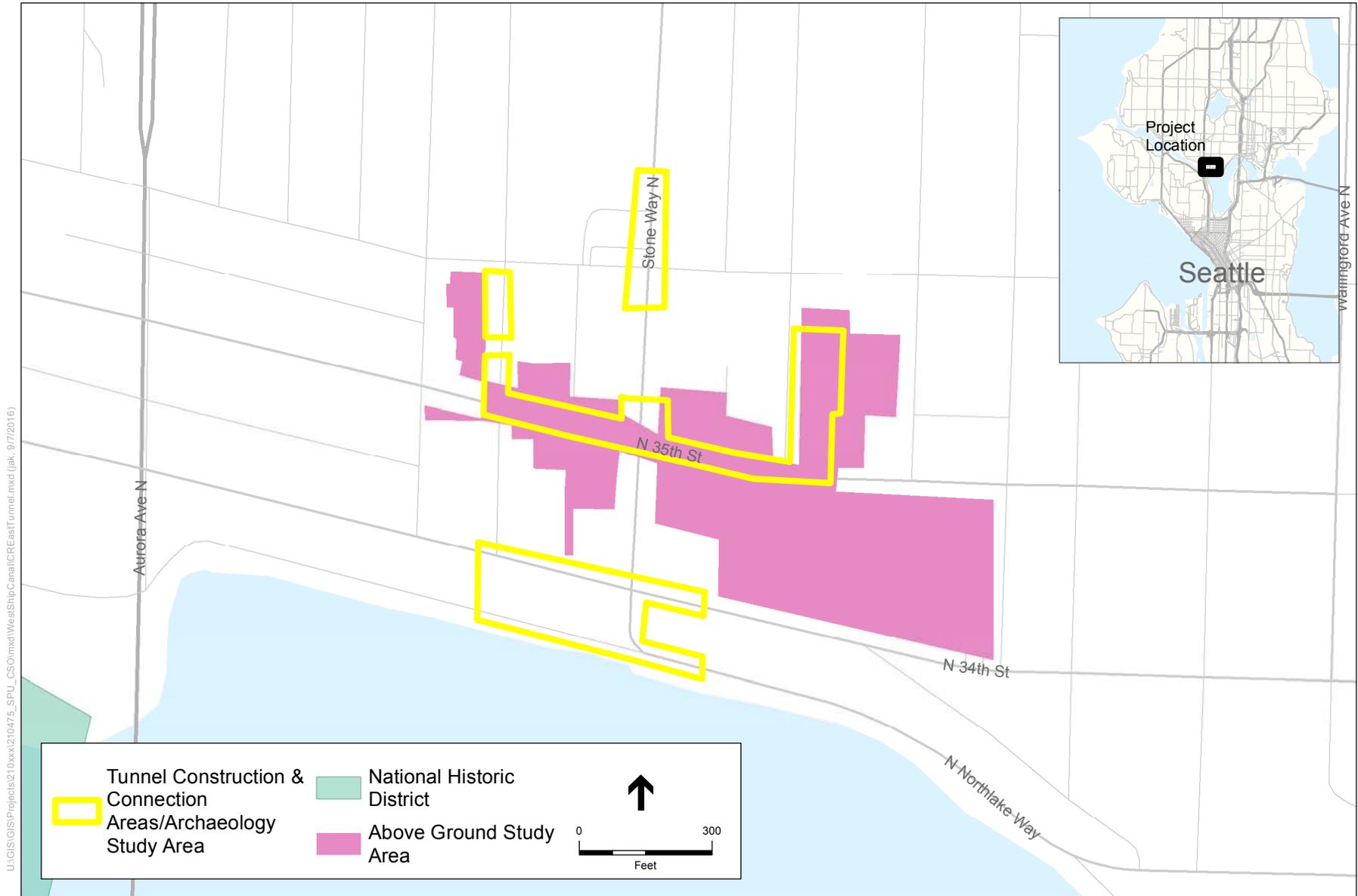


Figure 12-3 East Portal and Wallingford Conveyance Study Area

12.4.2 Archaeological Resources

The analysis of archaeological resources focused on two datasets: (1) WISAARD, and (2) previous local geotechnical analyses. The EIS team reviewed data produced in the 2014 and 2016 geotechnical investigations for this project, as well as other geotechnical analyses conducted in the project vicinity. Generally, buried cultural resources would not be expected more than 25 feet below the present-day ground surface.

12.5 What historic properties were identified in the project area?

Three previously documented historic register properties are located in the study area identified for the project. The Seattle Lake Shore & Eastern Railroad Grade (now known as the Ballard Terminal Railroad alignment) and the Stimson Lumber Company Office are both located adjacent to the West Portal construction area. The Seattle Boiler Works is adjacent to the tunnel alignment. These were each determined eligible for listing on the NRHP by the Washington State Department of Archaeology and Historic Preservation (DAHP). Several structures have been evaluated for nomination to the NRHP and were determined not eligible; these would not require consideration during the project.

The Ship Canal Project is adjacent to and overlaps portions of three historic districts: one City of Seattle historic district and two NRHP historic districts (see Figures 12-1, 12-2, and 12-3). A four-block stretch of Ballard Avenue is recorded as both a National Register Historic District (the Ballard Avenue Historic District) and as a City Landmark District (the Ballard Avenue Landmark District). The Seattle Landmarks Preservation Board treats the Ballard Avenue Historic District as an individual resource; buildings within the district are not typically nominated individually as landmarks. This differs from the management approach for NRHP historic districts, wherein buildings must first be nominated individually to the NRHP and then the district is defined to include eligible and contributing buildings. The Hiram M. Chittenden Locks and Ship Canal Historic District is an NRHP historic district that includes three parcels; the Locks Parcel and Fremont Cut Parcel overlap or are adjacent to the Ship Canal Project.

Dozens of properties in the aboveground cultural resources study area meet the minimum age threshold for inclusion on a historic register but have not been evaluated. Many of these are assumed not to meet historic register significance criteria. Unless these properties were considered eligible for inclusion on a historic register, they would not require any specific consideration or mitigation.

12.5.1 Storage Tunnel

As noted above, the storage tunnel would be bored through pre-Holocene soils that predate human occupation of the Puget Sound region. No historic properties are associated with the storage tunnel.

12.5.2 West Portal and Ballard Conveyance

The West Portal and Ballard conveyance study area is adjacent to two NRHP-eligible properties, the Stimson Lumber Company Office and the Ballard Terminal Railroad alignment. The study area is adjacent to two national historic districts and one City of Seattle landmark district: the Ballard Avenue Historic District (national) and the Hiram M. Chittenden Locks and Ship Canal Historic District (national); and the Ballard Avenue Landmark District (City). More than a dozen properties meet the minimum age threshold for listing on a historic register within this portion of the study area; those adjacent to the West Portal have been recommended not eligible for inclusion on a historic register, but no formal determination of eligibility has been made by DAHP (Valentino et al., in progress).

To comply with City of Seattle code (SMC 25.05.675.H), the City-owned public 24th Avenue NW pier, which was built in 1935 and would be directly impacted by the project, was evaluated and recommended not eligible for listing as a Seattle City Landmark. A formal determination of eligibility is forthcoming from the Seattle Department of Neighborhoods, Historic Preservation Office.

12.5.3 East Portal and Wallingford Conveyance

Eight historic-aged properties adjacent to the East Portal location were recorded and evaluated for their inclusion on a historic register—each was recommended not eligible (Valentino et al., in progress), but no formal determination of eligibility has been made by DAHP.

12.5.4 Drop Shafts and Associated Conveyance

The study area for the drop shafts and associated conveyance facilities is considered conceptual. Based on the conceptual locations, there are no recorded historic properties in this portion of the study area. Within the conceptual drop shaft and associated conveyance study area, dozens of properties meet the minimum age threshold for inclusion on a historic register, but they have not been formally evaluated. The project study area for the North 3rd Avenue/174 and South 3rd Avenue Drop Shafts overlaps the Fremont Cut Parcel portion of the Hiram M. Chittenden Locks and Ship Canal Historic District (see Figure 12-2).

12.6 What recorded and potential archaeological resources were identified in the project area?

No archaeological sites are recorded within the study area. Although no subsurface survey has been conducted in the study area, there has been archaeological monitoring of several King County wastewater facilities including the Ballard Siphon. No cultural resources were identified during monitoring activities (Lockwood and Hoyt, 2012). WISAARD includes a statewide predictive model for precontact archaeology; the archaeological study area is considered “high risk” and “very high risk” for buried cultural resources. Buried cultural resources could include precontact sites such as Native American encampments, resource procurement sites, food processing sites, or historic buried resources such as foundations, historic abandoned infrastructure, privies, and dumps. These might be present as deep as 25 feet below the present-day ground surface. A review of geological maps suggests that the tunnel itself does not have the potential to intersect cultural deposits because it would be constructed within pre-Holocene soils; however, associated near-surface utility trenching may encounter precontact resources, depending on the location.

12.7 How would the project affect cultural resources?

12.7.1 During Construction

12.7.1.1 Historic Resources

Two types of effects on register-eligible, aboveground historic properties may occur during construction: (1) physical effects; and (2) effects due to noise, dust, mud, traffic congestion, construction traffic, loss of parking, and limited access to buildings. The project could introduce increased dust, vibrations, and noise that may diminish the integrity of a property’s significant historic features in the short term. However, these are not expected to be significant impacts to historic and cultural resources.

West Portal and Ballard Conveyance. The study area overlaps with the Hiram M. Chittenden Locks and Lake Washington Ship Canal Historic District, but the district is limited to the waterway within the study area. Project activity is therefore not likely to affect this district. The 24th Avenue NW pier, a City-owned public pier, was built in

1935 and would be replaced. Because it is proposed for replacement, the pier must be reviewed for its historical significance as a Seattle Landmark by the City Historic Preservation Officer. A Seattle City Landmarks eligibility referral has been prepared for the project, and the pier was recommended as not eligible for Landmark listing (Valentino et al., in progress). A formal determination is forthcoming. Vibration from construction activities is not expected to affect historic structures within the study area.

Potentially eligible properties are located adjacent to the West Portal and Ballard conveyance facilities: the Ballard Terminal Railroad alignment and the Stimson Lumber Company Office building. Improvements to the Ballard Terminal Railroad to allow for the transportation of project spoils are not expected to cause a significant probable impact. Typically, an NRHP-eligible railroad is not considered diminished if it is expanded. Construction in the right-of-way in front of the Stimson Lumber Company Office would likely involve increased dust or vibration, but this is not anticipated to be a significant impact.

East Portal and Wallingford Conveyance. No construction impacts to historic resources are anticipated.

Drop Shafts and Associated Conveyance. This portion of the study area is considered conceptual. As conceptually defined, there could be construction impacts to the Hiram M. Chittenden Locks and Lake Washington Ship Canal Historic District from noise, dust, or vibration, but they are not expected to be significant.

12.7.1.2 Archaeological Resources

While no archaeological resources have previously been identified in the study area, if archaeological resources were identified during construction, potential impacts to archaeological resources would be permanent because it is assumed that the resources would be displaced from their context during construction. Near-surface ground disturbance that affects Holocene-aged sediments and historical fill deposits has the potential to affect archaeological resources.

Storage Tunnel. Geotechnical analyses in the project vicinity suggest that Holocene-age strata may be encountered within approximately 20 feet below the ground surface. Soils below this depth predate human occupation of the region. Tunnel boring would occur below this depth and is therefore unlikely to impact cultural resources.

West Portal and Ballard Conveyance, East Portal and Wallingford Conveyance, and Drop Shafts and Associated Conveyance. Ground disturbance has the potential to disturb, destroy, or remove precontact archaeological resources. Depending on its origin and context, overlying historic fill could contain historic archaeological resources. However, the conveyance facilities would be constructed largely in public rights-of-way in areas already disturbed by utilities and other infrastructure.

12.7.2 Operational Impacts

12.7.2.1 Historic Resources

Operational impacts to historic resources could include permanent visual impacts or operational odor, noise, or vibration. Based on preliminary design information, no significant probable operational impacts are expected to aboveground historic resources. Although there are historic-aged buildings adjacent to or across the right-of-way from all project elements, operational impacts would depend on whether the buildings are found eligible for listing and which elements contribute to their historic significance. Considering that the project will incorporate measures to reduce the potential for any off-site noise, odor, and vibration impacts, operational impacts to any nearby historic resources are not anticipated.

12.7.2.2 Archaeological Resources

Potential impacts to archaeological resources would occur during construction and are assumed to be permanent. No operational impacts to archaeological resources are expected.

12.8 What measures would reduce or eliminate potential impacts to cultural resources?

This project requires compliance with the National Historic Preservation Act of 1966 as amended (16 United States Code [U.S.C.] 470a to 470w-6). The U.S. Army Corps of Engineers is the lead federal agency for NHPA compliance. The Corps of Engineers has defined the project's Area of Potential Effects and requested the completion of a cultural resources assessment. This report, which includes geotechnical monitoring, documentation of historic structures, and background research, is in progress (Valentino et al., in progress).

12.8.1 Historic Resources

No aspect of the proposed project would require significant changes to any of the identified eligible or listed historic properties. No work is proposed within the City's Ballard Avenue Landmark District so no approvals would be required from the Special Review District Board. When the final design is prepared, any specific avoidance or minimization measures will be developed in consultation with the City of Seattle Historic Preservation Program. If required, measures might include additional survey activities or vibration monitoring.

If the footprint of the project elements changes during final design, SPU will evaluate whether any additional historic survey is required. If significant adverse impacts to the Ballard Terminal Railroad alignment or Stimson Lumber Company Office building would occur, specific mitigation measures would be developed. If the 24th Avenue NW pier is found to be eligible for Seattle Landmarks designation, specific mitigation measures for alterations to the structure would be developed.

