Protecting Seattle's Waterways

Volume 4
Draft Programmatic Environmental Impact Statement

May 29, 2014

City of Seattle
Seattle Public Utilities

May 29, 2014

Dear Affected Agencies, Tribes, Organizations and Interested Parties:

The City of Seattle (City) is pleased to issue the Draft Environmental Impact Statement (Draft EIS) for the Plan to Protect Seattle's Waterways.

The City is preparing a comprehensive strategy, called the Plan to Protect Seattle's Waterways (Plan), to reduce overflows and the discharge of pollutants from combined sewers and stormwater runoff. The City must correct this problem to protect public health and the environment, and comply with the federal Clean Water Act, state regulations, and a Consent Decree with the Washington State Department of Ecology, the U.S. Environmental Protection Agency, and the U.S. Department of Justice. This Draft EIS is one of four volumes included in the Plan. The Executive Summary is Volume 1, the Long Term Control Plan (LTCP) is Volume 2, the Integrated Plan is Volume 3, and the Draft EIS is Volume 4.

This programmatic EIS discloses the construction and operational impacts associated with implementation of each Plan alternative:

- The No Action Alternative – completes only the combined sewer overflow (CSO) reduction projects currently planned or underway by the City, leaving 22 CSO outfalls uncontrolled;
- The Long Term Control Plan Alternative – completes CSO reduction projects needed to control the remaining 22 CSO outfalls,
- The Integrated Plan Alternative – also completes CSO reduction projects needed to control the remaining 22 CSO outfalls and implements additional projects to reduce stormwater pollution.

The Long Term Control Plan Alternative includes four options, any of which would control the remaining 22 CSO outfalls and meet regulatory requirements:

- Neighborhood Storage Option – All storage projects would be completed independently by the City, with one option providing storage in tanks/pipes, and the other a combination of a tunnel and tanks/pipes.
- Shared West Ship Canal Tunnel Option – Where feasible, storage projects would be completed jointly by the City and King County. This option includes storage tanks/pipes and a shared City/King County tunnel for storage of flows from three of the largest CSO areas.
- Shared Ship Canal Tunnel Option – This option includes a large shared City/King County tunnel for storage from seven of the largest CSO areas, as well as storage tanks and pipes.
- Shared Storage Option – The City and King County would complete shared storage projects in the Ship Canal, Portage Bay and Lake Washington areas.

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Any shared projects between the City and King County would be implemented in accordance with joint project agreements between the two agencies.

Impacts are evaluated at a programmatic level, to provide a comprehensive evaluation of potential impacts and mitigation associated with implementation of the Plan. Site-specific project evaluations will be conducted at a later date, when additional information is available.

Environmental elements covered in the EIS include Earth and Groundwater, Air Quality and Odors, Surface Water, Biological Resources, Energy and Climate Change, and Environmental Health. Noise and Vibration, Land Use and Visual Quality, Recreation, Historic and Cultural Resources, Transportation, Utilities, and Socioeconomics and Environmental Justice are also evaluated.

Key issues associated with the alternatives and options include potential construction-related impacts, particularly traffic, noise, and other community impacts during construction periods that could range from roughly one year to as much as seven years, depending upon the size of the project. Possible long term impacts include a potential for odor and noise at storage facilities, and potential operational implications for the region's wastewater system. Appropriate design and mitigation, along with coordination with potentially affected agencies and organizations, will reduce the potential for significant impacts.

A **public meeting on the Plan and a public hearing on the Draft EIS** will be held **Tuesday, June 24, 2014 starting at 6:00 pm** at **the Lake Washington Rowing Club,** 910 N. Northlake Way, Seattle. The **public hearing will begin at 6:30 pm.** The public, interested agencies, and tribal governments are invited to review and comment on the Plan and proposed alternatives during the public meeting. Public testimony and written comments on the Draft EIS will be accepted during the public hearing. Additional information on the Plan, public meeting and public hearing, and other opportunities to comment on the Plan can be found in the Fact Sheet and at www.seattle.gov/CSO.

Thank you for your interest in the Plan to Protect Seattle's Waterways.

Sincerely,

Betty Meyer

Betty Meyer

SEPA Responsible Official

Fact Sheet

Name of Proposal

Plan to Protect Seattle's Waterways (the Plan)

Proponent

City of Seattle (City): Seattle Public Utilities (SPU)

Location

Projects included in the Plan would be located throughout the City of Seattle in the following areas:

- Ship Canal Neighborhoods
- Lake Washington Neighborhoods
- Longfellow Creek/ Duwamish Neighborhoods
- Elliott Bay/ Lake Union Neighborhoods
- Piper's Creek Neighborhoods
- Thornton Creek Neighborhoods

Purpose

The objective of this proposal is to adopt a Plan to reduce overflows and the discharge of pollutants from combined sewers and stormwater runoff, in order to protect public health and the environment and to comply with federal and state regulations. When implemented, the Plan would bring Seattle into compliance with state and federal combined sewer overflow (CSO) regulations and a Consent Decree with the Washington State Department of Ecology, the U.S. Environmental Protection Agency, and the U.S. Department of Justice. Specifically, the Plan would achieve the following objectives:

- Identify areas of Seattle where projects are needed to reduce combined sewer overflows.
- Evaluate alternatives for reducing combined sewer overflows in these areas.
- Identify additional areas where projects to reduce stormwater pollution would improve water quality.
- Recommend a schedule for designing and constructing projects.
- Estimate program costs and associated impacts on SPU customer bills.
- Consider regulatory, public and stakeholder input.

Proposed Alternatives

SPU identified the following alternatives for evaluation in this EIS:

- No Action Alternative
- Long-Term Control Plan Alternative
- Integrated Plan Alternative

No Action Alternative: Under the No Action Alternative, the City would not implement the Plan. Progress would be made in reducing the number and volume of CSOs through implementation of previously planned CSO control projects identified in the City's National Pollutant Discharge Elimination System (NPDES) Waste Discharge Permit. Most of these projects were identified in the 2010-2015 Implementation Plan for the *2010 CSO Reduction Plan Amendment* (2010 Plan Amendment). These projects are currently funded and are scheduled for implementation, and they will occur regardless of whether the Plan is implemented. The City would also continue to implement a portion of two of its CSO reduction strategies: combined sewer system improvements and Natural Drainage Systems (called 'Green Infrastructure' in the LTCP). However, the City would not implement any additional projects to further reduce CSOs or reduce stormwater pollution. Under the No Action Alternative, the City would not be in compliance with the Consent Decree. SEPA requires that the No Action Alternative be included, and serves as a baseline for comparison with the action alternatives.

Long-Term Control Plan Alternative: The Long-term Control Plan (LTCP) Alternative is focused solely on controlling all remaining uncontrolled CSO outfalls. As a planning-level document, the LTCP presents a comprehensive strategy to reduce the remaining uncontrolled CSO discharges in the city. The City must address these CSOs to protect public health and the environment, and comply with the Clean Water Act and state regulations. The City would implement the projects identified in the LTCP Alternative from 2016 through 2025.

There are four potential combinations of storage facilities, referred to as "options" under the LTCP that are evaluated in this EIS. Any of these four options would meet the Plan objectives. The options were developed under one of two basic concepts: the City meets its Consent Decree-mandated CSO control requirements through implementation of independent (City only) control projects, or the City participates in one or more shared projects with King County to take advantage of potential cost /impact reduction opportunities. The options vary in terms of the number, size, and potential location of storage facilities considered.

- Neighborhood Storage Option (independent, City only implementation)
  - Neighborhood Tanks/Pipes, or
  - Neighborhood West Ship Canal Tunnel plus Tanks/Pipes
- Shared West Ship Canal Tunnel Option (Shared King County / City implementation)
- Shared Ship Canal Tunnel Option (Shared King County /City implementation)
- Shared Storage Option (Shared King County / City implementation)

Integrated Plan Alternative: The Integrated Plan Alternative includes control of all remaining uncontrolled CSO outfalls and reduction of stormwater pollution. Stormwater that enters the City's separate stormwater system is a major contributor to surface water quality issues. The objective of the Integrated Plan is to implement stormwater pollution management projects that would provide greater benefits to surface water quality than those provided by the LTCP CSO reduction strategies alone. The Integrated Plan represents a more comprehensive approach to water quality management by integrating stormwater pollution management with CSO reduction strategies.