12.8.2 Archaeological Resources

Under Revised Code of Washington Chapter 27.53, archaeological resources identified during construction would need to be evaluated. If considered significant, any impacts on archaeological resources would require mitigation that would likely entail archaeological investigation, such as excavation and analysis. At a minimum, an Archaeological Monitoring Plan and an Inadvertent Discovery Plan would be prepared in consultation with DAHP that outlines the procedures to follow if archaeological resources were identified during construction activities. SPU will continue to coordinate with DAHP as the project proceeds, to ensure compliance with applicable requirements.

12.9 Unavoidable Significant Adverse Impacts

No unavoidable significant adverse impacts to cultural resources are anticipated.

Cumulative Impacts

This chapter describes the likely level of cumulative effects associated with the Ship Canal Project, given the updates to the proposed project. In contrast to the potential direct and indirect effects described in Chapters 3 through 12, cumulative effects are those that could result from the combined incremental impacts of multiple actions over time. As described in Chapter 7 of the 2014 Plan EIS, the purpose of a cumulative effects analysis is to identify the potential for the project to contribute to these incremental impacts to a degree that, if left unmitigated, could cause them to reach significant proportions. It is also helpful for decision makers in evaluating how sustainable a proposed project is likely to be and how it might interact with other projects that are reasonably foreseeable but have not yet been built.

13.1 What are the past, present, and reasonably foreseeable projects and actions that could affect or be affected by the Ship Canal Project?

Construction of the Ship Canal Project would occur in the context of multiple private development and public infrastructure projects that are expected to be under construction or completed by the time the Ship Canal Project is constructed. These reasonably foreseeable projects and actions are largely the same as described in the 2014 Plan EIS, except that planning for the Burke-Gilman Trail Extension Project (Missing Link) has advanced, and the Nordic Heritage Museum is planning to relocate in the general Ship Canal project area. A Draft SEPA EIS was issued for the Missing Link project in June 2016 (SDOT, 2016), which has an overlapping project area in the Ballard area. All Missing Link alternatives would be in the Ballard neighborhood and overlap with Ship Canal Project components at multiple points. Although the Missing Link Project does not yet have a construction schedule, construction could occur between 2018 and 2024. This estimate suggests that Ship Canal Project construction would overlap with construction of the Burke-Gilman Trail Missing Link in the same timeframe.

In the Ballard area, the Nordic Heritage Museum is relocating to a location south of NW Market Street between 28th Avenue NW and 26th Avenue NW, with a planned opening in 2018. Construction of the conveyance facilities could potentially overlap with construction of the new museum, or could result in access issues for the newly opened facility. Other reasonably foreseeable projects in the Ballard area include a new office campus planned by C.D. Stimson Co. for a site adjacent to the West Portal along Shilshole Avenue NW. No construction dates have been identified for this project. In preparation for a potential inclusion of a Ballard light rail line in the future Sound Transit 3 ballot measure, the Ballard to Downtown Enhanced Transit Corridor project would include intelligent transportation systems in the corridor's existing transit operations and would add interim safety improvements for people who bike and walk crossing the Lake Washington Ship Canal.

In the Wallingford area, construction of SPU's North Transfer Station project was completed in late 2016, and has been a source of temporary and intermittent construction-related effects in the Wallingford neighborhood during its 2-year construction period. In the Fremont area, construction of King County DNRP's Fremont Siphon project is anticipated to continue until early 2017 in the vicinity of the North 3rd Avenue/174 Drop Shaft, but is unlikely to overlap with construction of the drop shaft.

These, and other past and present actions, including numerous private construction projects for offices, multi-unit housing, and other types of projects, have contributed to trends related to traffic congestion and delays, noise, vibration, and air quality in the project area.

13.2 How were cumulative impacts evaluated for the Ship Canal Project?

The design and construction changes relative to the 2014 Plan EIS that were considered for potential contributions to cumulative effects include the following:

- Design, construction, schedule, and location updates related to the West Portal, East Portal, drop shafts and conveyance facilities; and
- Reconstruction and barge use of the 24th Avenue NW pier.

Adverse cumulative effects would primarily be limited to temporary effects during construction of the Ship Canal Project, if construction coincides with construction of reasonably foreseeable projects in the project vicinity. Cumulative impacts are described below for Land and Shoreline Use, and Visual Quality; Recreation; Transportation; Noise and Vibration; Air Quality; Surface Water; and Fisheries and Biological Resources. No cumulative impacts were identified for Earth and Groundwater, Energy, and Cultural Resources. As described in the 2014 Plan EIS, SPU will focus on measures to minimize construction-related cumulative impacts. SPU will coordinate closely with the proponents of major projects in the project area to minimize the potential for cumulative impacts.

13.3 What are the potential cumulative impacts of the Ship Canal Project?

13.3.1 Surface Water

Construction of the Ship Canal Project, in combination with concurrent construction activities, may result in temporary adverse cumulative effects on surface water resources.

Adverse effects on surface water resources could include increased contamination of surface water that is transported to the receiving waterways and increased risk of accidental spills, which could result in surface water contamination. However, it is assumed that other reasonably foreseeable projects, like the Ship Canal Project, would all implement measures required by regulatory agencies to avoid or minimize potential adverse effects and protect water quality during construction. Thus, any cumulative effects on water quality would likely be limited to occasional exceedances of water quality standards over a prolonged period if on-site measures are not effective in containing sediments and other pollutants. The proposed project would reduce CSO discharges to the Ship Canal, to an average annual rate of no more than one overflow per year at each outfall, reducing the overall pollutant loadings from CSO discharges to the Ship Canal. Combined with other efforts to reduce pollutant loading through stormwater treatment features included in the project, the project would result in a long-term cumulative beneficial effect on water quality.

13.3.2 Air Quality

Construction of the Ship Canal Project, in combination with concurrent construction activities of reasonably foreseeable projects, may result in adverse cumulative effects on air quality during the construction period. The potential for cumulative effects on air quality depends on the proximity to the construction work zone. Some air pollutants, such as ozone precursors (reactive organic gases and nitrogen oxides), have a rather large region of influence due to the timeframe in which atmospheric chemical reactions take place. Other pollutants such as

carbon monoxide and directly emitted particulate matter have a more localized region of influence because they are emitted fully formed and disperse with increasing distance from the emissions source.

The projects with the greatest potential for localized cumulative effects on air quality in combination with the Ship Canal Project are the Burke-Gilman Trail Missing Link project and numerous private development and redevelopment projects in the project vicinity, including the future C.D. Simpson Co. office campus project. Overlapping construction activities in the Ballard area from construction at the West Portal and for Ballard conveyance facilities (for the Ship Canal Project), and these other reasonably foreseeable projects may contribute to temporarily increased amounts of fugitive dust, carbon monoxide, and particulate matter in the area. These overlaps are likely to increase traffic congestion in the project area and cause local, cumulative adverse effects on air quality relating to vehicle emissions and dust.

Construction traffic management plans for the project would include measures to help offset cumulative effects of construction on air quality and would include coordination with other major projects in the project area. With the odor control measures included in the Ship Canal Project, the project would result in no long-term adverse cumulative effects on air quality; therefore, no additional measures are recommended.

13.3.3 Fisheries and Biological Resources

While no reasonably foreseeable projects have been identified in Salmon Bay near the proposed in-water work at the 24th Avenue NW pier, other public or private projects could potentially occur concurrent with this activity. If there were concurrent construction, the cumulative effects on water quality in Salmon Bay, and therefore on fisheries and other aquatic resources, could consist of occasional temporary exceedances of water quality standards over the concurrent construction period. This would be more likely to occur if on-site best practices are not effective in containing sediments and other pollutants.

Following tunnel construction, the reconstructed 24th Avenue NW pier would result in the same or slightly less overwater coverage compared to the existing pier. As a result, there would be no measurable cumulative effect on the shoreline migratory corridor for juvenile salmon and other aquatic animals.

13.3.4 Land and Shoreline Use/Visual Quality

Adverse cumulative effects associated with land use, shorelines, and visual quality would be limited to effects during construction of the Ship Canal Project, if the construction timeframe coincides with construction of other private and public projects in the project area. In the Ballard area, cumulative impacts to land use associated with reduced or restricted access and construction-related noise and dust could result from successive work in the road or right-of-way of Shilshole Avenue NW or other roads in the project area, overlapping or successive construction activities and construction truck trips in the same area, and easement acquisition in the same area for both the Burke-Gilman Trail Missing Link and the Ship Canal Project. SPU and SDOT would coordinate activities to minimize disruptions. With effective coordination, cumulative impacts to land use are not anticipated to be significant.

The cumulative effects of the updates to design, construction, and location of project components on visual quality, in combination with concurrent construction activities, are likely to be very similar to those described in the 2014 Plan EIS. While the location of certain construction activities along public rights-of-way, parks, and the Ship Canal may expose a larger population of viewers to the visual clutter for construction activities, all effects would be temporary and would cease at the end of construction. The project changes related to the construction schedule would extend the timing of construction-related effects, particularly at the West Portal, but would not change their intensity. Therefore, there would be no change to the cumulative effects to land use, shorelines, and visual quality described in the 2014 Plan EIS. Since the Ship Canal Project would have only minor long-term

adverse impacts to land use, shorelines, and visual quality, all cumulative impacts would be limited to the 6- to 7-year construction period.

13.3.5 Recreation

Adverse cumulative effects associated with recreation would be limited to effects during construction of the Ship Canal Project, if the construction timeframe coincides with construction of other private and public projects in the project area. Concurrent construction of the Burke-Gilman Missing Link project and the Ship Canal Project could disrupt bicycling, walking, and other recreational use of roads and rights-of-way in Ballard and disrupt access to recreational sites. SPU and SDOT would coordinate to reduce impacts to project schedules and recreationists. Since the Ship Canal Project would have no long-term adverse impacts to recreation and the Missing Link project would have a positive long-term impact to recreation, all cumulative impacts to recreation would be limited to the construction period.

13.3.6 Transportation

Adverse cumulative effects associated with transportation would be limited to effects during construction of the Ship Canal Project, if the construction timeframe coincides with the construction of other private and public projects in the project area. The Ship Canal Project would need to be coordinated with the Burke-Gilman Trail Missing Link project, because they have potentially overlapping schedules and study areas, including segments of Shilshole Avenue NW, NW 54th Street, 28th Avenue NW, NW Market Street, 11th Avenue NW, and NW 45th Street. Construction of the new Nordic Heritage Museum between 28th Avenue NW and 26th Avenue NW in 2017 could also overlap with some conveyance facility construction. If construction occurs concurrently, congestion would increase during this period, as would travel times due to road closures and detours. In addition, construction of the Ship Canal Project components would occur in the context of multiple private development and public infrastructure projects throughout the project area that are expected to be under construction or completed by the time the Ship Canal Project is constructed. The combined effect would likely increase traffic congestion, and increase travel times due to the number of lane closures, detours, or delay on streets within the project vicinity.

The East Portal site is located adjacent to a school and a residential area, where maintaining access and parking availability are concerns. While no major reasonably foreseeable projects have been identified for this area that would occur during the time of East Portal construction activity, the neighborhood recently experienced effects from the construction of the North Transfer Station and has expressed concerns about “construction fatigue” associated with major construction projects. While the construction of the East Portal will occur approximately 2 years after completion of the Transfer Station, many residents will likely view this as a continued disruption in their neighborhood.

As described in the 2014 Plan EIS, SPU will focus on measures to minimize construction-related cumulative impacts, including measures to reduce noise, dust, and traffic that could affect quality of life and land use. SPU will continue to coordinate with SDOT, local businesses, and neighborhoods to coordinate construction sequencing between projects.

13.3.7 Noise and Vibration

Adverse cumulative effects associated with noise and vibration would be limited to effects during construction of the Ship Canal Project, if the construction timeframe coincides with construction of other private and public projects in the project area. Concurrent construction projects could increase the amount of noise and extend the duration over which some receptors are exposed to construction-related noise. Residential areas near the Ballard conveyance facilities and near the East Portal and Wallingford conveyance facilities have the greatest potential

for experiencing intermittent and temporary cumulative impacts, should there be concurrent construction projects. The construction activities associated with the Ship Canal Project and other nearby projects would be temporary and periodic; therefore, they would not constitute long-term incremental increases in the overall noise environment. However, the increase above existing sound levels would result in noticeable and potentially bothersome noise impacts at nearby residential properties.

The East Portal site is adjacent to a school and a residential area, where noise and vibration levels are a concern. While no major reasonably foreseeable projects have been identified for this area that would occur during the time of East Portal construction, the neighborhood recently experienced effects from the construction of the North Transfer Station. As previously noted, SPU will work with stakeholders to reduce construction-related noise impacts.