Under the Integrated Plan Alternative, the City would still build the CSO reduction projects included in one of the four LTCP options outlined above. However, the City would delay the completion of some of the CSO control projects until 2030, while high-benefit stormwater treatment technology projects would be completed prior to 2025. Six projects to control CSO discharges into the lower Duwamish, Portage Bay and Ship Canal waterways would be constructed between 2028 and 2030.

Under the Integrated Plan Alternative, the City would implement three programs/projects in Seattle neighborhoods to reduce pollution from stormwater runoff in areas that are not part of the combined sewer system, using a combination of stormwater treatment technologies. These programs/projects include:

- Natural Drainage System (NDS) Partnering
- Arterial Street Sweeping Expansion
- South Park Water Quality Facility

Selection of a Preferred Alternative

Foremost in the development of the Plan is the need to comply with the Consent Decree and meet federal and state regulatory requirements. In order to comply with the Consent Decree, the City must select and implement an LTCP option. The option that is selected as the preferred alternative could have smaller elements than those described in the draft LTCP/Integrated Plan. For example, smaller flow diversions could become small storage tanks. However, the major CSO control measure, such as Shared Storage Tanks along the Ship Canal or the Shared Ship Canal Tunnel would not change. An Integrated Plan is an optional approach that is not required, but can be used to satisfy the Consent Decree.

The City will continue to solicit input on the Plan from the public and other stakeholders, during and following the Draft EIS comment period. Identification of a preferred alternative is expected to occur following release of the Final EIS in late 2014.

Timing of Additional Environmental Review

The analysis presented in this EIS is programmatic in nature. The EIS has been prepared to disclose probable significant adverse impacts associated with the Plan to Protect Seattle's Waterways. As individual projects are identified, site-specific environmental review will be conducted prior to implementation. Depending on the preferred alternative and the amount of time needed to obtain regulatory approval of the Plan, some projects and actions would be ready for site-specific environmental review starting in 2016.

Required Approvals or Permits

Because a preferred alternative has not been selected, it is not possible to present a complete list of approvals and permits that would be required for future projects. It is possible to identify the most common types of approvals and permits that would generally be required for the types of projects presented in this document. These approvals and permits are listed below by jurisdictional agency.

- Federal
  - Section 10/404 permit--U.S. Army Corps of Engineers
  - Endangered Species Act consultation--National Marine Fisheries Service and/or U.S. Fish and Wildlife Service
- State
  - National Pollutant Discharge Elimination System (NPDES) construction stormwater general permit--Ecology
  - Section 401 water quality certification--Ecology
  - Shoreline conditional use permit, or variance--Ecology
  - Hydraulic project approval--Washington Department of Fish and Wildlife (WDFW)
  - Section 106 National Historic Preservation Act or Executive Order 05-05 consultation--Department of Archaeology and Historic Preservation
- City
  - Environmentally critical areas approval--Department of Planning and Development (DPD)
  - Master Use Permit--DPD, Seattle City Council, as appropriate
  - Floodplain development permit---DPD
  - Shoreline Management Program permit--DPD
  - Building and related permits--DPD
  - Clearing and grading permit--DPD
  - State Environmental Policy Act (SEPA) compliance--Seattle Public Utilities
  - Initiative 42 approval (park lands conversion)--Seattle City Council
  - Street use permit--Seattle Department of Transportation

Authors and Principal Contributors to this EIS

This Draft EIS has been prepared under the direction of Seattle Public Utilities. The following consulting firms provided research and analysis associated with this EIS:

- **ESA** - lead EIS consultant, document preparing; writing of all EIS sections
- **CH2M Hill** - engineering support
- **Brown and Caldwell** - engineering support
- **Herrera Environmental Consultants** – analysis of water resources
- **Heffron Transportation, Inc.** – transportation analysis
- **PRR** – public outreach

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May 29, 2014

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Due Date of Draft EIS Comments

Comments on the Draft EIS are invited and must be postmarked or emailed on or before midnight on June 30, 2014. Comments must be addressed to the SEPA Responsible Official noted above.

Date of Draft EIS Public Hearing

A public meeting on the Plan and a public hearing on the Draft EIS will be held Tuesday, June 24, 2014 starting at 6:00 p.m. at the Lake Washington Rowing Club, 910 N Northlake Way, Seattle, WA. The public hearing will begin at 6:30 p.m.

The purpose of the public hearing is to provide an opportunity for individuals, agencies, and organizations to review information concerning the Draft EIS and to present oral or written comments on the Draft EIS.

Availability of the Draft EIS and Background Materials

The Draft EIS is available for viewing at the following locations:

- Seattle Public Utilities, Director's Office Main Reception Area, Seattle Municipal Tower, Suite 4900, 700 Fifth Avenue, Seattle, Washington
- Seattle Central Library, General Reference Section
- Online at www.seattle.gov/CSO

The Draft EIS can be downloaded for free from the City's website www.seattle.gov/CSO or purchased on CD for $10 or in paper form for $170. Purchased copies will be mailed upon receipt of a check made payable to Seattle Public Utilities.

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

They may also be viewed in paper form by arranging a time with Ed Mirabella at the number or email listed above.

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List of Abbreviations

Term	Definition
BMP	best management practice
BNSF	Burlington Northern Santa Fe
BPA	Bonneville Power Administration
CFR	Code of Federal Regulations
City	City of Seattle
CSO	Combined Sewer Overflow
DAHP	Washington Department of Archaeology and Historic Preservation
dB	decibel
dBA	decibels on the A-weighted scale
DDE	dichlorodiphenyldichloroethylene
DHHS	Department of Health and Human Services
DNRP	King County Department of Natural Resources and Parks
DPD	Seattle Department of Planning and Development
DPS	Distinct Population Segment
Ecology	Washington State Department of Ecology
EIS	Environmental Impact Statement
EDCs	endocrine-disrupting compounds
EPA	Environmental Protection Agency
ESU	Evolutionarily Significant Unit
FHWA	Federal Highway Administration
GHG	greenhouse gas
GIS	Geographic Information System
I-5	Interstate 5
I-90	Interstate 90
LTCP	Long-Term Control Plan
LUST	leaking underground storage tank
MG	million gallons
MGD	million gallons per day
MG/yr	million gallons per year
MODA	Multiple Objective Decision Analysis
MS4	municipal separate storm sewer system
MTCA	Model Toxics Control Act

Term	Definition
MUTCD	*Manual on Uniform Traffic Control Devices*
NIDCD	National Institute on Deafness and Other Communication Disorders
NMFS	National Marine Fisheries Service
NPDES	National Pollutant Discharge Elimination System
PCB	polychlorinated biphenyl
PHS	Priority Habitat and Species
The Plan	The Plan to Protect Seattle's Waterways
PPCPs	pharmaceuticals and personal care products
PSCAA	Puget Sound Clean Air Agency
PSE	Puget Sound Energy
RCW	Revised Code of Washington
RPZ	Restricted Parking Zone
SDOT	Seattle Department of Transportation
SEPA	State Environmental Policy Act
SMC	Seattle Municipal Code
SODO	South of Downtown neighborhood
SPU	Seattle Public Utilities
SR	State Route
TBM	Tunnel Boring Machine
TMDL	Total Maximum Daily Load
USFWS	U.S. Fish and Wildlife Service
WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife
WDNR	Washington Department of Natural Resources
WNHP	Washington National Heritage Program
WSDOT	Washington State Department of Transportation

Glossary

Term	Definition
Alternative	There are 3 alternatives for the Plan to Protect Seattle's Waterways: 1. The LTCP Alternative is focused solely on reducing CSOs under an approved Long-term Control Plan (LTCP), 2. The Integrated Plan Alternative includes reduction of both CSOs and stormwater pollution, 3. The No Action Alternative, which provides a baseline for comparison of potential effects of the Plan alternatives, as required by the State Environmental Policy Act (SEPA).
Anadromous Fish	Fish species, such as salmon, which are born in fresh water, spend most of their lives in salt water, and return to fresh water to spawn.
Best Management Practice (BMP)	A method, activity, or procedure for reducing the amount of pollution entering a water body.
Carbon Monoxide	A colorless and odorless toxic gas.
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act.
CFS	Flow rate in Cubic Feet per Second.
Code of Federal Regulations (CFR)	A compilation of federal laws.
Combined Sewers	Conveyance systems designed to carry both wastewater and stormwater.
Combined Sewer Overflow(CSO)	During rainfall events, the volume of the stormwater entering a combined sewer system often is far greater than the capacity of the conveyance system and, as a result, the untreated sewage and stormwater mixture empties directly into receiving waters through designated overflow points.
Combined Sewer System (CSS)	The wastewater collection and conveyance system owned or operated by the City, including all pipes, force mains, gravity sewer segments, pump stations, lift stations, interceptors, diversion structures, maintenance holes, and appurtenances thereto, designated to collect and convey municipal sewage, including residential, commercial, and industrial wastewaters, and stormwater, through a single-pipe system to King County's wastewater treatment plants, King County's CSO treatment plants, or to permitted CSO outfalls.