CHAPTER 14

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CHAPTER 15

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Appendix A

Draft Supplemental EIS Comments and Responses

From: [Church, Dave](#)
To: [Meyer, Betty](#)
Cc: [Whitehead, Melanie](#)
Subject: Comment regarding Ship Canal Water Quality Project
Date: Tuesday, September 27, 2016 11:12:10 AM
Attachments: [Ship Canal Water Quality Draft EIS 49.pdf](#)

Hi Betty,

First, a thank you to Seattle Public Utilities (and King County Department of Natural Resources and Parks) for the past in-person briefings regarding this project. We received the Notice of Availability for the Draft EIS for the project and have reviewed the document as it relates to Seattle Pacific University. We appreciate being kept up to speed as the design and engineering evolves. During this comment period, I want to restate our concerns:

- 1-1
 - The north driveway to our athletic complex, Royal Brougham Pavilion (RBP), must be kept open at all times during construction (plating and providing temporary pathway is acceptable). If the speedbump at the north parking lot entry to RBP is impacted, it will need to be restored. We have easily suffered flooding via the City sewer system overflowing.
 - It's helpful if the construction at 3rd and Ewing, near the Royal Brougham Pavilion Parking lot, occurs over a summer break. If an academic quarter was to be encroached upon by construction at that location, I would prefer it be in the Spring vs. Fall.
- 1-2
 - Our Crew Program needs access to be maintained between RBP and our Crew Dock on the LWSC. We note that your documents include RBP and Wallace Field as recreation facilities adjacent to the planned South 3rd Avenue Drop Shaft, but the Crew Dock is not specifically mentioned.
- 1-3
 - Efforts to minimize noise and vibration need to be made during construction. The University's Physics and Electrical Engineering program is housed adjacent to the project in Otto Miller Hall located at 3469 3rd Avenue West.
- 1-4
 - The 100 anticipated truck trips on the south side of the canal are concerning to the University. 3rd Avenue West and W. Nickerson and the ship canal bike trail traffic will all be impacted. This area is already significantly challenging to navigate and both vehicle and pedestrian traffic backs up (suffers delays and congestion). Roughly a quarter of the University's classroom stock is north of Nickerson. Flaggers will be needed to ensure safe pedestrian passage through this area during construction. To the best degree possible, off peak hours should be used for truck trips. Staging of trucks should not occur adjacent to campus. The on and off street parking within the University's Major Intuition Overlay does not contain enough parking supply, and any parking removed will push vehicles into the adjacent single family neighborhoods – assuredly generating complaints for both the City and the University.
- 1-5
 - Frequent communication with the University during construction will be needed to mitigate impacts.
 - The University has privately owned utilities in the vicinity of the work area. Care needs to be taken to not disturb them.
 - I can see that the project timeline is currently 2017 – 2024. It would be great to understand

1-5 | when the work will occur that will be adjacent to the University.

I look forward to continued conversation as this project progresses.

Best,

Dave

Dave Church

Assistant Vice President for Facility Management

Seattle Pacific University

3307 Third Avenue West, Suite 311

Seattle, WA 98119

[Office] 206-281-2602 | [Fax] X2737 | [Cell] 206-799-4169

Response to Comment 1-1

Comment noted. Transportation impacts are described in Chapter 9 of the Draft Supplemental EIS. SPU will coordinate with Seattle Pacific University to accommodate the academic calendar as much as possible, and to ensure that driveways impacted by construction would remain passable unless access can be provided by an alternative driveway on the property.

Response to Comment 1-2

The Crew Dock has been added as a recreation facility in Chapter 8. SPU will coordinate with Seattle Pacific University to ensure that access for crew is maintained.

Response to Comment 1-3

The discussion of Noise and Vibration in Chapter 10 noted vibration-sensitive equipment in Otto Miller Hall, and the University's Physics and Electrical Engineering program has been added to the discussion. SPU will coordinate closely with Seattle Pacific University to reduce potential noise and vibration impacts to campus facilities.

Response to Comment 1-4

Comment noted. Transportation impacts are described in Chapter 9 of the Draft Supplemental EIS. Mitigation measures will be instituted to reduce the impact of truck trips along the transportation routes of the project, to the extent practicable. SPU will comply with all permit requirements included in the SDOT Street Use Permit, and will coordinate with Seattle Pacific University to reduce potential impacts to University students and staff.

Response to Comment 1-5

Comment noted. SPU will coordinate with the University and other affected stakeholders throughout the construction process to reduce potential impacts and ensure that mitigation measures are implemented in accordance with SDOT permit requirements. As the design process proceeds and the construction schedule is determined, SPU will coordinate with the University regarding construction in the vicinity of the University, and any University-owned utilities.



City of Seattle
Seattle Parks and Recreation

October 13, 2012

Betty Meyer, SEPA Responsible Official
Seattle Public Utilities
Seattle Municipal Tower, Suite 4900
P.O. Box 34018
Seattle, WA 98124-4018

Sent via e-mail: betty.meyer@seattle.gov

Re: Ship Canal Water Quality Project – Draft Supplemental EIS Comments

Seattle Parks and Recreation (SPR) appreciates the opportunity to provide comments on Seattle Public Utilities’ Ship Canal Water Quality Project - Draft Supplemental Environmental Impact Statement (DSEIS). SPR recognizes the necessity of the proposed water quality project and the benefits provided to the City upon the project’s completion. That said, SPR has concerns related to the potential impacts to park users during the construction of the project. The DSEIS notes potential disruption and/or occupation of the following parks/public access points during construction:

2-1

- 24th Avenue NW Pier - SDOT
- 20th Avenue NW Pier - SDOT
- 14th Avenue NW Boat Ramp – SPR owned/managed
- Burke-Gilman Trail - SPR owned/managed
- Fremont Canal Park - SPR owned/managed
- West Ewing Mini-Park - SPR owned/managed

SPR’s central concern is that adequate notice be provided to recreational users and that safe detour route(s) be identified and legible. SPR understands the challenges of undertaking a large construction project in a dense urban environment however, the safety of park users should be paramount. In addition, any work that occurs on SPR owned property must first be approved by SPR through the Revocable Use Permit (RUP) process. Information about the RUP process can be found here: <http://www.seattle.gov/parks/reserve/non-park-use-of-parks-property-permits>

While the proposed project will be beneficial to the city, the construction activities constitute a non-park use of park property and must be authorized prior to the commencement of any activities on SPR property.

2-2

2-2

SPR looks forward to working cooperatively with Seattle Public Utilities throughout the process to ensure that the construction can be completed in a timely manner in a way that minimizes impacts to recreational users. Thank you for your consideration of these comments as you move forward. If you have any questions regarding these comments, please contact me at 206.684.7048 or david.graves@seattle.gov.

Regards,



David Graves, AICP
Senior Planner
Planning & Development Division
Seattle Parks & Recreation

Cc: Michael Shiosaki, Planning & Development Division Director
Max Jacobs, Property & Acquisitions Manager

Response to Comment 2-1

Comment noted. Impacts to recreation are discussed in Chapter 8 of the Draft Supplemental EIS. Additionally, Sections 5.10.5 and 6.10.4 of the 2014 Plan EIS include a discussion of the mitigation measures that would be implemented to reduce the impacts to recreation. These measures include providing advance notice to stakeholders and the placement of signs throughout the project area. SPU will coordinate closely with SPR to ensure that its concerns are incorporated into the project design and construction. SPU will coordinate with SPR to ensure that the notice provided is sufficient to direct recreational users to safe detour routes, and is committed to ensuring the safety of park users throughout project construction.

Response to Comment 2-2

A discussion of the RUP process has been added to Chapter 8. SPU is committed to working cooperatively with SPR throughout the project design and construction process.

#p00p



Protecting Seattle's Waterways

Ship Canal Water Quality Project Comment Form

Seattle Public Utilities and King County are working together on the [Ship Canal Water Quality Project](#) to build an underground storage tunnel. During storms, this tunnel will hold polluted water from Ballard, Fremont, Wallingford, and north Queen Anne, preventing it from overflowing into the Lake Washington Ship Canal. As the lead agency, SPU is preparing a project-level Supplemental Environmental Impact Statement (EIS) to better understand how the project will affect the environment and community.

Background

Last year, SPU completed a comprehensive long-range plan to reduce sewage overflows and stormwater pollution. The Plan to Protect Seattle's Waterways programmatic environmental impact statement (EIS) is available online at www.seattle.gov/CSO. The Ship Canal Project was evaluated in the Plan and is one of the first projects moving forward. The supplemental EIS will expand upon the programmatic EIS to address new and changed project-level effects.



What is Scoping?

SPU is seeking public input on the range or "scope" of potential environmental effects to study in the supplemental EIS, as required by the State Environmental Policy Act. SPU plans to study new and updated information, in the following elements:

- Earth and Groundwater
- Surface Water
- Air Quality and Odors
- Biological Resources
- Land and Shoreline Use/Visual Quality
- Recreation
- Transportation
- Noise and Vibration
- Energy and Climate Change
- Cultural Resources

Please review the scoping notice at www.seattle.gov/util/shipcanalproject and share your comments below.

**What environmental, community or neighborhood issues are most important to you?
Are there any other issues we should consider?**

3-1

This project will include significant construction adjacent to the shoreline at waterway 22 (just south of the intersection of stone way and 34th). There have been multiple community-oriented proposals to improve the shoreline and sidewalks around waterway 22 - one specific proposal was recently awarded a grant from Seattle Department of Neighborhoods. Since the construction of the SCWQP will negatively impact ~~waterway~~ waterway 22, we request that mitigation funds be devoted to protecting waterway 22 or to investing in improvements to a public ~~space~~ space at waterway 22. In sum, the project (SCWQP) should include the creation of a small public space (eg park) at waterway 22.

Do you have any other comments or questions for the project team?

Please submit comments by August 24, 2015

- Learn more online at: www.seattle.gov/util/shipcanalproject
- Submit scoping comments by email to betty.meyer@seattle.gov or mail, using this self-addressed form

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SEATTLE PUBLIC UTILITIES
ATTENTION: BETTY MEYER, SEPA RESPONSIBLE OFFICIAL
SEATTLE MUNICIPAL TOWER, SUITE 4900
P.O. BOX 34018
SEATTLE, WA 98124-4018

..... FOLD HERE

Would you like to receive future project information? Yes / No (circle one)

Email: reid.haefer@gmail.com

Name: Reid Haefer

Neighborhood: Wallingford Organization (if applicable) Friends of North Lake Union (FOLU)

Address: 1409 N. 45th St #302

City / State / Zip: Seattle WA 98103

Response to Comment 3-1

SPU is committed to maintaining beneficial uses within the Ship Canal Water Quality Project area, and will restore areas disturbed by construction to the extent possible. SPU does not have the authority to create a park within the city; however, SPU will coordinate with the Department of Parks and Recreation during project construction to reduce potential impacts to community parks.

Do you have any other comments or questions for the project team?

Please submit comments by August 24, 2015

- Learn more online at: www.seattle.gov/util/shipcanalproject
- Submit scoping comments by email to betty.meyer@seattle.gov or mail, using this self-addressed form

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P.O. BOX 34018
SEATTLE, WA 98124-4018

..... FOLD HERE

Would you like to receive future project information? Yes / No (circle one)

Email: _____

Name: _____

Neighborhood: _____ Organization (if applicable) _____

Address: _____

City / State / Zip: _____

Response to Comment 4-1

Comment noted. As described in the response to Comment 3-1, SPU will coordinate with the Department of Parks and Recreation to reduce impacts to community parks, and to mitigate impacts in accordance with applicable permit requirements.



Ship Canal Water Quality Project Comment Form

Seattle Public Utilities and King County are working together on the [Ship Canal Water Quality Project](#) to build an underground storage tunnel. During storms, this tunnel will hold polluted water from Ballard, Fremont, Wallingford, and north Queen Anne, preventing it from overflowing into the Lake Washington Ship Canal. As the lead agency, SPU is preparing a project-level Supplemental Environmental Impact Statement (EIS) to better understand how the project will affect the environment and community.

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- Surface Water
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- Biological Resources
- Land and Shoreline Use/Visual Quality
- Recreation
- Transportation
- Noise and Vibration
- Energy and Climate Change
- Cultural Resources

Please review the scoping notice at www.seattle.gov/util/shipcanalproject and share your comments below.

**What environmental, community or neighborhood issues are most important to you?
Are there any other issues we should consider?**

5-1 [① Soil Remediation at 3500 Wallingford Site. Since a preschool with very young children abuts the property, please provide assurances that high standards are followed regarding air quality. Please ensure that during soil remediation, there is no risk to young children with potential hazardous air particles.

5-2 [② The project has conducted work on weekends to minimize noise for school. We appreciate this thoughtful consideration but as long as work does not pose an environmental hazard to young children, you may do work during school week. Our children love to watch construction and machine work and we do not mind the "noise."

Do you have any other comments or questions for the project team?

5-3

③ As mentioned at previous community meetings, we are concerned about disposition of surplus property upon completion of project. We join the rest of our neighbors in supporting a public use of "surplus" property which serves our community.

Thank you,

Teresa Donovan
School Administrator
Fremont Community School
admin@fremontcommunityschool.org

Please submit comments by August 24, 2015

- Learn more online at: www.seattle.gov/util/shipcanalproject
- Submit scoping comments by email to betty.meyer@seattle.gov or mail, using this self-addressed form

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SEATTLE MUNICIPAL TOWER, SUITE 4900
P.O. BOX 34018
SEATTLE, WA 98124-4018

..... FOLD HERE

Would you like to receive future project information? Yes / No (circle one)

Email: _____

Name: _____

Neighborhood: _____ Organization (if applicable) _____

Address: _____

City / State / Zip: _____

Response to Comment 5-1

Additional information on the handling of contaminated sediments has been added to Chapter 3, Earth and Groundwater. In addition, a discussion of the potential air quality impacts from airborne particulates associated with soil remediation has been added to Chapter 5. SPU will comply with all applicable regulatory requirements associated with handling of contaminated soils within the project site, including consideration of potential airborne contaminants.

Response to Comment 5-2

Comment noted. SPU will coordinate with the Fremont Community School and other stakeholders during the construction process.

Response to Comment 5-3

Comment noted. Impacts to Land Use are covered in Chapter 7 of the Draft Supplemental EIS. SPU currently leases the East Portal site from the City of Seattle Finance and Administrative Services (FAS). Following construction, jurisdiction for a small area of the site needed for permanent operation of the facility will be transferred from FAS to SPU. The land whose jurisdiction is not transferred would remain under FAS jurisdiction following construction. The use of any property not needed for permanent SPU facilities would be decided by FAS on a case-by-case basis following project completion in 2025. SPU would not be part of that decision-making process.



Allyson Brooks Ph.D., Director
State Historic Preservation Officer

October 24, 2016

Mr. Betty Meyer
SEPA Responsible Official
City of Seattle - Public Utilities
Seattle Municipal Tower
PO Box 34018
Seattle, WA34018

In future correspondence please refer to:
Project Tracking Code: 2016-05-03344
Property: Seattle Public Utilities Ship Canal Water Quality Project
Re: More Information Needed

Dear Mr. Meyer:

Thank you for contacting the Washington State Historic Preservation Officer (SHPO) and Department of Archaeology and Historic Preservation (DAHP) regarding the above referenced proposal. In response, we have reviewed the materials you provided for this project. The project area has a high probability for containing both historic and precontact archaeological resources. In order to complete our review we request the following information be provided to our office:

- The 2014 and 2016 complete cultural resources reports.