Consent Decree	A written agreement entered in federal court on July 3, 2013, between the City of Seattle, Washington State Department of Ecology, the EPA, and the United States Department of Justice that describes the actions that The City must take to address violations of the Clean Water Act.
Control Status	Whether an outfall meets the Consent Decree's definition of "greatest reasonable reduction" of CSOs; an average of no more than one overflow occurrence per outfall per year determined on a 20 year moving average.
Controlled	The control of a CSO outfall in accordance with WAC 173-245-020(22).
Critical Habitat	Habitat which is essential for the conservation of a threatened or endangered species.
CSO Control Measure	A project, action, or other activity set forth in the City's Long-Term Control Plan or any Supplemental Compliance Plan, provided for in Section V.B. of the Consent Decree, that controls CSO outfall.
CSO Outfall	The water structure from which a CSO is discharged into a receiving water.
CWA	Clean Water Act; passed by Congress in 1972, meant to restore and maintain the integrity of the nation's waters.
Designated Receiving Water	Waters determined by SPU as having sufficient capacity to receive discharges of drainage water such that a site discharging to the designated receiving water is not required to implement flow control. Includes the Duwamish River, Puget Sound, Lake Washington, Lake Union, Elliott Bay, Portage Bay, Union Bay, and the Lake Washington Ship Canal.
Dewatering	The pumping of groundwater from an excavated area so the area to facilitate construction.
DNRP	King County Department of Natural Resources and Parks
Early Action Projects	The Consent Decree mandates that the City shall implement all CSO control measures necessary to reduce discharges from CSO outfalls in the North and South Henderson Areas.
Ecology	The State of Washington Department of Ecology.
Endocrine-Disrupting Compounds	Natural and synthetic compounds that are known to disrupt hormone systems in animals.
Environmental Impact Statement (EIS)	A document that discloses the probable significant adverse environmental impacts of a proposed project or planning, discusses reasonable mitigation of identified impacts, and evaluates alternatives to the project and/or proposal. EISs are required under certain circumstances by the Washington State Environmental Policy Act (SEPA).

Environmental Justice	The fair treatment of people of all races and incomes with respect to actions affecting the environment. Fair treatment implies that there is equity of the distribution of benefits and risks associated with a proposed project and that one group does not suffer disproportionate adverse effects.
Erosion	The wearing away of land surfaces by wind or water. Erosion can be intensified by land clearing processes. Sediment is a product of stream erosion.
Fecal Coliform	A group of bacteria that are passed through the fecal excrement of humans, livestock, and wildlife.
Green (Stormwater) Infrastructure	Systems and practices that use or mimic natural processes to infiltrate, evapotranspire, and/or harvest stormwater on or near the site where it is generated. Green infrastructure may include, but is not limited to, green roofs, downspout disconnection, trees and tree boxes, rain gardens, vegetated swales, pocket wetlands, infiltration planters, vegetated median strips, permeable pavements, reforestation, and protection and enhancement of riparian buffers and floodplains.
Groundwater	Water that infiltrates into the earth and is stored in the soil and rock within the zone of saturation below the earth's surface. Groundwater is created by rain, which soaks into the ground and flows down until it is collected at a point where the ground is not permeable. Groundwater then usually flows laterally toward a river, lake, or ocean. It is often used for supplying wells and springs.
Historic Property	Any building, site, district, structure, or object (that has archeological or cultural significance) included in, or eligible for inclusion in, the National Register.
Impaired Waters	Waters whose beneficial uses are impaired by pollutants.
Launching Portal	A primary portal used to insert a tunnel boring machine for excavation of tunnels. Lining and ventilation operations would also occur at these portals.
Lead	A toxic metal found in the emissions from motor vehicles and industrial sources.
Long Term Control Plan (LTCP)	The Long Term Control Plan under development by the City in accordance with Section V.B. of the CD, as well as any additional remedial measures for eliminating or reducing the City's CSOs included in any Supplemental Compliance Plan developed and implemented in accordance with Section V.B. of the CD.
LTCP Option	An overall CSO Control Strategy which ultimately will resolve all SPU uncontrolled outfalls; the four possible Options are: Neighborhood Storage, Shared Storage, Shared West Ship Canal Tunnel, Shared Ship Canal Tunnel.

Natural Drainage System	A method that uses soil to absorb stormwater and slow the rate that it enters the sewer system. Examples include rain gardens, porous pavement, and cisterns.
Neighborhood	A term used in this EIS to characterize the potential affected areas. (Note: this term is not used in Volume 2, LTCP.)
Nitrogen Dioxide	A highly reactive gas formed from the emissions of motor vehicles, power plants, and off-road equipment. Nitrogen dioxide contributes to ground-level ozone and fine particle pollution and has adverse effects on the respiratory system.
Open Cut	See “trenching”.
Ozone	An atmospheric pollutant created by chemical reactions of other pollutants in the air when exposed to sunlight.
Partially Separated Stormwater System	Street drainage system that routes runoff to separate storm sewers and conveys the remaining drainage in a combined sewer.
Pharmaceuticals and Personal Care Products	Prescription and over-the-counter drugs, illicit drugs, other pharmaceutical substances (diagnostic agents and inert ingredients), and products such as shampoo, soap, fragrances, and lotions.
Pile	A large pole driven into the earth to support a building or other superstructure.
The Plan	The Plan to Protect Seattle’s Waterways, includes 4 Volumes: Executive Summary, Long Term Control Plan, Integrated Plan, and Environmental Impact Statement.
Priority Habitats and Species	The Priority Habitats and Species list is a catalog of habitats and species considered to be priorities for conservation and management. The list is published by the Washington Department of Fish and Wildlife.
Pump Station	A structure that houses pumps and other equipment for lifting stormwater or wastewater in pipes to higher elevations so that it can continue to flow by gravity
Rain Garden	Small vegetated depressions with designed soil mixes that retain runoff for subsequent infiltration or delayed release to the combined sewer system.
Receiving Water	Any body of water which receives CSO and stormwater discharges.
Recovery Portal	A primary portal used to remove tunnel boring machines during construction of tunnels.
Salmonids	The common name for several species of fish of the family Salmonidae. The family includes salmon, trout, and char.
Sensitive Receptors	Noise-sensitive locations including residences, schools, hospitals, and nursing homes.