Thank you for the opportunity to comment and we look forward to receiving the cultural resources reports so we can complete our review. Should you have any questions, please feel free to contact me.

Sincerely,

Gretchen Kaehler
Assistant State Archaeologist, Local Governments
(360) 586-3088
gretchen.kaehler@dahp.wa.gov

cc. Dennis Lewarch, THPO, Suquamish Tribe
Richard Young, Cultural Resources Director, Tulalip Tribe
Laura Murphy, Archaeologist, Muckleshoot Tribe
Cecile Hansen, Chair, Duwamish



Response to Comment 6-1

Comment noted. The requested reports have been forwarded to DAHP.

From: [Donna Kostka](#)
To: [Meyer, Betty](#)
Cc: [Glowacki, Margaret](#); [DeCaro, Barbara](#); ["Anderson, Chris"](#); ["Atkins, Kathleen"](#); ["Carpine, Heidi"](#); ["Friesen, Walter"](#); ["Jacobsen, Debbie"](#); [Mirabella, J Edward](#); [Adams Betty](#); ["Master, Marla"](#); ["Mike Marsh"](#)
Subject: RE: HHH comments on Ship Canal draft EIS
Date: Monday, October 24, 2016 8:46:45 AM

Betty – Below are HHH’s comments I mistakenly sent to Edward Mirabella.
Please confirm receipt and add to the public record. Thanks, Donna for Heron
Habitat Helpers (HHH)

Donna Kostka, PhD
Artist, Naturalist
450 NE 100th St, #811
Seattle, WA 98125
Donna4510@comcast.net
206-283-7805

From: Mirabella, J_Edward [mailto:J.Edward.Mirabella@Seattle.Gov]
Sent: Monday, October 24, 2016 6:42 AM
To: Donna Kostka
Cc: Glowacki, Margaret; DeCaro, Barbara; Anderson, Chris; Atkins, Kathleen; Carpine, Heidi; Friesen, Walter; Jacobsen, Debbie; Master, Marla; Mike Marsh
Subject: RE: HHH comments on Ship Canal draft EIS

Hi Donna,

Thank you for your input. All comments on the draft SEIS for the Ship Canal Water Quality Project need to be addressed to:

By Mail: Seattle Public Utilities, Attention: Betty Meyer, SEPA Responsible Official, P.O. Box 34018, Seattle, WA 98124-4018

Or by E-Mail: betty.meyer@seattle.gov

Could you please forward your comments to Betty. Comments are due October 24, 2016.

Thank you.

Ed Mirabella
Ship Canal Water Quality Project
Seattle Public Utilities
700 5th Ave. Suite 4900
P O Box 34018
Seattle, WA 98124-4018

Phone (206) 684-5959

Email" J.Edward.Mirabella@seattle.gov

From: Donna Kostka [<mailto:donna4510@comcast.net>]

Sent: Friday, October 21, 2016 12:27 PM

To: Mirabella, J_Edward <J.Edward.Mirabella@Seattle.Gov>

Cc: Glowacki, Margaret <Margaret.Glowacki@seattle.gov>; DeCaro, Barbara <Barbara.DeCaro@seattle.gov>; Anderson, Chris <christopher.anderson@dfw.wa.gov>; Atkins, Kathleen <kathleea1@comcast.net>; Carpine, Heidi <heidicarpine@comcast.net>; Friesen, Walter <friesenipa@gmail.com>; Jacobsen, Debbie <dajacobsen@comcast.net>; Kostka, Donna <donna4510@comcast.net>; Master, Marla <marla@masterdesign.ca>; Mike Marsh <swamp@blarg.net>

Subject: HHH comments on Ship Canal draft EIS

Importance: High

RE: Ship Canal Water Quality Project Draft EIS

Dear Mr. Mirabella:

The Ship Canal Water Quality Project Draft EIS has a serious omission. As members of the board of Heron Habitat Helpers (HHH), we would like to bring this omission to your attention. Please confirm receipt of this message and add these comments to the public record. Your omission involves an inadequacy in Chapter 6 addressing fishery and biological resources.

The defined project location covers the Ship Canal on its north side from Ballard through Fremont to Wallingford and on the south side for north Queen Anne. It does not cover Magnolia.

In Magnolia, about one-half mile west of the West Portal of the project (at 24th Ave NW and Shilshole Ave NW) is located the largest nesting colony of Great Blue Herons (GBH) in the City of Seattle. In this 2016 nesting season there were 60 nests in Commodore Park, on the south side of the U.S. Corps of Engineers Locks. Staging began in January, and the last chicks did not fledge until August.

7-1

The GBH is a protected species in the state of Washington. The Seattle Department of Construction and Inspections is in the process of updating its Director's Rule 5-2007 to improve protections for this species. These improved protections would include controlling the timing of loud noises such as pile driving during the nesting season. The West Portal if not more of the project could fall within the protected area.

By our calculations, the west portal is approximately 900 meters from the center of the colony's staging area. Control of noise and soil vibration from pile driving would be necessary the first four months of each year, January through April, to ensure no disturbance to GBH staging. Your draft EIS says you would notify Parks when their facilities need to be closed. However, we are sure you appreciate the herons have their own schedule, so the City will have to schedule its noisy activities around the herons.

7-2

Our HHH group is the official adopt-a-park steward for the colony. We watch over Commodore Park and Kiwanis Memorial Preserve Park – sites of Seattle's first and only official "wildlife sanctuary." Our mission includes monitoring the GBH nesting activity, improving habitat, raising funds, serving as a watchdog for governmental and private construction projects, and building public support.

We have not yet seen a final version of the updated Director's Rule, as it is in process. But, please contact Margaret Glowacki of DCI for its current status. Contact Barbara DeCaro of Seattle Parks and Recreation for information on Commodore Park and the colony. Contact Chris Anderson of the Department of Fish and Wildlife for the state's policies.

And, most important, include Magnolia and its GBH colony in the project area.

-
Thank you for this opportunity to comment.

HHH Board

Kathleen Atkins, Heidi Carpine, Walter Friesen, Debbie Jacobsen, Donna Kostka,
Mike Marsh, Marla Master

Cc:

Margaret.glowacki@seattle.gov

Barbara.decaro@seattle.gov

Christopher.anderson@dfw.wa.gov

Donna Kostka, PhD
Artist, Naturalist
450 NE 100th St, #811
Seattle, WA 98125
Donna4510@comcast.net
206-283-7805

Response to Comment 7-1

Magnolia and Commodore Park were not included in the study area of the Draft Supplemental EIS because no construction impacts were anticipated in those areas. Information about the great blue heron colony in Commodore Park and the City of Seattle's great blue heron management buffers have been added to Section 6.1 of the Final Supplemental EIS, and information on construction impacts has been added to Section 6.2.1.1.

Response to Comment 7-2

Analysis of the potential impacts to the great blue heron nesting colony at Commodore Park has been added to Section 6.2.1.1 of the Final Supplemental EIS. The analysis concludes that the closest construction is outside the existing and proposed management buffers established by the City of Seattle and also outside the larger buffers recommended by WDFW. Therefore, no significant impacts to the colony are anticipated. A discussion of Director's Rule 5-2007 (Great Blue Heron Management Plan) and the proposed updates has been added to Chapter 6. SPU will coordinate with SDCI to ensure the project is in compliance with the updated Director's Rule once it becomes effective. SPU will provide public notification of all construction activity, and will comply with all applicable permit requirements during construction, to minimize potential impacts to wildlife, including great blue herons.

From: Karen Walter [<mailto:KWalter@muckleshoot.nsn.us>]
Sent: Monday, October 24, 2016 2:11 PM
To: Meyer, Betty <Betty.Meyer@seattle.gov>
Cc: Fernandez, Richard <Richard.Fernandez@seattle.gov>; Iwasaki, Karen <Karen.Iwasaki@seattle.gov>
Subject: Ship Canal Water Quality Project, Draft Supplemental EIS comments

Betty,

Our Habitat Program staff have reviewed the Draft Supplemental Environmental Impact Statement (DSEIS) for the Seattle Public Utilities Ship Canal Water Quality Project. We offer the following comments in the interest of protecting and restoring the Tribe's treaty-protected fisheries resources:

8-1 [Scoping Comments-Tribal Fishing
Thank you for including and responding to our scoping comments in the DSEIS. We have started our discussions with SPU staff regarding potential impacts to fisheries resources and Muckleshoot Tribal fishing activities in conjunction with the 24th Ave NW pier and CSO 150/151 replacement project, one of the Ship Canal Water Quality project components. As noted in the SDEIS, we will be continuing these discussions regarding potential impacts and mitigation measures necessary to address the Tribe's fisheries resources concerns through the US Army Corps of Engineers' permitting process which has been initiated.

8-2 [Additional environmental impact to salmon resources not considered in SDEIS
The SDEIS lacks discussion about potential artificial lighting impacts to juvenile salmon during construction and post-project as they outmigrate through past the 24th Avenue NW pier and West Portal project area. Current artificial lighting conditions can cause migratory delays for juvenile salmon, leading to increased predation risks. These impacts could be substantial as the in-water construction is proposed for at least 2 years in an area where juvenile Chinook may hold for extended periods (see Mark Celedonia et al 2011 power point, attached, as well as other studies from US Fish and Wildlife Service conducted in the Lake Washington and Ship Canal system).

The SFEIS needs to fully discuss potential impacts from artificial lighting during construction and how the project will seek to avoid and minimize these impacts. The SFEIS also needs to discuss how the permanent pier at 24th Ave NW and the West Portal site will avoid nighttime lighting with the permanent facilities.

We appreciate the opportunity to comment on this proposal and look forward to continue working with SPU on this project. Please let me know if you have any questions.

Thank you,
Karen Walter
Watersheds and Land Use Team Leader

*Muckleshoot Indian Tribe Fisheries Division
Habitat Program
39015 172nd Ave SE
Auburn, WA 98092
253-876-3116*

Response to Comment 8-1

Comment noted. SPU is committed to coordinating with tribal representatives throughout the process.

Response to Comment 8-2

A discussion of potential lighting impacts to fisheries resources has been added to Chapter 6. SPU will implement mitigation measures to reduce these impacts, as described in Chapter 6 of the Final Supplemental EIS.

1 your name, and be prepared to come up when it's your turn.

2 I'm going to turn the podium here so you actually
3 are speaking to our listeners here, Betty and Ed, and you
4 can also see the light. I'll put the microphone up here.

5 All right. So our first speaker will be John
6 Chaney, followed by Robert Olander.

7 So John, if you could come up, and please state your
8 name. If you are a member of a relevant organization, you
9 may state that, and then you can start your comment.

10 MR. CHANEY: Great. My name is John
11 Chaney. It's C-H-A-N-E-Y, unlike the former vice
12 president. And I'm a member of the board of the Lake
13 Union Live-Aboard Association. So many of our members
14 live on the water to which the discharge is now going
15 into.

16 I really have three comments. One of them is the
17 Brightwater project, and I hate to mention it, the Bertha
18 project, all saw tunneling issues. Now, a 14- to 18-foot
19 tunnel is not a big issue for a tunneling machine, but I
20 think that both of those projects will show that the
21 criteria for the selection of the contractor related to
22 that portion of the work failed. And this project needs
23 -- This can't have a failure as it moves along with a very
24 long tunneling project.

25 The second is if this fails, if in 2025 we've looked

9-1

9-2

Verbatim Transcript of Proceedings
Marlis DeJongh & Associates, Ltd. (206) 583-8711

9-2 1 at this for a year and it's not working the way it was
2 designed to work, there's more outflow than you had
3 projected, I believe that this should include now the
4 consideration of a supplemental plan. How will you meet
5 the requirement, the Consent Decree requirement, if it is
6 not successful in 2025? If that's making a decision today
7 between a 14-foot tunnel and an 18-foot tunnel, those kind
8 of things need to be taken into consideration now.
9 Decision makers need to understand that there may not be
10 very many options, and maybe there are. So I'm hoping
11 that you have covered those.

9-3 12 The very last one is you're creating a model for
13 looking at one overflow per each of the seven discharges
14 per year. That's great. I think that's just wonderful.
15 It's far less than we have today. But if you're modeling
16 to one, I would like you to model to zero, and then tell
17 us what is the difference between modeling to one and
18 modeling to zero. Is that a year's work? Is it
19 \$50 million? What is it?

20 Because at this point we don't really have a way of
21 understanding that. You are controlled in part by the
22 Consent Decrees, which show that you just need to meet the
23 standard of one, and you're modeling to that. I prefer
24 that you also expand the modeling to take it to zero and
25 to show us then what the impacts would be from taking it

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9-3

1 to zero, because that's really my goal. For the fish, for
2 the people, for everybody, let's just not do it rather
3 than doing it just a little. Thank you.

4 MS. STRAUZ-CLARK: All right. So next up
5 at the microphone is Robert Olander, followed by Paul
6 Willumson.

7 Robert.

8 MR. OLANDER: I'll pass.

9 MS. STRAUZ-CLARK: Okay. Then next up at
10 the microphone is Paul Willumson. Is Paul still with us?
11 Oh, there he is.

12 MR. WILLUMSON: Yes. I thought it was
13 going to be more of a question-and-answer type thing
14 rather than testimony.

15 MS. STRAUZ-CLARK: We'll do a question and
16 answer afterwards.

17 MR. WILLUMSON: Anyway, since we're --

18 MS. STRAUZ-CLARK: Please state your name.

19 MR. WILLUMSON: Paul Willumson,
20 W-I-L-L-U-M-S-O-N.

21 I just want to bring up the fact I'm a neighbor
22 directly abutting what would be the Wallingford end of
23 this whole project. We understand that you're going to
24 only use a third of the property. You're going to need
25 the full property to be able to -- until about 2024, and

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Response to Comment 9-1

Comment noted. For information on the tunneling efforts required for the project, please refer to Chapter 2. SPU will consider experience gained during other tunneling projects in the region when developing selection criteria for the project.

Response to Comment 9-2

Comment noted. Please refer to Chapter 2 for a discussion of the alternative selection process. SPU has carefully considered a wide range of alternatives over the course of the project, and has undertaken the Programmatic EIS and the Supplemental EIS processes to fully inform decision makers about the impacts and benefits of all the alternatives considered. The tunnel diameter will be determined during design and will take into consideration such things as storage volume, tunnel operations, costs, and recent storm patterns.

Response to Comment 9-3

Comment noted. SPU developed the Plan to Protect Seattle's Waterways (the Plan) to reduce overflows from combined sewers and stormwater runoff. This Plan was developed to comply with the Consent Decree, a written agreement between the City of Seattle, Washington State Department of Ecology, and the U.S. Department of Justice. The Consent Decree describes the actions that the City must take to meet the requirement of reducing uncontrolled discharges to no more than one event per year per outfall on a 20-year moving average. Refer to the 2014 Plan EIS for additional information on the Consent Decree. The City of Seattle and King County have entered into a Joint Project Agreement intended to meet the conditions outlined in the Consent Decree, which have been determined by all the parties involved to be protective of human health and other beneficial resources. As such, the City is not evaluating the option of zero overflows per year.

1 to zero, because that's really my goal. For the fish, for
 2 the people, for everybody, let's just not do it rather
 3 than doing it just a little. Thank you.

4 MS. STRAUZ-CLARK: All right. So next up
 5 at the microphone is Robert Olander, followed by Paul
 6 Willumson.

7 Robert.

8 MR. OLANDER: I'll pass.

9 MS. STRAUZ-CLARK: Okay. Then next up at
 10 the microphone is Paul Willumson. Is Paul still with us?
 11 Oh, there he is.

12 MR. WILLUMSON: Yes. I thought it was
 13 going to be more of a question-and-answer type thing
 14 rather than testimony.

15 MS. STRAUZ-CLARK: We'll do a question and
 16 answer afterwards.

17 MR. WILLUMSON: Anyway, since we're --

18 MS. STRAUZ-CLARK: Please state your name.

19 MR. WILLUMSON: Paul Willumson,
 20 W-I-L-L-U-M-S-O-N.

21 I just want to bring up the fact I'm a neighbor
 22 directly abutting what would be the Wallingford end of
 23 this whole project. We understand that you're going to
 24 only use a third of the property. You're going to need
 25 the full property to be able to -- until about 2024, and

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1 then it will be scaled down to about a third of its
2 size -- I mean a third of the property.

3 What we're concerned about is the other two-thirds
4 of the property and that since it is public land, owned by
5 the people, that it shouldn't be sold to the highest
6 bidder. We're hoping that we'll find in the next ten
7 years something that will benefit both the city and the
8 people in Wallingford and that it just doesn't turn into
9 more 30-foot condos. That's my concern.

10 MS. STRAUSZ-CLARK: Okay. Before we take
11 some Q&A, is there anyone else who would like to make a
12 comment at the microphone?

13 Oh, you have one person? Okay. You are up.

14 MR. HAEFER: Cool.

15 MS. STRAUSZ-CLARK: Okay. So this is Reid
16 Haefer.

17 MR. HAEFER: Yes.

18 MS. STRAUSZ-CLARK: Please state your name,
19 and then you will have three minutes.

20 MR. HAEFER: So my name is Reid Haefer, and
21 I'm with a community group. We're called the Friends of
22 North Lake Union. It's people who live in the
23 Wallingford/Fremont area around Lake Union.

24 And what we're really concerned about is an area of
25 land at the very bottom of Stone Way, just south of the

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Response to Comment 10-1

Comment noted. Refer to the response to Comment 5-3, above.

1 then it will be scaled down to about a third of its
 2 size -- I mean a third of the property.

3 What we're concerned about is the other two-thirds
 4 of the property and that since it is public land, owned by
 5 the people, that it shouldn't be sold to the highest
 6 bidder. We're hoping that we'll find in the next ten
 7 years something that will benefit both the city and the
 8 people in Wallingford and that it just doesn't turn into
 9 more 30-foot condos. That's my concern.

10 MS. STRAUZ-CLARK: Okay. Before we take
 11 some Q&A, is there anyone else who would like to make a
 12 comment at the microphone?

13 Oh, you have one person? Okay. You are up.

14 MR. HAEFER: Cool.

15 MS. STRAUZ-CLARK: Okay. So this is Reid
 16 Haefer.

17 MR. HAEFER: Yes.

18 MS. STRAUZ-CLARK: Please state your name,
 19 and then you will have three minutes.

20 MR. HAEFER: So my name is Reid Haefer, and
 21 I'm with a community group. We're called the Friends of
 22 North Lake Union. It's people who live in the
 23 Wallingford/Fremont area around Lake Union.

24 And what we're really concerned about is an area of
 25 land at the very bottom of Stone Way, just south of the

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1 intersection of Stone Way and 34th when it turns to the
2 Northlake Way and the road goes east. There's a piece of
3 land there called Waterway 22, and I'm aware that as part
4 of this project there will be construction in that area.

5 And so there have been multiple community-oriented
6 proposals to improve that area, both the shoreline slope
7 and the roadway, with sidewalks, better intersections and
8 a public space. And so my comment is as part of this
9 project, given that there will be construction in that
10 area, we think that there should be some sort of
11 mitigation or funding for improvements to the Waterway 22
12 area, whether it's in the form of improved sidewalks or
13 the creation of a small public space at Waterway 22.

14 And this is supported by multiple community groups
15 and people in the community, and it's something that we
16 believe should happen, so -- Thank you.

17 MS. STRAUSZ-CLARK: Okay. Anyone else who
18 would like to make a comment up at the microphone tonight?

19 (No audible response.)

20 MS. STRAUSZ-CLARK: Okay. Do we want to do
21 some questions and answers? Would that be okay?

22 Okay. So we can take a couple of questions,
23 clarifying questions about Ed's presentation that he can
24 answer.

25 Yes, sir.

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Response to Comment 11-1

Refer to the response to Comment 3-1. SPU will mitigate impacts associated with the project construction in accordance with all applicable permit requirements. SPU will continue to coordinate with community stakeholder groups throughout project design and construction, to reduce potential impacts.

Appendix B

Existing Transportation Facilities

West Portal and Ballard Conveyance

| Table B-1. Existing Transportation Facilities – West Portal and Ballard Conveyance Study Area | | | | | |
|--|---|------------------------------------|---|---|--|
| Roadway | Functional Class¹ / Width² | AWDT / % Trucks³ | Transit and Rail Characteristics⁴ | Non-Motorized Characteristics⁵ | Parking Characteristics⁶ |
| 24th Avenue NW, Shilshole Avenue NW – Salmon Bay Dock ⁷ | Local Access 2 lanes | 810 (10% trucks) | No transit routes. BTRR tracks cross on south side of NW 54th Street. | Sidewalks, both sides between NW Market Street and Shilshole Avenue NW. No sidewalks south of Shilshole Avenue NW. Unsigned arterial bicycle route. | Angle parking on east side of street. Off-street parking adjacent to entire length of street on west side. |
| Shilshole Avenue NW, NW Market Street – NW Dock Place | Minor Arterial Major Truck Street 2 lanes | 14,100 (5% trucks) | No transit routes. BTRR tracks located adjacent to street on south side. | Sidewalks on north side. Included in Shilshole Alternative of Burke-Gilman Extension project. | Mix of angle and parallel parking on both sides. Segments have restricted parking between 2 and 5 A.M. |
| 20th Avenue NW, Ballard Avenue NW – Shilshole Avenue NW | Local Access 2 lanes | 1,210 (10% trucks) | No transit routes. | Sidewalks, both sides. | Parking both sides. |
| NW Dock Place, Ballard Avenue NW – Shilshole Avenue NW | Local Access 2 lanes | 1,290 (9% trucks) | No transit routes. | Sidewalks, both sides. | Parking both sides. |
| 28th Avenue NW, NW 56th Street – NW 58th Street | Local Access 2 lanes | 1,220 (5% trucks) | No transit routes. | Sidewalks, both sides. Unsigned non-arterial bicycle route. | Parking both sides. |
| 20th Avenue NW, NW Market Street – NW 56th Street | Collector 2 lanes | No data. ⁸ | No transit routes. | Sidewalks and bike lanes, both sides. | Parking both sides. |
| Conveyance Options | | | | | |
| Option 1 – via NW 54th Street | | | | | |
| NW 54th Street, 24th Avenue NW – 28th Avenue NW | Local Access 2 lanes – narrows to 1 lane at west end | 600 (16% trucks) | No transit routes. BTRR tracks located adjacent to street on south side | No sidewalks. Included in Shilshole Alternative of Burke-Gilman Extension project. | No on-street parking but truck loading docks and off-street parking adjacent to entire length of street on both sides. |
| 28th Avenue NW, NW 54th Street – Market Street | Local Access 2 lanes | 600 (16% trucks) | No transit routes. | No sidewalks. Unsigned non-arterial bicycle route. Included in Ballard Alternative of Burke-Gilman Extension project. | No on-street parking but truck loading docks and off-street parking adjacent to entire length of street on both sides. |

Table B-1. Existing Transportation Facilities – West Portal and Ballard Conveyance Study Area

| Roadway | Functional Class ¹ / Width ² | AWDT / % Trucks ³ | Transit and Rail Characteristics ⁴ | Non-Motorized Characteristics ⁵ | Parking Characteristics ⁶ |
|---|--|------------------------------|---|--|---|
| 28th Avenue NW, Market Street – NW 56th Street | Local Access 2 lanes | 1,220 (5% trucks) | No transit routes. | Sidewalks, entire length of east side, northern half of west side. Unsigned non-arterial bicycle route. Included in Ballard Alternative of Burke-Gilman Extension project. | Entire length of east side, northern half of west side. Off-street parking adjacent to southern half of west side. |
| Option 2 – via NW Market Street | | | | | |
| NW Market Street, 24th Avenue NW – 28th Avenue NW | Minor Arterial Major Transit Street 4 lanes | 14,900 (6% trucks) | Metro Routes 17, 18, 29, 40, 44. 1 bus stop on each side. Electric overhead bus trolley lines on each side. | Sidewalks, both sides. Unsigned arterial bicycle route. Included in Leary Alternative of Burke-Gilman Extension project. | Parking both sides. |
| 28th Avenue NW, Market Street – NW 56th Street | Same as Option 1. | | | | |
| Option 3 – via NW 56th Street | | | | | |
| 24th Avenue NW, NW Market Street – NW 56th Street | Minor Arterial Minor Transit Street 3 lanes | 12,260 (5% trucks) | Metro Routes 18, 40. No bus stops. | Sidewalks, both sides. Unsigned arterial bicycle route. | Parking both sides. |
| NW 56th Street, 24th Avenue NW – 28th Avenue NW | Local Access 2 lanes | 660 (7% trucks) | No transit routes. | Sidewalks, both sides. | Parking both sides between 24th and 26th Avenues NW. Parking south side between 26th and 28th Avenues NW. |

1. Source: City of Seattle, 2003a; City of Seattle, 2003b.

2. Width = total number of through- and continuous center turn lanes

3. Source: Idax Data Solutions, June 2015. AWDT = Average Weekday Daily Traffic (two-way)

4. Source: King County Metro, 2015, and field observation, May 2015.

5. Source: City of Seattle, 2015a; City of Seattle, 2015b; and field observation, May 2015.

6. Source: City of Seattle, 2015c, and field observation, May 2015. Parking is parallel unless otherwise noted.

7. Marine dock located at south end of 24th Avenue NW in Salmon Bay.

8. No traffic data available. Street primarily provides access for adjacent businesses and also serves some through-traffic.