Shared	A reduction strategy that is implemented by Seattle Public Utilities and King County Department of Natural Resources and Parks (DNRP).
State Environmental Policy Act (SEPA)	A Washington State law (Chapter 43.21C RCW) that requires state agencies and local governments to consider environmental impacts when making decisions regarding certain activities, such as development proposals over a certain size, and comprehensive plans. As part of this process, environmental impacts are documented and opportunities for public comment are provided.
Storm Drain	A system of gutters, pipes, or ditches used to carry stormwater from surrounding lands to streams, lakes, or other receiving water. Also refers to the end of the pipe where the stormwater is discharged.
Storm Sewer	A pipe (separated from sanitary sewers) that carries only stormwater runoff from buildings and land surfaces.
Stormwater Runoff	Stormwater is rain and melting snow that runs off surfaces that cannot readily absorb water, such as streets, rooftops, and parking lots. As stormwater runs across these hard surfaces, it picks up pollutants such as oil, grease, and metals, carrying them through the City's storm drain system to our lakes, streams, rivers, and Puget Sound. It also flows into the combined sewer system and causes overflows of raw sewage and polluted stormwater into Seattle waterways.
Sulfur Dioxide	A highly reactive gas emitted by fossil fuel combustion at power plants and industrial facilities. Sulfur dioxide has adverse effects on the respiratory system.
Superfund Sites	Site designated by the EPA as having uncontrolled hazardous materials. EPA develops plans for a long-term cleanup process for each Superfund site.
Surface Water	Any water, including fresh water and salt water, on the surface of the earth.
Trenching	A method for installing pipe near the surface, also called "open cut." The trenching method consists of three stages: digging a trench and stockpiling excavated materials; installing pipe in the trench; and backfilling the trench and restoring the surface.
Truck Trip	A trip made by a truck hauling materials or workers for construction projects.
Tunneling	Method used for excavating a tunnel within the earth and installing pipes. A tunnel boring machine (TBM) is inserted through a launching portal and retrieved from a recovery portal.

CHAPTER 1

Summary

This summary highlights the major components of the Draft Environmental Impact Statement (EIS) for the **Plan to Protect Seattle's Waterways** (the Plan). It provides an overview of the Plan, discusses the main features of the alternatives, and summarizes the potential adverse impacts and proposed measures for reducing the potential adverse impacts of each Plan alternative.

1.1 What is the Plan to Protect Seattle's Waterways and why is it needed?

Sewers in the City of Seattle carry raw sewage and other wastewater away from neighborhoods for treatment at King County's West Point Treatment Plant before discharge to Puget Sound. When it rains, some of these same sewers also carry untreated stormwater from neighborhood roofs, foundation drains, and some streets. During heavy rains, if the amount of raw sewage and untreated stormwater exceeds the sewer system capacity, the excess flow discharges into local waterways. These "combined sewer overflows," or CSOs, are a public health and environmental concern. In addition, stormwater runoff from streets, parking lots, and buildings contributes a wide range of pollutants to the city's waters.

The objective of this proposal is to adopt a Plan to reduce overflows and the discharge of pollutants from combined sewers and stormwater runoff, in order to protect public health and the environment and to comply with federal and state regulations.

1.2 What Alternatives does this EIS Consider?

The Draft EIS is a programmatic or plan-level evaluation, assessing the broad, comprehensive implications and impacts associated with adoption and implementation of the Plan. Additional project-level evaluations will be conducted in accordance with the City's State Environmental Policy Act (SEPA) ordinance when additional project details are available, and as such this EIS is part of a phased review SEPA process.

The Draft EIS evaluates two Plan alternatives and a No Action Alternative. The two Plan alternatives represent different ways of achieving the objectives of the Plan.

The **LTCP Alternative** is focused solely on reducing CSOs under an approved Long Term Control Plan (LTCP). As a planning-level document, the LTCP presents a comprehensive strategy to reduce the remaining uncontrolled CSO discharges in the city. The City must address these CSOs to protect public health and the environment, and comply with the Clean Water Act and state regulations. The City would implement the projects identified in the LTCP Alternative from 2016 through 2025, to comply with federal requirements, including a federal Consent Decree.

What is the Consent Decree?

The Consent Decree is a written agreement between the City of Seattle, Washington State Department of Ecology, U.S. Environmental Protection Agency, and the U.S. Department of Justice that describes the actions that the City of Seattle must take to address violations of the Clean Water Act.

The **Integrated Plan Alternative** includes reduction of CSOs and stormwater pollution. Stormwater that enters the City's separate stormwater system is a major contributor to surface water quality issues. The objective of the Integrated Plan is to implement stormwater pollution management projects that would provide greater benefits to surface water quality than those provided by the LTCP CSO reduction strategies alone. The Integrated Plan represents a more comprehensive approach to water quality management by integrating stormwater pollution management with CSO reduction strategies.

Previously, the City implemented CSO control measures and stormwater management as separate and distinct programs. Recognizing that polluted runoff has a big impact on surface water quality, the Consent Decree allows the City to prepare a plan that integrates CSO control projects with stormwater control projects. Under the Consent Decree, the City may submit an Integrated Plan that proposes stormwater control projects and defers certain CSO control projects, provided that the stormwater projects will result in significant benefits to surface water quality beyond those that would be achieved by implementation of CSO controls alone, and the CSO control projects deferred would be completed by a specific date after 2028.

The **No Action Alternative** provides a baseline for comparison of potential effects of the Plan alternatives, as required by SEPA. Under the No Action Alternative, progress will be made in controlling CSOs through implementation of previously planned CSO control projects identified in the City's National Pollutant Discharge Elimination System (NPDES) Waste Discharge Permit (WA0031682) and included in the 2010-2015 Implementation Plan for the *2010 CSO Reduction Plan Amendment* (2010 Plan Amendment). These projects are currently funded and are scheduled for implementation, and they will occur regardless of whether the Plan is implemented.

The City would also continue to implement a portion of two of its CSO reduction strategies, combined sewer system improvements and Natural Drainage Systems (called 'Green Infrastructure' in the LTCP). However, the City would not implement any additional CSO reduction or stormwater control projects beyond those that are currently funded and slated for implementation. Under the No Action Alternative, untreated sewage and stormwater in excess of current regulations would continue to discharge into Lake Washington, the Lake Washington Ship Canal (Ship Canal), the Duwamish River, and Puget Sound when the capacity of the existing systems is exceeded. Under the No Action Alternative, the City would not be in compliance with the Consent Decree.

1.3 What is included in the LTCP Alternative?

The LTCP Alternative uses a combination of traditional storage facilities and sewer system improvements to reduce CSOs in 11 CSO areas throughout Seattle. For the purpose of this EIS, CSO areas within the City's service area have been grouped into what are referred to as "neighborhoods". In *Volume 2, LTCP* these are referred to as CSO areas only. Figure 1-1 illustrates the neighborhoods relative to designated CSO areas and outfalls. The LTCP also explores opportunities to partner with King County on collaborative projects to control both agencies' CSOs. These Plan area neighborhoods include:

- **Ship Canal Neighborhoods**—Ballard, Fremont/Wallingford, Magnolia;
- **Lake Washington Neighborhoods**—North Union Bay, Portage Bay, Montlake, and Leschi
- **Longfellow Creek/Duwamish Neighborhoods**—Delridge, Duwamish, and East Waterway; and
- **Elliott Bay/Lake Union Neighborhoods**—Central Waterfront part.

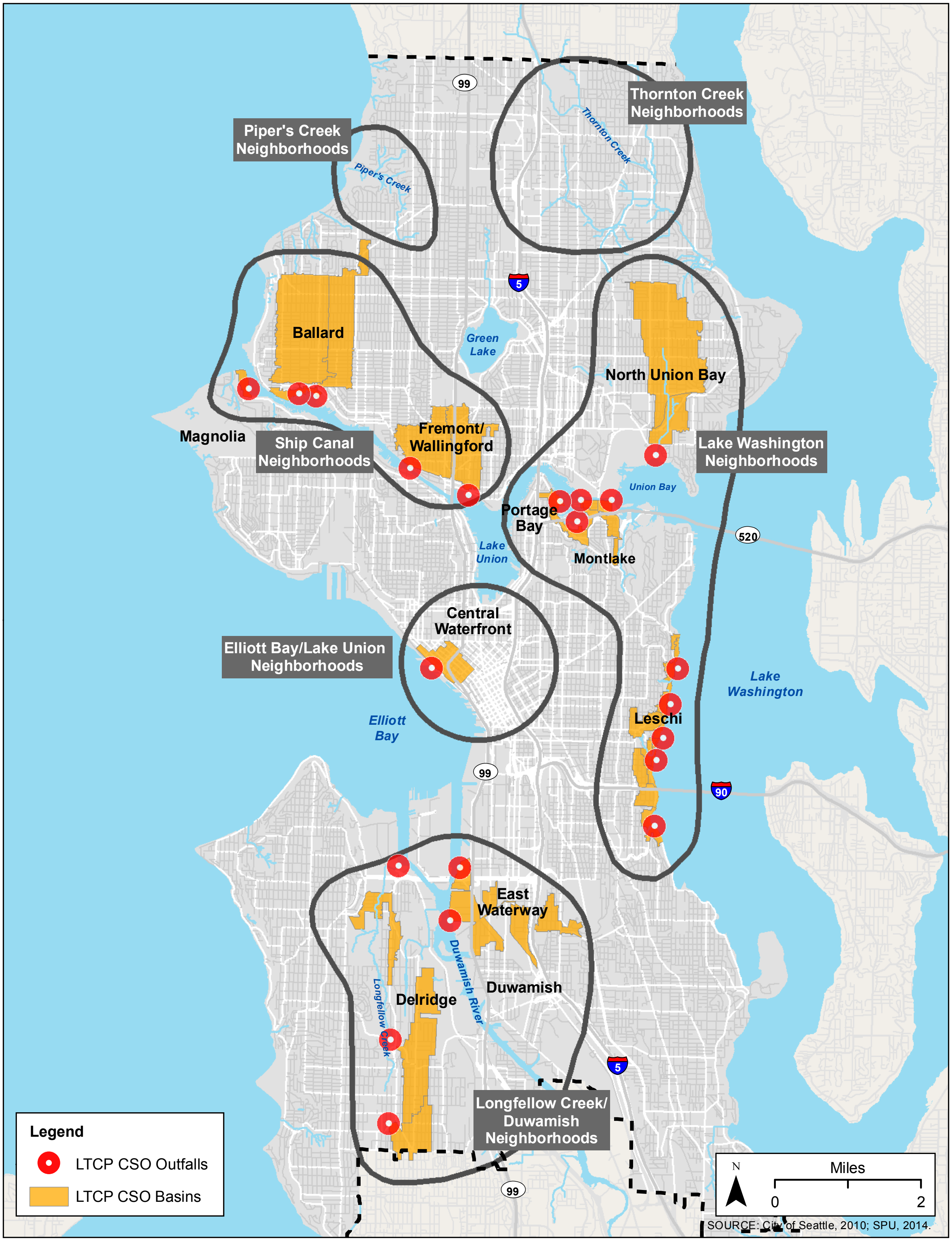

Figure 1-1 Plan Area Neighborhoods.

1.4 What are the options for implementing the LTCP Alternative?

There are four potential combinations of storage facilities, referred to as “options,” that could meet U.S. Environmental Protection Agency (EPA) requirements for an LTCP that are evaluated in this EIS. These options were developed under one of two basic concepts; the City meets its Consent Decree-mandated control requirements through implementation of independent (City only) control projects, or the City participates in one or more shared projects with King County to take advantage of potential cost/impact reduction opportunities. These options vary in terms of the number, size, and potential location of storage facilities considered.

- Neighborhood Storage Option (City only implementation)
  - Neighborhood Tanks/Pipes
  - Neighborhood West Ship Canal Tunnel
- Shared Storage Option (Shared City/King County implementation)
- Shared West Ship Canal Tunnel Option (Shared City/King County implementation)
- Shared Ship Canal Tunnel Option (Shared City/King County implementation)

Under the **Neighborhood Storage Option**, the City would build underground storage facilities in Ballard, Fremont/Wallingford, Magnolia, Portage Bay, Montlake, Leschi, Central Waterfront, Duwamish, Delridge, and East Waterway CSO areas, and sewer system improvements in the North Union Bay CSO area. This option involves building the largest number of storage facilities throughout the city.

There are two variations in the Neighborhood Storage Option: one would provide storage in tanks/pipes only, and the other would include a tunnel (Neighborhood West Ship Canal Tunnel) in combination with tanks and pipes. The storage tank/pipe option involves the greatest number of affected locations. The Neighborhood West Ship Canal Tunnel Option was developed because the two CSO areas with the largest storage volumes (Ballard and Fremont/Wallingford) are relatively close to one another. The Neighborhood West Ship Canal Tunnel Option likely reduces the number of facilities and neighborhood impacts.

Implementation of the North Union Bay sewer system improvements will require City coordination with King County because additional flows will be transferred to the King County system. Specifically, the City and King County will need to analyze the impacts of the proposed project on the downstream system and agree on an approach to address those impacts.

Under the **Shared Storage Option**, the City and King County would jointly build larger but fewer storage tanks in three CSO areas: Fremont/Wallingford/King County 3rd Avenue West CSO; North Union Bay/King County University Regulator CSO; and Montlake/Leschi/King County Montlake Regulator. These three shared storage projects were recommended in the approved 2012 King County CSO plan. In the Duwamish CSO area, the City would divert flows to a treatment facility proposed by King County. All other CSO areas would have the same storage facilities as proposed under the Neighborhood Storage Option.

Prior to implementing any shared projects between the City and King County, a shared project agreement would need to be signed between the two agencies. Specifically, the City and King County would need to analyze the impacts of the proposed project on the downstream system and agree on an approach to address those impacts.

The **Shared West Ship Canal Tunnel Option** combines three of the largest CSO areas into a single deep tunnel. The West Ship Canal Tunnel is proposed as a shared option because the three CSO areas (two from the City and one from King County) with the largest control volumes are relatively close to one another. The tunnel would extend from Fremont/Wallingford to Ballard and would provide the storage needed to address sewage overflows in Ballard, Fremont/Wallingford, and King County's 3rd Avenue West CSO basins. The tunnel would eliminate the need for a separate King County CSO project at an outfall near 3rd Avenue West.

Prior to implementing any shared projects between the City and King County, a shared project agreement would need to be signed between the two agencies as noted above.

Within this option, the remaining CSO areas would be controlled by their respective neighborhood control measures except for Magnolia and East Waterway where flow diversions to King County's system are proposed. Any City flow diversion projects would require coordination with King County. Specifically, the City and King County would need to analyze the impacts of the proposed flow diversion projects on the downstream system and agree on an approach to address those impacts.

The **Shared Ship Canal Tunnel Option** combines the control volumes from six City CSO areas along the Ship Canal and Lake Washington, and three of the largest King County CSO areas along the Ship Canal in a deep tunnel extending from the University District to Fremont/Wallingford. The tunnel would provide the storage needed to address sewage overflows in the City's CSO areas of Ballard, Fremont/Wallingford, Portage Bay, Montlake, North Union Bay, and Leschi. The tunnel would also eliminate the need for three separate King County CSO projects at outfalls near Pacific Street (University Regulator), Montlake Avenue (Montlake Regulator), and 3rd Avenue West.

The remaining City CSO areas (Magnolia, Duwamish, East Waterway, and the northernmost Delridge CSO basin) would be diverted to King County under the assumption that flow diversions could be incorporated into mutual interagency agreements. The Central Waterfront and the southern Delridge CSO neighborhoods would continue to be served by their respective neighborhood control measures.

Prior to implementing any shared projects between the City and King County, a shared project agreement would need to be signed between the two agencies. Specifically, the City and King County would need to analyze the impacts of the proposed project on the downstream system and agree on an approach to address those impacts.

Table 1-1 illustrates the total number of CSO storage facilities that would be constructed under the four LTCP options, either by City-only, King County-only, or as shared facilities. As shown in the table, the opportunity to construct shared facilities reduces the total number of facilities constructed by both the City and King County and reduces impacts to the neighborhoods slated for several major storage facilities. More detailed information can be found in *Volume 2, LTCP.*

Table 1-1. CSO Storage Facilities Constructed under LTCP Options

	Neighborhood Storage		Shared West Ship Canal Tunnel	Shared Ship Canal Tunnel	Shared Storage
	Neighborhood Tanks/Pipes	Neighborhood West Ship Canal Tunnel			
City-only CSO Facilities	18	16	14	3	9
King County-only CSO Facilities	9	9	8	6	6
Shared Facilities			1	1	3
TOTAL	**27**	**25**	**23**	**10**	**18**

1.5 How will the City and King County coordinate on CSO projects?

The City recognizes the importance of strong coordination with King County in controlling CSOs in the City. All of the proposed LTCP options have elements which may have an impact on King County's downstream wastewater system. Three of the proposed LTCP options include shared City/King County projects along the Ship Canal. Several of the proposed LTCP options include sewer system improvements which will convey additional wastewater volume to the downstream King County system. Regardless of which LTCP option is selected, coordination between the City and King County is critical to successfully designing, constructing, and eventually operating the proposed CSO control projects in the City.