11th Avenue NW Drop Shaft and Associated Conveyance

Table B-2. Existing Transportation Facilities – 11th Avenue NW Drop Shaft and Associated Conveyance Study Area

| Roadway | Functional Class ¹ / Width ² | AWDT / % Trucks ³ | Transit and Rail Characteristics ⁴ | Non-Motorized Characteristics ⁵ | Parking Characteristics ⁶ |
|--|--|------------------------------|--|--|--|
| 11th Avenue NW, NW 46th Street – Ship Canal | Local Access 2 lanes | 6,690 (4% trucks) | No transit routes. BTRR crossing at NW 45th Street. | Sidewalks on east side (no curb between NW 45th and NW 46th Streets) Unsigned non-arterial bicycle route. From NW 45th Street to the north, included in Leary and Ballard Alternatives of Burke-Gilman Extension project. | Parking on east side between NW 46th and 45th Streets. Parking on both sides between NW 45th Street and Ship Canal. |
| NW 45th Street, 14th Avenue NW – 9th Avenue NW | Local Access 2 lanes | 3,040 (18% trucks) | No transit routes. BTRR tracks located in center of street. | Between 9th and 11th Avenues NW, sidewalk on north side and the Burke-Gilman Trail on south side. 11th Avenue NW is the western terminus of the east portion of the Burke-Gilman Trail. Between 11th and 14th Avenues NW, there are no sidewalks, but a two-way bicycle lane is located on the north side of the street. Included in Shilshole Alternative of Burke-Gilman Extension project. | No on-street parking between 9th and 11th Avenues NW. Parking both sides between 11th and 14th Avenues NW. |

1. Source: City of Seattle, 2003a; City of Seattle, 2003b.

2. Width = total number of through- and continuous center turn lanes

3. Source: Idax Data Solutions, June 2015. AWDT = Average Weekday Daily Traffic (two-way)

4. Source: King County Metro, 2015, and field observation, May 2015.

5. Source: City of Seattle, 2015a; City of Seattle, 2015b; and field observation, May 2015.

6. Source: City of Seattle, 2015c, and field observation, May 2015. Parking is parallel unless otherwise noted.

North 3rd Avenue/174 Drop Shaft and Associated Conveyance

Table B-3. Existing Transportation Facilities – North 3rd Avenue/174 Drop Shaft and Associated Conveyance Study Area

| Roadway | Functional Class ¹ / Width ² | AWDT / % Trucks ³ | Transit and Rail Characteristics ⁴ | Non-Motorized Characteristics ⁵ | Parking Characteristics ⁶ |
|---|---|------------------------------|---|---|---|
| 3rd Avenue NW, NW 41st Street – Leary Way NW | Collector 2 lanes | 3,460 (4% trucks) | No transit routes. | Sidewalks both sides. Unsigned arterial bicycle route. | Parking on west side, north of NW 40th Street |
| Leary Way NW, NW 41st Street – NW Bowdoin Place/ 3rd Avenue NW | Principal Arterial Major Truck Street Minor Transit Street 5 lanes | 31,500 (6% trucks) | Metro Routes 28, 40. 1 bus stop on each side between NW 40th Street and NW Bowdoin Place / 3rd Avenue NW | Sidewalks both sides. | Parking allowed along most of curbside lane on both sides, outside of AM and PM peak periods. |
| NW 36th Street, Leary Way NW – 1st Avenue NW | Principal Arterial Major Truck Street Minor Transit Street 4 lanes | 31,500 (6% trucks) | Metro Routes 28, 40. 1 bus stop on north side, west of 1st Avenue NW | Sidewalks both sides. | Parking both sides. |
| 2nd Avenue NW, NW 39th Street – NW 36th Street | Local Access 2 lanes | 240 (4% trucks) | No transit routes. | Sidewalks both sides. | Parking both sides. |
| NW 39th Street, 3rd Avenue NW – Leary Way NW | Local Access 2 lanes | No data ⁷ | No transit routes. | No sidewalks. | Off-street loading zones or parking adjacent to both sides. |
| via Leary Way NW | | | | | |
| Leary Way NW, NW Bowdoin Place/ 3rd Avenue NW – NW 36th Street/ 2nd Avenue NW | Principal Arterial Major Truck Street Minor Transit Street 5 lanes | 31,500 (6% trucks) | Metro Routes 28, 40. No bus stops. | Sidewalks both sides. | Parking allowed along most of curbside lane on both sides, outside of AM and PM peak periods. |
| via NW 36th Street/3rd Avenue NW | | | | | |
| 3rd Avenue NW/ NW 36th Street, Leary Way NW – Leary Way NW | Local Access 2 lanes | 420 (10% trucks) | No transit routes. | No sidewalks. Burke-Gilman Trail located adjacent to the central portion of the street segment, to the west. | Parking allowed at north and south ends of segment. |

1. Source: City of Seattle, 2003a; City of Seattle, 2003b.

2. Width = total number of through- and continuous center turn lanes

3. Source: Idax Data Solutions, June 2015. AWDT = Average Weekday Daily Traffic (two-way)

4. Source: King County Metro, 2015, and field observation, May 2015.

5. Source: City of Seattle, 2015a, and field observation, May 2015.

6. Source: City of Seattle, 2015c, and field observation, May 2015. Parking is parallel unless otherwise noted.

7. No traffic data available. Low-volume street primarily provides access for adjacent businesses.

South 3rd Avenue Drop Shaft and Associated Conveyance

Table B-4. Existing Transportation Facilities – South 3rd Avenue Drop Shaft and Associated Conveyance Study Area

| Roadway | Functional Class ¹ / Width ² | AWDT / % Trucks ³ | Transit and Rail Characteristics ⁴ | Non-Motorized Characteristics ⁵ | Parking Characteristics ⁶ |
|---|--|------------------------------|---|--|---|
| W Ewing Street, 6th Avenue W – 3rd Avenue W | Local Access 2 lanes | 320 (11% trucks) | No transit routes. | Sidewalk along portion of north side. South Ship Canal Trail located between the north and south street segments. | Parking both sides. 19-space parking lot serves West Ewing Mini Park, to the east of 3rd Avenue W. |
| 3rd Avenue W, W Ewing Street – W Nickerson Street | Local Access 2 lanes | 1,330 (5% trucks) | No transit routes. | Sidewalks both sides. South Ship Canal Trail crosses street at W Ewing Street. | Parking both sides. |

1. Source: City of Seattle, 2003a; City of Seattle, 2003b.

2. Width = total number of through- and continuous center turn lanes

3. Source: Idax Data Solutions, June 2015. AWDT = Average Weekday Daily Traffic (two-way)

4. Source: King County Metro, 2015, and field observation, May 2015.

5. Source: City of Seattle, 2015a, and field observation, May 2015.

6. Source: City of Seattle, 2015c, and field observation, May 2015. Parking is parallel unless otherwise noted.

East Portal and Wallingford Conveyance

Table B-5. Existing Transportation Facilities – East Portal and Wallingford Conveyance Study Area

| Roadway | Functional Class ¹ / Width ² | AWDT / % Trucks ³ | Transit and Rail Characteristics ⁴ | Non-Motorized Characteristics ⁵ | Parking Characteristics ⁶ |
|--|---|------------------------------|---|--|--|
| Stone Way N, N 38th Street – N Northlake Way | Minor Arterial Minor Transit Street (N 34th St – N 38th St) Major Truck Street (N 34th St – N 35th St) 3 lanes | 12,400 (6% trucks) | Metro Route 62 One bus stop on west side, south of N 38th Street | Sidewalks both sides. North of N 34th Street, sharrows on west side, bike lane on east side. Street crosses Burke-Gilman Train on south side of N 34th Street. | Parking on both sides, north of N 34th Street. |
| N 35th Street, Albion Place N – Woodlawn Avenue N | Collector Minor Transit Street 2 lanes | 5,730 (4% trucks) | Metro Routes 31, 32, 62 1 stop on each side between Woodland Park Avenue N and Stone Way N | Sidewalks both sides. | Parking on both sides. |
| N 36th Street, Stone Way N – Woodlawn Ave N | Local Access 2 lanes | No data ⁷ | No transit routes. | Sidewalks both sides. | Parking on both sides. |
| Woodlawn Avenue N, N 36th Street – N 35th Street | Local Access 2 lanes | No data ⁷ | No transit routes. | Sidewalks both sides. | Parking on both sides. |
| Interlake Avenue N, N 36th Street – N 35th Street | Local Access 2 lanes | 540 (3% trucks) | No transit routes. | Sidewalks both sides. | Parking on both sides. |
| N 34th Street, Woodland Park Avenue N – N Northlake Place | Principal Arterial, Major Truck Street Minor Transit Street 2 lanes | 17,500 (3% trucks) | No transit routes. | Sidewalks both sides. Bike lanes both sides. Burke Gilman Trail adjacent to south side of street. | No on-street parking |
| Woodland Park Avenue N, N 35th Street – N 36th Street | Local Access 2 lanes | No data ⁷ | No transit routes. | Sidewalks both sides. | Parking on both sides. |

1. Source: City of Seattle, 2003a; City of Seattle, 2003b.

2. Width = total number of through- and continuous center turn lanes

3. Source: Idax Data Solutions, June 2015. AWDT = Average Weekday Daily Traffic (two-way)

4. Source: King County Metro, 2015, and field observation, May 2015.

5. Source: City of Seattle, 2015a, and field observation, May 2015.

6. Source: City of Seattle, 2015c, and field observation, May 2015. Parking is parallel unless otherwise noted.

7. No traffic data available. Low-volume street primarily provides access for adjacent residences and businesses.

Transportation System Elements Potentially Affected by Construction

West Portal and Ballard Conveyance

Table B-6. Transportation System Elements Potentially Impacted by Construction of West Portal and Ballard Conveyance

| Roadway | Driveways / Alleyways | Transit ^{1,2} | Intersection Crossings | On-Street Parking ² | Special Conditions ³ |
|---|--------------------------------|------------------------|--|--------------------------------|--|
| 24th Avenue NW, Shilshole Avenue NW – Salmon Bay Dock | 1 west side 0 east side | None. | <u>Unsignalized</u> Shilshole Avenue NW NW 54th Street BTRR tracks cross on south side of NW 54th Street. | East side. | Off-street parking adjacent to entire length of street on west side. Driveway on west side has narrow width that could hinder ability to close half at a time. |
| Shilshole Avenue NW, NW Market Street – NW Dock Place | 25 north side 14 south side | None. | <u>Signalized</u> NW Market Street <u>Unsignalized</u> 24th Avenue NW 22nd Avenue NW NW Vernon Place 20th Avenue NW NW Dock Place | Both sides. | 24 driveways on north side and 8 driveways on south side have narrow widths that could hinder ability to close half at a time. BTRR tracks located adjacent to street on south side. |
| 20th Avenue NW, Ballard Avenue NW – Shilshole Avenue NW | 3 west side 1 east side | None. | <u>Unsignalized</u> Shilshole Avenue NW | Both sides. | West side driveways have narrow widths that could hinder ability to close half at a time, but all provide access to the same building. |
| NW Dock Place, Ballard Avenue NW – Shilshole Avenue NW | None. | None. | <u>Unsignalized</u> Shilshole Avenue NW | Both sides. | None. |
| 28th Avenue NW, NW 56th Street – NW 58th Street | 2 west side 4 east side | None. | <u>Unsignalized</u> NW 56th Street NW 57th Street NW 58th Street | Both sides. | 2 alleys on west side and 1 alley/3 driveways on east side have narrow widths that could hinder ability to close half at a time. |
| 20th Avenue NW, NW Market Street – NW 56th Street | 3 west side 1 east side | None | <u>Signalized</u> Market Street <u>Unsignalized</u> NW 57th Street | Both sides | Alley on east and west side have narrow widths that could hinder ability to close half at a time. |
| Conveyance Options | | | | | |
| Option 1 – via NW 54th Street | | | | | |
| NW 54th Street, 24th Avenue NW – 28th Avenue NW | 2 north side 2 south side | None. | <u>Unsignalized</u> 24th Avenue NW 26th Avenue NW 28th Avenue NW | None. | 1 driveway on north side and 1 driveway on south side have narrow widths that could hinder ability to close half at a time. Truck loading docks and off-street parking adjacent to entire length of street on both sides. |

| Table B-6. Transportation System Elements Potentially Impacted by Construction of West Portal and Ballard Conveyance | | | | | |
|---|-------------------------------|--|--|--------------------------------------|---|
| Roadway | Driveways / Alleyways | Transit^{1,2} | Intersection Crossings | On-Street Parking² | Special Conditions³ |
| | | | | | Travel way narrows to one lane at west end. BTRR tracks located adjacent to street on south side |
| 28th Avenue NW, NW 54th Street – Market Street | 2 west side 0 east side | None. | <u>Signalized</u> Market Street <u>Unsignalized</u> NW 54th Street | None. | Truck loading docks and off-street parking adjacent to entire length of street on both sides. |
| 28th Avenue NW, Market Street – NW 56th Street | 1 west side 3 east side | None. | <u>Signalized</u> Market Street <u>Unsignalized</u> NW 56th Street | Both sides. | 1 driveway on west side and 2 driveways on east side have narrow widths that could hinder ability to close half at a time. Off-street parking adjacent to entire length of southern half of west side. |
| Option 2 – via NW Market Street | | | | | |
| NW Market Street, 24th Avenue NW – 28th Avenue NW | 11 north side 5 south side | 5 bus routes. 1 bus stop on each side. Electric overhead bus trolley lines on each side. | <u>Signalized</u> 24th Avenue NW 28th Avenue NW <u>Unsignalized</u> 26th Avenue NW | Both sides. | 2 driveways on north side and 4 driveways on south side have narrow widths that could hinder ability to close half at a time. |
| 28th Avenue NW, Market Street – NW 56th Street | Same as Option 1. | | | | |
| Option 3 – via NW 56th Street | | | | | |
| 24th Avenue NW, NW Market Street – NW 56th Street | 2 west side 1 east side | 2 bus routes. No bus stops. | <u>Signalized</u> Market Street <u>Unsignalized</u> NW 56th Street | Both sides. | 1 driveway on east side has narrow widths that could hinder ability to close half at a time. |
| NW 56th Street, 24th Avenue NW – 28th Avenue NW | 8 north side 3 south side | None. | <u>Unsignalized</u> 24th Avenue NW 26th Avenue NW 28th Avenue NW | Both sides. | 6 driveways on north side and 1 driveway on south side have narrow widths that could hinder ability to close half at a time. |

Source: Heffron Transportation, 2015.

1. Source: King County Metro, 2015, and field observation, May 2015.
2. See Table B-1 for more detailed description of affected transit routes, transit stops, and on-street parking.
3. Identification of special conditions is based upon preliminary field assessment. Prior to project construction, the contractor would need to coordinate individually with all property owners of access driveways that would be affected by construction activities to determine the appropriate measures needed to maintain property access.

11th Avenue NW Drop Shaft and Associated Conveyance

Table B-7. Transportation System Elements Potentially Impacted by Construction of 11th Avenue NW Drop Shaft and Associated Conveyance

| Roadway | Driveways / Alleyways | Transit ^{1,2} | Intersection Crossings | On-Street Parking ² | Special Conditions ³ |
|--|------------------------------|------------------------|---|---|---|
| 11th Avenue NW, NW 46th Street – Ship Canal | 6 west side 3 east side | None. | <u>Unsignalized</u> NW 45th Street BTRR crossing at NW 45th Street. | East side, north of NW 45th Street. Both sides, south of NW 45th Street. | Driveway on west side has narrow width that could hinder ability to close half at a time. |
| NW 45th Street, 14th Avenue NW – 9th Avenue NW | 7 north side 4 south side | None. | <u>Unsignalized</u> 11th Avenue NW | Both sides, west of 11th Avenue NW. | 3 driveways on north side have narrow widths that could hinder ability to close half at a time. BTRR tracks located in center of street. Burke-Gilman Trail adjacent to south side of street east of 11th Avenue NW; bicycle lanes adjacent to north side of street west of 11th Avenue NW. |

Source: Heffron Transportation, 2015.

1. Source: King County Metro, 2015, and field observation, May 2015.
2. See Table B-2 for more detailed description of affected transit routes, transit stops, and on-street parking.
3. Identification of special conditions is based upon preliminary field assessment. Prior to project construction, the contractor would need to coordinate individually with all property owners of access driveways that would be affected by construction activities to determine the appropriate measures needed to maintain property access.

North 3rd Avenue/174 Drop Shaft and Associated Conveyance

Table B-8. Transportation System Elements Potentially Impacted by Construction of North 3rd Avenue/174 Drop Shaft and Associated Conveyance

| Roadway | Driveways / Alleyways | Transit ^{1,2} | Intersection Crossings | On-Street Parking ² | Special Conditions ³ |
|---|------------------------------|--|---|---|--|
| 3rd Avenue NW, NW 41st Street – Leary Way NW | 4 west side 5 east side | None. | <u>Unsignalized</u> NW 41st Street NW 40th Street (east and west segments offset) Leary Way NW | West side, north of NW 40th Street. | 1 driveway on west side and 2 driveways on east side have narrow widths that could hinder ability to close half at a time. |
| Leary Way NW, NW 41st Street – NW Bowdoin Place/ 3rd Avenue NW | 3 west side 5 east side | 2 bus routes. 1 bus stop on each side. | <u>Unsignalized</u> NW 41st Street NW 40th Street NW Bowdoin Place/ 3rd Avenue NW | Both sides during off-peak hours. | None identified. |
| NW 36th Street, Leary Way NW – 1st Avenue NW | 1 north side 2 south side | 2 bus routes. 1 bus stop on north side. | <u>Unsignalized</u> 2nd Avenue NW 1st Avenue NW | Both sides. | None identified. |
| 2nd Avenue NW, NW 39th Street – NW 36th Street | 2 west side 2 east side | None. | <u>Unsignalized</u> NW 39th Street NW 36th Street | Both sides. | 1 driveway and 1 alley on west side and 2 driveways on east side have narrow widths that could hinder ability to close half at a time. |
| NW 39th Street, 3rd Avenue NW – Leary Way NW | 1 south side. | None. | <u>Signalized</u> Leary Way NW <u>Unsignalized</u> 3rd Avenue NW | None. | Off-street loading zones or parking adjacent to both sides. |
| via Leary Way NW | | | | | |
| Leary Way NW, NW Bowdoin Place/ 3rd Avenue NW – NW 36th Street/ 2nd Avenue NW | 0 west side 6 east side | 2 bus routes. | <u>Signalized</u> NW 39th Street <u>Unsignalized</u> NW 36th Street/ 2nd Avenue NW NW Bowdoin Place/ 3rd Avenue NW | Both sides during off-peak hours | None identified. |
| via NW 36th Street/3rd Avenue NW | | | | | |
| 3rd Avenue NW/ NW 36th Street, Leary Way NW – Leary Way NW | 4 west side 2 east side | None. | <u>Unsignalized</u> NW Bowdoin Place/ Leary Way NW NW 39th Street (east and west segments offset) Leary Way NW | Both sides at north and south ends of street segment. | Burke-Gilman Trail located near central portion of street segment on the west side. |

Source: Heffron Transportation, 2015.

1. Source: King County Metro, 2015, and field observation, May 2015.
2. See Table B-3 for more detailed description of affected transit routes, transit stops, and on-street parking.
3. Identification of special conditions is based upon preliminary field assessment. Prior to project construction, the contractor would need to coordinate individually with all property owners of access driveways that would be affected by construction activities to determine the appropriate measures needed to maintain property access.

South 3rd Avenue Drop Shaft and Associated Conveyance

Table B-9. Transportation System Elements Potentially Impacted by Construction of South 3rd Avenue Drop Shaft and Associated Conveyance

| Roadway | Driveways / Alleyways | Transit ^{1,2} | Intersection Crossings | On-Street Parking ² | Special Conditions ³ |
|---|------------------------------|------------------------|--|--------------------------------|---|
| W Ewing Street, 6th Avenue W – 3rd Avenue W | 6 north side 4 south side | None. | <u>Unsignalized</u> 3rd Avenue W 6th Avenue W | Both sides. | 3 driveways on north side and 1 driveway on south side have narrow width that could hinder ability to close half at a time. South Ship Canal Trail located in between the north and south street segments. |
| 3rd Avenue W, W Ewing Street – W Nickerson Street | 2 west side 2 east side | None. | <u>Signalized</u> W Nickerson Street <u>Unsignalized</u> W Ewing Street | Both sides. | 1 driveway on west side and 1 driveway on east side have narrow width that could hinder ability to close half at a time. South Ship Canal Trail crosses street at W Ewing Street. |

Source: Heffron Transportation, 2015.

1. Source: King County Metro, 2015, and field observation, May 2015.
2. See Table B-4 for more detailed description of affected transit routes, transit stops, and on-street parking.
3. Identification of special conditions is based upon preliminary field assessment. Prior to project construction, the contractor would need to coordinate individually with all property owners of access driveways that would be affected by construction activities to determine the appropriate measures needed to maintain property access.

East Portal and Wallingford Conveyance

Table B-10. Transportation System Elements Potentially Impacted by Construction of East Portal and Wallingford Conveyance

| Roadway | Driveways / Alleyways | Transit ^{1,2} | Intersection Crossings | On-Street Parking ² | Special Conditions ³ |
|--|--|---|---|--------------------------------|---|
| Stone Way N, N 38th Street – N Northlake Way | 13 west side 3 east side | 1 bus route. 1 bus stop on west side. | <u>Signalized</u> N 35th Street N 34th Street <u>Unsignalized</u> N 38th Street N 36th Street | Both sides. | 3 driveways on west side have narrow width that could hinder ability to close half at a time. Street crosses Burke-Gilman Train on south side of N 34th Street |
| N 35th Street, Albion Place N – Woodlawn Avenue N | 13 north side 6 south side | 3 bus routes. 1 bus stop on each side. | <u>Signalized</u> Stone Way N <u>Unsignalized</u> Albion Place N Woodland Park Avenue N Interlake Ave N Ashworth Ave N Woodlawn Ave N | Both sides. | 1 driveway on north side and 4 driveways on south side have narrow width that could hinder ability to close half at a time. |
| N 36th Street, Stone Way N – Woodlawn Ave N | 4 north side 6 south side | None. | <u>Unsignalized</u> Stone Way N Interlake Ave N Ashworth Ave N Carr PI N Woodlawn Ave N | Both sides. | 2 driveways on north side and 4 driveways on south side have narrow width that could hinder ability to close half at a time. |
| Woodlawn Avenue N, N 36th Street – N 35th Street | 5 west side 7 east side | None. | <u>Unsignalized</u> N 36th Street N 35th Street | Both sides. | 5 driveways on west side and 7 driveways on east side have narrow width that could hinder ability to close half at a time. |
| Interlake Avenue N, N 36th Street – N 35th Street | 3 west side 3 east side | None. | <u>Unsignalized</u> N 36th Street N 35th Street | Both sides. | 3 driveways on east side have narrow width that could hinder ability to close half at a time. |
| N 34th Street, Woodland Park Avenue N – N Northlake Place | 3 north side 0 south side | None. | <u>Signalized</u> Stone Way N <u>Unsignalized</u> Woodland Park Ave N | None. | 1 driveway and 1 alley on north side have narrow width that could hinder ability to close half at a time. Burke Gilman Trail adjacent to south side of street. |
| Woodland Park Avenue N, N 35th Street – N 36th Street | 0 west side 1 east side | None | <u>Unsignalized</u> N 35th Street N 36th Street | Both sides. | 1 driveway on east side has narrow width that could hinder ability to close half at a time. |

Source: Heffron Transportation, 2015.

1. Source: King County Metro, 2015, and field observation, May 2015.

2. See Table B-5 for more detailed description of affected transit routes, transit stops, and on-street parking.

3. Identification of special conditions is based upon preliminary field assessment. Prior to project construction, the contractor would need to coordinate individually with all property owners of access driveways that would be affected by construction activities to determine the appropriate measures needed to maintain property access.

Appendix C

Noise and Vibration Technical Information

West Portal

The equipment included in the noise analysis for construction activities during each construction phase at the project's West Portal is provided in Table C-1 below.

| Table C-1. West Portal Construction Equipment Included in Noise Model | | | | |
|--|---------------------------|------------------------------|------------------------------|----------------------------------|
| Equipment | Construction Phase | | | |
| | Mobilization | Tunnel Pit Excavation | Tunneling | Pump Station Construction |
| Backhoe | Daytime | | | |
| Compressor | Daytime | Daytime | Daytime/Nighttime | |
| Concrete Mixer Truck | | | | Daytime |
| Concrete Pump Truck | | Daytime | | Daytime |
| Concrete Saw | Daytime | | | |
| Conveyer | | | Daytime/Nighttime | |
| Crane | Daytime | Daytime | Daytime/Nighttime | |
| Dozer | Daytime | Daytime | Daytime/Nighttime | |
| Drill Rigs | | Daytime | | |
| Excavator | Daytime | Daytime | Daytime/Nighttime | |
| Gantry Crane | | | Daytime/Nighttime | |
| Generator | | | Daytime/Nighttime | Daytime |
| Grout Plant | | | Daytime/Nighttime | |
| Haul Trucks | Daytime (0.5/hour) | Daytime (1.7/hour) | Daytime/Nighttime (1.7/hour) | Daytime (0.5/hour) |
| Light Plant | | | Daytime/Nighttime | |
| Loader | Daytime | Daytime | | Daytime |
| Pump Truck | | | | Daytime |
| Pump | | Daytime | | |
| Transformer | | | Daytime/Nighttime | Daytime |
| Tunnel Vent Fan | | | Daytime/Nighttime | |

Predicted sound levels include delivery and haul vehicles operating within the West Portal construction site. Vehicles operating outside the limits of the West Portal construction area are not included in the predicted sound levels.

East Portal

The equipment included in the noise analysis for construction activities during each construction phase at the project's East Portal is provided in Table C-2 below.

Table C-2. East Portal Construction Equipment Included in Noise Model

| Equipment | Construction Phases | | |
|----------------------|--------------------------|-------------|------------------|
| | Retrieval Pit Excavation | TBM Removal | Site Restoration |
| Backhoe | | | Daytime |
| Compressor | Daytime | Daytime | |
| Concrete Mixer Truck | | | Daytime |
| Concrete Pump Truck | Daytime | | |
| Crane | Daytime | Daytime | Daytime |
| Dozer | | | Daytime |
| Drill Rigs | Daytime | | |
| Excavator | Daytime | | |
| Generator | Daytime | Daytime | Daytime |
| Haul Trucks | Daytime | Daytime | Daytime |
| Light Plant | | Daytime | |
| Loader | Daytime | Daytime | |
| Paver | | | Daytime |
| Pump | Daytime | Daytime | |

Drop Shafts

The equipment included in the noise impact analysis for construction activities associated with the construction of the drop shafts are provided in Table C-3 below.

Table C-3. Drop Shaft Construction Equipment Included in Noise Model

| Equipment | Construction Phase | |
|----------------------|--------------------|----------------------|
| | Excavation | Drop Shaft Structure |
| Backhoe | | Daytime |
| Compressor | Daytime | Daytime |
| Concrete Pump Trucks | Daytime | |
| Crane | Daytime | Daytime |
| Drill Rig | Daytime | |
| Excavator | Daytime | |
| Generator | Daytime | Daytime |
| Haul Trucks | Daytime | Daytime |
| Loader | Daytime | Daytime |
| Pump | Daytime | Daytime |
| Welder | | Daytime |

Ballard Conveyance

The equipment included in the noise analysis for construction of the conveyance system in Ballard is provided in Table C-4 below.

| <i>Table C-4. Ballard Conveyance Construction Equipment Included in Noise Model</i> | |
|---|------------------|
| Equipment | Operating Period |
| Backhoe | Daytime |
| Dump Truck | Daytime |
| Hoe Ram | Daytime |
| Welder | Daytime |

Wallingford Conveyance

The equipment included in the noise analysis for construction of the conveyance in Wallingford is provided in Table C-5 below.

| <i>Table C-5. Wallingford Conveyance Construction Equipment Included in Noise Model</i> | |
|---|------------------|
| Equipment | Operating Period |
| Backhoe | Daytime |
| Dump Truck | Daytime |
| Hoe Ram | Daytime |
| Welder | Daytime |

Vibration Analysis

The FTA Manual (2006) divides construction vibration impact assessment criteria into two classes: building damage and occupant annoyance. Vibration levels at nearby receptors were calculated in accordance with FTA guidelines. Calculations for general building damage are based on PPV (peak particle velocity) vibration levels, were conducted as follows:

$$PPV = PPV_{ref} * (25/D)^{1.5}$$

Where PPV is the predicted peak vibration level at a nearby receptor

PPV_{ref} is the reference peak equipment vibration level at 25 feet

D is the distance between the equipment and the nearby receptor

General annoyance calculations at nearby receptor, which are based on VdB (RMS velocity) vibration levels were calculated as follows:

$$L_v = L_{v,ref} - 30 \log_{10}(D/25)$$

Where L_v is the predicted RMS vibration level at a nearby receptor

L_{v,ref} is the reference RMS equipment vibration level at 25 feet

D is the distance between the equipment and nearby receptor

The building damage and annoyance calculations above were used to determine the distance required for vibration produced from construction equipment to attenuate to below the FTA damage and annoyance criteria. This screening distance was used to determine the properties which may be affected by vibration produced from construction activities. The results in this section will be refined during final design by determining the site specific soil vibration propagation characteristics.