The City and King County are continuing to work together closely to analyze and recommend LTCP options that are more cost-effective, produce better environmental outcomes, and minimize disruption to communities. King County must also reach its own independent conclusions about the benefits of a shared project to the regional system, and the implications of such as project to its own Long Term Control Plan and Consent Decree. Selection of a shared City/King County project will be dependent on the City's and County's analytical results as well as a number of joint factors mutually agreed upon in a City/County Coordination Plan. These factors include such things as which agency will be responsible for the design/construction/operations of the shared facility, each agency's project cost-share, operational and implementation roles and responsibilities, the process for dispute resolution, and the ability to fulfil regulatory and contractual obligations. If the City and King County choose to implement a shared City/King County project, then a shared project agreement between the two agencies will be necessary prior to designing and constructing the project. In addition, the City and King County will analyze the impacts of any recommended project on the downstream King County system and agree on an approach to addressing those impacts prior to constructing the project.

1.6 What is included in the Integrated Plan Alternative?

Under the Integrated Plan Alternative, the City would implement three stormwater control programs/projects in Seattle neighborhoods to address stormwater runoff in areas that are not part of the combined sewer system, using a combination of stormwater treatment technologies. These programs/projects include:

- Natural Drainage System (NDS) Partnering
- Arterial Street Sweeping Expansion
- South Park Water Quality Facility

These three programs/projects would collectively reduce the volume of polluted stormwater runoff discharging into the following waterways: Duwamish Waterway, Lake Washington, Piper’s Creek, Thornton Creek, Longfellow Creek, and Lake Union/Ship Canal. The City is focusing stormwater control projects in these areas to meet the Integrated Plan objectives established by the Consent Decree.

Under the Integrated Plan Alternative, the City would still build CSO reduction projects using one of the four LTCP options outlined above. However, the City would delay the completion of some of the CSO control projects until 2030, while high-benefit stormwater treatment technology projects would be completed prior to 2025. Six CSO projects to control discharges into the lower Duwamish, Portage Bay and Ship Canal waterways would be constructed between 2028 and 2030.

The stormwater control programs/projects are summarized below.

1.6.1 NDS Partnering

Natural Drainage System (NDS) Partnering, a flow control and stormwater treatment best management practice (BMP), involves using natural drainage systems, such as engineered rain gardens within various basins that drain to Piper’s, Thornton, and Longfellow Creeks. Piper’s Creek ultimately discharges to Puget Sound; Thornton Creek discharges to Lake Washington; and Longfellow Creek discharges to the Duwamish River and then into Puget Sound.

Projects implemented under this program would involve reconstructing City rights-of-way to manage flow and provide water quality treatment for polluted urban runoff, primarily using bioretention facilities such as engineered rain gardens. Project locations would be identified by site factors and a community-nomination process. Projects would be designed to infiltrate into native soil where appropriate. Where complete reliance on infiltration is not technically feasible, systems would be augmented with underdrains.

Project locations would be prioritized based on stormwater management goals; however, community partnering goals (mobility, traffic calming, and beautification) would also be accomplished as a secondary benefit. As a first step to NDS Partnering, the City would develop a program for encouraging residents or community groups to nominate their block(s) as a candidate for NDS. Candidate blocks must be among the blocks identified by the City as potentially feasible for bioretention; the majority of these blocks are part of informal drainage systems (i.e., lacking curbs and gutters). If the Integrated Plan Alternative is selected, NDS Partnering would be implemented in six phases during 2020-2025.

1.6.2 Arterial Street Sweeping Expansion (Weekly Arterial Sweeping)

Street sweeping, a source control BMP, removes pollutants from roadways before they wash off into sewers and local waterways.

The City would expand its existing arterial street sweeping programs by adding new routes, increasing the frequency of sweeps, and employing new technologies. The arterial sweeping project would be expandable and adaptable to meet future needs. The proposed arterial street sweeping expansion has several benefits:

- Targets removal of pollutants from roadways, the City's stormwater management highest priority.
- Prevents a significant amount of solids/sediment and associated contaminants from reaching receiving waters, thereby improving receiving water quality and substrate conditions.
- Can be more cost-effective than removing pollutants after they have entered the drainage system.
- Provides reduced clogging of stormwater collection and conveyance systems, improved aesthetics, and improved air quality.

The proposed program expansion would:

- Increase the route coverage from 83 to approximately 85 percent of curbed arterials (for a total 10,600 annual curb-miles), by adding one route, for a total of 25 routes.
- Increase the sweeping season from 40 to 48 weeks per year.
- Increase the sweeping frequency from biweekly to weekly for some routes: 21 routes will be swept on a weekly basis and four routes will be swept on a biweekly basis.

Because most existing development and roadways in the city were constructed before stormwater controls were required, runoff from many areas discharges directly to receiving waters without treatment. Retrofitting these existing systems to improve stormwater quality is often difficult and in many cases, retrofitting is not feasible due to physical site constraints (e.g., utility conflicts, grade restrictions, and tidal influence). Street sweeping can provide effective pollutant load reductions in area where retrofitting is impractical. If the Integrated Plan Alternative is selected, the expanded arterial sweeping program would begin in 2016.

1.6.3 South Park Water Quality Facility

The South Park Water Quality Facility would treat stormwater prior to discharge into the Duwamish Waterway. The end-of-pipe facility would treat approximately 89 million gallons (MG) of stormwater runoff from the 7th Avenue S drainage system, which encompasses approximately 250 acres. The City identified the South Park location as a high priority for stormwater pollutant reduction because of the sensitivity of the Duwamish Waterway. The facility would be built in the same location as a new stormwater pump station the City plans to build to reduce flooding in this same area, creating an opportunity to leverage water quality and flood control projects.

Stormwater would be routed through a basic, active treatment system, such as chitosan-enhanced sand filtration (CESF), prior to discharge to the Lower Duwamish Waterway through an existing outfall.

1.7 What are the potential construction impacts?

Table 1-2 summarizes the identified potential construction impacts, as well as measures that the City would take to help reduce or minimize potential impacts associated with the LTCP, Integrated Plan, and No Action Alternatives. Those components that do not involve construction, such as street sweeping, are not included in the discussion.

The LTCP options include projects that would be implemented by the City independently, as well as projects that would be shared with King County. In addition to these options, King County is considering projects that would be implemented independently from the City. This EIS identifies those independent King County projects, but does not analyze them. As described in Section 1.10, constructing independent King County projects would add to overall cumulative impacts associated with the LTCP and Integrated Plan Alternatives.

This EIS programmatically addresses the impacts from independent City and shared City/King County projects. King County will address its independent projects separately, in accordance with its SEPA requirements. All projects implemented by both the City and King County will receive the appropriate project-level evaluation under SEPA.

1.8 What are the potential long term effects?

Table 1-3 summarizes the identified potential long term, operational impacts associated with the LTCP, Integrated Plan, and No Action Alternatives, as well as measures that the City would take to help reduce or minimize potential impacts. As described above, this EIS addresses the impacts from City projects constructed independently or jointly with King County. Independent King County projects will be addressed by the County, in accordance with their SEPA requirements.

1.9 Are there significant impacts that cannot be mitigated?

Implementation of the Plan would involve a wide range of short term impacts associated with the construction of numerous large infrastructure projects. Depending upon the size, location, and type of project, these impacts would include potentially substantial traffic impacts, including temporary road closures and traffic detours. Other construction-related impacts of potential significance include increases in noise and dust that could last from approximately one to seven years and potential disruptions of access to business, residential, or recreational facilities. These impacts, however, are expected to be reduced by compliance with all applicable regulations and permit requirements and as such would not be considered significant impacts under SEPA.

There are no significant long term or operational impacts associated with implementation of the Plan alternatives that cannot be mitigated. Implementation of the No Action Alternative would result in potentially significant long term adverse impacts to water quality and aquatic habitat in the Plan area. Non-compliance with the Consent Decree would be a result of this alternative.