Reference vibration velocities from construction equipment used in this vibration impact assessment is presented in Table C-6 below.

| Table C-6. Construction Equipment Vibration Levels Used in Analysis | | |
|--|----------------------------------|---------------------------------|
| Equipment | Peak (PPV, inches/second) | RMS (L_v, VdB) |
| Backhoe | 0.003 | 58 |
| Concrete Mixer Truck | 0.076 | 86 |
| Concrete Pump Truck | 0.076 | 86 |
| Crane | 0.089 | 87 |
| Dozer | 0.089 | 87 |
| Drill Rig | 0.089 | 87 |
| Excavator | 0.089 | 87 |
| Gantry Crane | 0.089 | 87 |
| Haul Truck | 0.076 | 86 |
| Loader | 0.003 | 58 |
| Pile Driver (impact) | 0.644 | 104 |
| Pump Truck | 0.076 | 86 |
| Tunnel Boring Machine | 0.0836 | 86 |

Source: FTA Manual, 2006 and the Regional Connector Transit Corridor FEIS

Distances between construction activities and the different building construction categories were calculated to determine the minimum distances needed to prevent building damage. These distances are summarized in Table C-7 below. Equipment used within these minimum distances is expected to exceed the building damage criteria and may result in building damage.

| Table C-7. Distance to Building Damage Criteria (Feet) | | | | |
|---|-------------------------------------|------------------------|-------------------------|-------------------------|
| Equipment | FTA Building Damage Category | | | |
| | I (0.5 in/sec) | II (0.3 in/sec) | III (0.2 in/sec) | IV (0.12 in/sec) |
| Backhoe | 1 | 1 | 2 | 2 |
| Concrete Mixer Truck | 7 | 10 | 13 | 18 |
| Concrete Pump Truck | 7 | 10 | 13 | 18 |
| Crane | 8 | 11 | 15 | 20 |
| Dozer | 8 | 11 | 15 | 20 |
| Drill Rig | 8 | 11 | 15 | 20 |
| Excavator | 8 | 11 | 15 | 20 |
| Gantry Crane | 8 | 11 | 15 | 20 |
| Haul Truck | 7 | 10 | 13 | 18 |
| Loader | 1 | 1 | 2 | 2 |
| Pile Driver (impact) | 30 | 42 | 55 | 77 |
| Pump Truck | 7 | 10 | 13 | 18 |
| Tunnel Boring Machine | 8 | 11 | 14 | 20 |

Distances between construction activities and the different building use annoyance criteria were calculated to determine the minimum distances required to prevent occupant annoyance. These distances were derived using the VdB level of the equipment in Table C-7 and the vibration propagation equation provided above. Adjustment factors for prediction of ground borne vibration were also utilized from the FTA Manual.

These distances between the construction equipment and the building categories are summarized in Table C-8 below.

| Table C-8. Distance to Annoyance Criteria (Feet) | | | |
|---|-------------------------------|-------------------|-------------------|
| Equipment | FTA Annoyance Criteria | | |
| | 1 (65 VdB) | 2 (72 VdB) | 3 (75 VdB) |
| Backhoe | 9 | 8 | 4 |
| Concrete Mixer Truck | 79 | 68 | 37 |
| Concrete Pump Truck | 79 | 68 | 37 |
| Crane | 85 | 73 | 40 |
| Dozer | 85 | 73 | 40 |
| Drill Rig | 85 | 73 | 40 |
| Excavator | 85 | 73 | 40 |
| Gantry Crane | 85 | 73 | 40 |

| Table C-8. Distance to Annoyance Criteria (Feet) | | | |
|---|-------------------------------|-------------------|-------------------|
| Equipment | FTA Annoyance Criteria | | |
| | 1 (65 VdB) | 2 (72 VdB) | 3 (75 VdB) |
| Haul Truck | 79 | 68 | 37 |
| Loader | 9 | 8 | 4 |
| Pile Driver (impact) | 315 | 270 | 146 |
| Pump Truck | 79 | 68 | 37 |
| Tunnel Boring Machine | 82 | 70 | 38 |

Appendix D

Energy and Climate Change Technical Information

| Table D-1 Greenhouse Gas Emissions Part 1 | | | | | | |
|---|---------|---|--|--------|----------------|--|
| Section I: Buildings | | | | | | |
| Type (Residential) or Principal Activity (Commercial) | # Units | Square Feet (in thousands of square feet) | Emissions Per Unit or Per Thousand Square Feet (MTCO ₂ e) | | | Lifespan Emissions (MTCO ₂ e) |
| | | | Embodied | Energy | Transportation | |
| Single-Family Home | | | 98 | 672 | 792 | |
| Multi-Family Unit in Large Building | | | 33 | 357 | 766 | |
| Multi-Family Unit in Small Building | | | 54 | 681 | 766 | |
| Mobile Home | | | 41 | 475 | 709 | |
| Education | | | 39 | 646 | 361 | |
| Food Sales | | | 39 | 1541 | 282 | |
| Food Service | | | 39 | 1994 | 561 | |
| Health Care Inpatient | | | 39 | 1938 | 582 | |
| Health Care Outpatient | | | 39 | 737 | 571 | |
| Lodging | | | 39 | 777 | 117 | |
| Retail (Other than Mall) | | | 39 | 577 | 247 | |
| Office | | | 39 | 723 | 588 | |
| Public Assembly | | | 39 | 733 | 150 | |
| Public Order and Safety | | | 39 | 899 | 374 | |
| Religious Worship | | | 39 | 339 | 129 | |
| Service | | | 39 | 599 | 266 | |
| Warehouse and Storage | | | 39 | 352 | 181 | |
| Other - Tunnel | | 483.1204 | 39 | 1278 | 257 | 18,842 |
| Vacant | | | 39 | 162 | 47 | |
| TOTAL Section I Buildings | | | | | | |
| Section II: Pavement | | | | | | |
| | | | | | | Emissions (MTCO ₂ e) |
| Pavement (sidewalk, asphalt patch) | | 69 | | | | 3.45 |
| Concrete Pad | | 121 | | | | 6.05 |
| TOTAL Section II Pavement | | | | | | 9.5 |
| Section III: Construction | | | | | | |
| (See detailed calculations below) | | | | | | Emissions (MTCO ₂ e) |
| TOTAL Section III Construction | | | | | | 16,840.41 |
| Section IV: Operations and Maintenance | | | | | | |
| (See detailed calculations below) | | | | | | Emissions (MTCO ₂ e) |
| TOTAL Section IV Operations and Maintenance | | | | | | 31.74 |
| TOTAL GREENHOUSE GAS (GHG) EMISSIONS FOR PROJECT (MTCO₂e) | | | | | | 35,692.00 |

| Table D-2 - Greenhouse Gas Emissions Part 2 | | |
|---|---------------------------|---|
| Section III: Construction Details | | |
| Construction: Diesel | | |
| Equipment | Diesel (gallons) | Assumptions |
| Storage Tunnel and TEPs | | |
| Semi Truck (Standard Engine/Flatbed) | 28,800 | Assume 360 days (8 trips per day) x 50 miles RT |
| Semi Truck (Standard Engine/Flatbed) | 4,800 | Assume 240 days (2 trips per day) x 50 miles RT |
| Dump Truck (w/ pup trailer) | 180,000 | Assume 360 days (50 trips per day) x 50 miles RT |
| Dump Truck (w/ pup trailer) | 24,000 | Assume 120 days (20 trips per day) x 50 miles RT |
| Concrete Truck, Standard Rear Barrel | 36,000 | Assume 180 days (20 trips per day) x 50 miles RT |
| Concrete Truck, Standard Rear Barrel | 14,400 | Assume 240 days (6 trips per day) x 50 miles RT |
| Service/Work Truck/Van | 24,000 | Assume 960 days (6 trips per day) x 50 miles RT |
| Excavator, Wheel Mounted, 164 HP | 16,704 | Assume 360 days (8 hours per day) |
| Front End Loader, GP, 4x4, 165 HP | 28,224 | Assume 720 days (8 hours per day) |
| Bulldozer, D10T, 646 HP | 31,104 | Assume 720 days (8 hours per day) |
| Backhoe CAT 446B, 100 HP | 21,888 | Assume 720 days (8 hours per day) |
| Crane, Lattice Boom, 260 HP | 80,640 | Assume 960 days (8 hours per day) |
| Drill Rig, Truck Mounted 115 HP | 2,752 | Assume 80 days (8 hours per day) |
| Drill Rig, Truck Mounted 190 HP | 3,648 | Assume 80 days (8 hours per day) |
| Asphalt Concrete Paver, AP-200B, 35 HP | 744 | Assume 30 days (8 hours per day) |
| Asphalt Concrete Compactor, CB-434C, 80 HP | 1,080 | Assume 30 days (8 hours per day) |
| Concrete Pump, Trailer Mounted, 60 HP | 16,128 | Assume 720 days (8 hours per day) |
| Onsite Diesel Generator, 100 kW | 56,832 | Assume 960 days (8 hours per day) |
| Conveyance | | |
| Semi Truck (Standard Engine/Flatbed) | 7,200 | Assume 360 days (2 trips per day) x 50 miles RT |
| Semi Truck (Standard Engine/Flatbed) | 800 | Assume 80 days (1 trips per day) x 50 miles RT |
| Dump Truck (w/ pup trailer) | 19,200 | Assume 480 days (4 trips per day) x 50 miles RT |
| Dump Truck (w/ pup trailer) | 2,400 | Assume 120 days (2 trips per day) x 50 miles RT |
| Concrete Truck, Standard Rear Barrel | 10,800 | Assume 180 days (6 trips per day) x 50 miles RT |
| Concrete Truck, Standard Rear Barrel | 3,600 | Assume 180 days (2 trips per day) x 50 miles RT |
| Service/Work Truck/Van | 24,000 | Assume 960 days (6 trips per day) x 50 miles RT |
| Excavator, Wheel Mounted, 164 HP | 33,408 | Assume 720 days (8 hours per day) |
| Front End Loader, GP, 4x4, 165 HP | 28,224 | Assume 720 days (8 hours per day) |
| Bulldozer, D10T, 646 HP | 3,456 | Assume 80 days (8 hours per day) |
| Backhoe CAT 446B, 100 HP | 21,888 | Assume 720 days (8 hours per day) |
| Crane, Mobile, Grove RT500C 28 Ton | 10,368 | Assume 240 days (8 hours per day) |
| Drill Rig, Truck Mounted 115 HP | 2,752 | Assume 80 days (8 hours per day) |
| Drill Rig, Truck Mounted 190 HP | 3,648 | Assume 80 days (8 hours per day) |
| Asphalt Concrete Paver, AP-200B, 35 HP | 4,464 | Assume 180 days (8 hours per day) |
| Asphalt Concrete Compactor, CB-434C, 80 HP | 6,480 | Assume 180 days (8 hours per day) |
| Concrete Pump, Trailer Mounted, 60 HP | 1,344 | Assume 60 days (8 hours per day) |
| Onsite Diesel Generator, 100 kW | 56,832 | Assume 960 days (8 hours per day) |
| Subtotal Diesel Gallons | 812,608 | |
| GHG Emissions in lbs CO₂e | 21,574,742 | 26.55 lbs CO ₂ e per gallon of diesel |
| GHG Emissions in metric tons CO₂e | 9,786.14 | 1,000 lbs = 0.45359237 metric tons |
| Construction: Gasoline | | |
| Equipment | Gasoline (gallons) | Assumptions |
| Construction worker personal vehicles | 640,000 | Assume 960 days (200 trips per day) x 50 miles RT |
| Subtotal Gasoline Gallons | 640,000 | |
| GHG Emissions in lbs CO₂e | 15,552,000 | 24.3 lbs CO ₂ e per gallon of gasoline |
| GHG Emissions in metric tons CO₂e | 7,054.27 | 1,000 lbs = 0.45 metric tons |
| Construction Summary | | |

| Activity | CO ₂ e in pounds | CO ₂ e in metric tons |
|---|-----------------------------|--|
| Diesel | 21,574,742 | 9,786.14 |
| Gasoline | 15,552,000 | 7,054.27 |
| Total for Construction | 37,126,742 | 16,840.41 |
| Section IV: Long-Term Operations and Maintenance Details | | |
| Operations and Maintenance: Diesel | | |
| Equipment | Diesel (gallons) | Assumptions |
| | | |
| | | |
| | | |
| Subtotal Diesel Gallons | | |
| GHG Emissions in lbs CO₂e | | 26.55 lbs CO ₂ e per gallon of diesel |
| GHG Emissions in metric tons CO₂e | | 1,000 lbs = 0.45 metric tons |
| Operations and Maintenance: Gasoline | | |
| Equipment | Gasoline (gallons) | Assumptions |
| Vactor Truck | 1,080 | Assume 1 day (per month) x 1 truck x 30-mile RT at 10 mpg |
| Service/Work Truck/Van, Standard | 1,440 | Assume 4 days (per month) x 1 truck x 10-mile RT at 10 mpg |
| Lift Truck, Boom | 360 | Assume 1 day (per month) x 1 truck x 10-mile RT at 10 mpg |
| | | |
| Subtotal Gasoline Gallons | 2,880 | |
| GHG Emissions in lbs CO₂e | 69,984 | 24.3 lbs CO ₂ e per gallon of gasoline |
| GHG Emissions in metric tons CO₂e | 31.74 | 1,000 lbs = 0.45 metric tons |
| Operations and Maintenance Summary | | |
| Activity | CO ₂ e in pounds | CO ₂ e in metric tons |
| Diesel | | |
| Gasoline | 69,984 | 31.74 |
| Total for Operations and Maintenance | 69,984 | 31.74 |