1.10 Are there areas of controversy?

As with all major infrastructure projects, there are difficult decisions associated with implementation of the Plan. Compliance with the federal Consent Decree (between the City, U.S. Department of Justice, EPA, and Ecology) will require a significant commitment of funding to construct major water quality control projects and programs.

There may be concern that the commitment of funding for these projects would limit the City's ability to fund other water and non-water quality projects. The Consent Decree includes a date of 2025 for completion of the LTCP, which limits the City's flexibility in compliance with this legal requirement. However, there are likely to be questions from stakeholders about the LTCP and the Integrated Plan regarding prioritization of projects, tradeoffs, and coordination with other CSO and/or water quality managers in the region, particularly King County. The timing of project implementation is a potential concern, and a wide range of viewpoints can be expected. Deferral of six CSO control projects in the Duwamish, Portage Bay, and Ship Canal waterways may be controversial with some stakeholders.

Construction of storage projects in a highly developed city where limited undeveloped land is available will result in difficult siting decisions that could require short term or permanent impacts to existing land uses, including the potential for impacts to parks or recreational facilities, private properties, or community facilities. Construction-related traffic impacts will be of considerable concern to affected residents, business owners, travelers, and commuters. Depending upon the alternative implemented, some neighborhoods that have been the locations for previous major construction projects would experience construction-related impacts. The City will follow its policies regarding the siting of underground storage facilities, which gives preference for City-owned or other public property and rights of way, but there will likely be controversy as individual sites are identified.

1.11 How do cumulative impacts compare among the alternatives?

Cumulative impacts are those that could result from the combination of individual effects of multiple actions (projects) over time. Plan elements could be constructed in areas that may have recently been subject to large-scale construction projects or will be subject to construction of future planned projects. In addition, there is a potential for construction under the Plan implementation to coincide with the construction of other projects.

Other projects that could occur in the same neighborhoods or coincide with implementation of the LTCP include CSO control projects being constructed by the City and King County. King County's 2012 CSO Control Plan identifies several CSO control projects that would be located within LTCP neighborhoods, including one each in the North Union Bay, Montlake, and Fremont/Wallingford neighborhoods and five in the Longfellow Creek/Duwamish Neighborhoods. Other major construction projects that could be under construction simultaneously with LTCP CSO control projects include the Sound Transit U-Link Extension (to be completed in 2016), Lynnwood Link Extension (construction in 2018-2023), East Link Extension (construction in 2015-2021), Waterfront Project (Elliott Bay Seawall and Waterfront Seattle Core projects), the Alaskan Way Viaduct Replacement Project, WSDOT's SR-509 and SR-167 project, Colman Ferry Dock Replacement, Denny Way Substation and other new or expanded Seattle City Light substations throughout the City, City of Seattle capital projects, and roadway and transit improvements. These projects, in addition to numerous large-scale private developments located throughout the Plan area, will likely result in cumulative impacts to traffic, noise and dust that will present inconveniences and varying levels of annoyance to the local population.

In terms of the LTCP options, the **Neighborhood Storage Option** has the potential for construction-related cumulative impacts that would affect the broadest area, because it involves construction of the largest number of storage tanks and storage pipes in neighborhoods throughout the city. While many of these projects would be constructed within public rights-of-way, there would be construction-related traffic, road closures and/or traffic constraints, dust, odor, and other short term impacts that would last between one and five years. Many of these neighborhoods have been the location of major construction projects such as the SR 520 bridge, major roadway renovations, and large scale residential/commercial building, creating a high level of "construction fatigue". In addition to the projects constructed by the City, King County would construct additional storage tanks and storage pipes in the Fremont/Wallingford, Montlake, and North Union Bay neighborhoods, adding to the construction-related impacts in those neighborhoods, including potential impacts to earth, air, noise, surface water, biological resources, land use, and transportation. This option would result in the highest potential for cumulative impacts resulting from construction of City and King County CSO projects.

The **Shared Storage Option** would affect fewer neighborhoods than the Neighborhood Storage Option because certain CSO control projects would be shared by the City and King County. The potential for cumulative impacts would be the same as under the Neighborhood Storage Option for the Longfellow Creek/Duwamish and Elliott Bay/Lake Union neighborhoods, but would be lower for the Fremont/Wallingford and Lake Washington neighborhoods because of the overall lower number of projects between the City and King County in those neighborhoods.

The **Shared West Ship Canal Tunnel Option** would have a potential for cumulative impacts similar to the Neighborhood Storage and Shared Storage Options. It would reduce impacts to the Ballard and Fremont/Wallingford neighborhoods associated with construction of storage tanks, but it would create longer duration and potentially more intense impacts (3.5 years or more) at the tunnel launch portal, which would likely be located along the Ship Canal in Ballard, and the recovery portal, which would likely be located in the Fremont/Wallingford neighborhood. Replacing storage tanks and pipes in the East Waterway and Magnolia neighborhoods with lower construction impact flow diversions would reduce the potential for cumulative impacts in these neighborhoods. As under the Neighborhood Storage Option, both the City and King County would be pursuing multiple storage projects in the Longfellow Creek/Duwamish neighborhoods.

The **Shared Ship Canal Tunnel Option** would have the lowest potential for construction-related cumulative impacts in terms of neighborhoods affected, because it would substantially reduce the number of storage facilities located throughout the city constructed by the City and King County. However, impacts would be concentrated for up to seven years at the portals. The tunnel launch portal would likely be located on the south side of the Ship Canal and the recovery portal would likely be located in the North Union Bay neighborhood. These neighborhoods have had, or will have, several large-scale projects constructed in recent years, including the renovation of Husky Stadium, Sound Transit U-Link Extension, and the SR 520 project, and have expressed concerns about additional large scale construction in their neighborhoods.

Implementing the **Integrated Plan Alternative** would not represent a substantive increase in cumulative impacts. The expansion of street sweeping on City arterials would not affect overnight parking and NDS Partnering would have minimal short-term construction-related and long-term impacts. Construction of the South Park Water Quality Facility would not result in extensive construction-related impacts. The facility is expected to be sited in an area with compatible land use, with a low potential to cause long term changes in use. Under the Integrated Plan Alternative, construction of LTCP projects would be delayed in some neighborhoods, potentially resulting in reduced or increased cumulative impacts depending on the neighborhood and project schedules.

The City would coordinate construction sequencing with other major planned projects to minimize the potential for cumulative impacts, but it is likely that some level of cumulative impact is unavoidable. Given the number of proposed projects throughout the City, it will be difficult to avoid overlapping with other construction projects in some areas. Close coordination with King County will be particularly key for all options to coordinate construction schedules. In addition, it will be important to coordinate with Seattle Department of Transportation (SDOT), Washington Department of Transportation (WSDOT), and other major utilities in the area.

Impacts of independent King County CSO control projects will be evaluated separately by King County in accordance with their SEPA requirements.

Tables 1-2 and 1-3, respectively summarize the construction and operation impacts associated with the LTCP, Integrated Plan, and No Action Alternatives. Impacts are described for City projects or projects shared by the City and King County; King County will evaluate impacts associated with their proposed facility in accordance with SEPA, as appropriate.

Table 1-2. Summary of Construction Impacts		
Earth		
Long Term Control Plan Alternative	Key Findings	Construction activities and equipment have the potential to cause temporary impacts to earth and groundwater during construction of major projects involving substantial excavation, trenching, or tunneling and removal of large quantities of soil. Any areas that are disturbed during construction would be subject to increased erosion, and control measures would be required. Ground settlement from dewatering could cause settlement of nearby structures, roadways, and utilities. Vibration associated with tunneling operations could result in soil settlement along tunneling alignments. The primary differences in potential effects of the LTCP options are related to the amount of surface disturbance and excavation potentially required.
	Neighborhood Storage Option	*Neighborhood (Tanks/Pipes):* Overall, this option has the second highest amount of surface disturbance for construction. Any areas that are disturbed during construction would be subject to increased erosion, and control measures would be required. Storage tanks constructed in the Ballard, Fremont/Wallingford, and East Waterway neighborhoods would require the most surface disturbance. Construction of storage pipes in the Leschi and Delridge neighborhoods have the potential to occur near steep slopes and known or potential landslide-prone areas. Projects near these zones would be at heightened risk for erosion and slope instability Ground settlement from dewatering could cause settlement of nearby structures, roadways, and utilities. Most projects would require significant dewatering. Impacts would be most dispersed under this option, which would result in the highest number of storage facilities constructed independently by the City. *Neighborhood West Ship Canal Tunnel:* (See Shared West Ship Canal Tunnel Option below – impacts would be similar)
	Shared Storage Option	This option would have the highest amount of surface disturbance for construction and second highest amount of excavation. However, the shared tanks would reduce the number of City and King County independently constructed CSO control facilities. Impacts would be similar to the Neighborhood Storage Option but would be concentrated in fewer locations. Larger shared storage facilities in Fremont/Wallingford, North Union Bay, and Montlake would require greater amounts of excavation and soil disposal. Construction of the shared storage tank in North Union Bay has increased potential to encounter organic or liquefiable soils, and dewatering has the potential to encounter contaminated groundwater or result in settlement of nearby structures due to the presence of historic landfill deposits and natural organic deposits.
	Shared West Ship Canal Tunnel Option	Construction of tunnel portals and movement of the tunnel boring machine could result in vibration and settling. The location of the portals and tunnel near liquefiable soils in Fremont and Ballard could result in soil settling. Geotechnical exploration and testing would be conducted during future project design to identify potential hazards along the tunnel alignment. Impacts from projects in the Lake Washington, Longfellow Creek/Duwamish, and Elliott Bay Neighborhoods would be similar to the Neighborhood Storage Option. Overall impacts would be reduced under this option compared to the Neighborhood Storage Option because the shared tunnel would reduce the number of City and King County independently constructed CSO control facilities.

Table 1-2. Summary of Construction Impacts		
	Shared Ship Canal Tunnel Option	This option would have the highest amount of excavation and earthwork. The longer tunnel would require additional geotechnical exploration and testing during future project design, and has a greater potential to encounter earth hazards and to result in vibration and settling than the Shared West Ship Canal Tunnel because of its greater length. Impacts from projects in the Longfellow Creek/Duwamish and Elliott Bay Neighborhoods would be similar to the Neighborhood Storage Option. The geographic extent of impacts would be reduced the most under this option because the shared tunnel would result in the fewest number of City and King County independently constructed CSO control facilities.
Integrated Plan Alternative		Construction of storage pipes, tanks, and tunnels under the Integrated Plan Alternative would have the same impacts as under the LTCP Alternative, but construction would be delayed in some neighborhoods. In addition, minor construction-related impacts associated with construction of the South Park Water Quality Facility and its proximity to the Duwamish River would be a potential concern during construction. Depending on the specific site location, the soils at the site location may be susceptible to liquefaction and compaction. The City would take appropriate engineering measures to account for these hazards. Street sweeping does not involve construction, and would therefore not result in any short-term impacts. Impacts associated with NDS Partnering would be localized and of short duration, with limited footprint and depth. Individual NDS Partnering projects would be evaluated with respect to geological hazards, would be relatively small in size, and would be conducted with appropriate erosion control measures in place.
No Action Alternative		Projects constructed under ongoing sewer system improvement and NDS programs would generally have a limited footprint and depth, and are unlikely to result in substantial erosion or dewatering. Impacts associated with storage facilities associated with currently planned projects are evaluated in their respective site-specific SEPA evaluations.
Measures to reduce or minimize potential impacts		The City would: • Avoid construction on steep slopes, known and potential landslide zones, and areas with organic or liquefiable soils, where feasible. • Use appropriate shoring during construction. • Use erosion and runoff control measures, including retention of vegetation, replanting, ground cover, etc. • Comply with relevant federal, state, and local critical areas and groundwater requirements. • Dispose of soils at approved disposal sites. • Monitor settlement during dewatering and tunnel construction as appropriate.

Table 1-2. Summary of Construction Impacts		
Air Quality		
Long Term Control Plan Alternative	Key Findings	Construction would not have a significant effect on air quality in the Seattle area, but may result in moderate localized impacts during the construction periods, largely related to vehicle emissions and dust. The primary differences in potential air quality and odor effects of the LTCP options are related to the length of construction period and estimated number of truck trips.
	Neighborhood Storage Option	*Neighborhood (Tanks/Pipes):* This option has the most individual project locations. As a result, this option would have dispersed short term construction-related air and odor impacts in numerous neighborhoods throughout the city, with impacts likely to be most noticeable in residential areas. Storage tank construction in the largely residential Ballard and Fremont/Wallingford neighborhoods could last up to five years (Ballard) and 3.5 years (Fremont/Wallingford). Multiple storage pipes/tanks would be constructed in residential areas of Leschi. *Neighborhood West Ship Canal Tunnel:* (See Shared West Ship Canal Tunnel Option below – impacts would be similar)
	Shared Storage Option	Air quality impacts would occur at fewer sites than under the Neighborhood Storage Option. However, construction-related air quality impacts (largely vehicle emissions and dust) would occur for longer construction durations at the shared storage facility locations in Fremont/Wallingford, North Union Bay, and Montlake. Overall impacts would be reduced under this option because the shared tanks reduce the number of City and King County independently constructed CSO control facilities.
	Shared West Ship Canal Tunnel Option	Construction-related air quality impacts would occur at fewer sites than under the Neighborhood Storage and Shared Storage Options. However, impacts would be concentrated in fewer areas (Ship Canal Neighborhoods). Construction of the tunnel would require a substantially higher number of truck trips and associated emissions than storage facilities in Ballard and Fremont/Wallingford, resulting in more concentrated and longer duration impacts in these neighborhoods. Overall impacts would be reduced under this option because the shared tunnel would reduce the number of City and King County independently constructed CSO control facilities.
	Shared Ship Canal Tunnel Option	Compared to all other options, the Ship Canal Tunnel Option would have the fewest City and King County independently constructed CSO storage facilities, and therefore the fewest areas that would experience air quality and odor impacts. Construction of the tunnel would require a substantially higher number of truck trips and associated emissions in Ballard, Fremont/Wallingford, and the Lake Washington neighborhoods than would occur for storage facilities, resulting in the potential for noticeable impacts in these areas for several years.
Integrated Plan Alternative		Construction of CSO storage pipes, tanks, and tunnels under the Integrated Plan Alternative would have the same air emissions as under the LTCP Alternative, but construction would be delayed in some neighborhoods. The South Park Water Quality Facility would involve a small construction footprint, which would result in short-term, localized emissions. The facility would be located in an industrial area and any air emissions would not impact residential properties or other sensitive receptors. Temporary air quality and odor emissions associated with NDS Partnering projects would also be minor.

Table 1-2. Summary of Construction Impacts		
No Action Alternative		Construction activity associated with ongoing sewer system improvements and NDS projects would produce dust and exhaust emissions that would be minimal, localized, and temporary.
Measures to reduce or minimize potential impacts		Mitigation measures would include: • Using measures to control dust, such as watering of 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 encourage use of well maintained construction vehicles to reduce vehicle emissions. • Encouraging contractors to offer carpooling options for employees. • When possible, using local building materials to reduce transport distances.
Surface Water		
Long Term Control Plan Alternative	Key Findings	Construction effects on surface water could include increased pollutants and sediments from site runoff and would require control measures. Construction of pipes, tanks, and portals could occur in proximity of sensitive receiving water bodies, including Lake Washington, the Ship Canal, and the Duwamish River. Discharges of dewatering water could introduce contaminants and sediments into local water bodies if not properly managed. The primary differences in potential effects of the LTCP options are related to the amount of surface disturbance and the amount of excavation potentially required.
	Neighborhood Storage Option	*Neighborhood (Tanks/Pipes):* Construction effects on surface water could include increased pollutants and sediments from site runoff and would require control measures. Short term construction-related impacts to Salmon Bay, the Ship Canal, Portage Bay, North Union Bay, Lake Union, Lake Washington, the Duwamish River/East Waterway, and Elliott Bay could occur if site runoff controls do not function effectively. Overall, construction related impacts are expected to be minor because all construction will comply with applicable regulations and permit conditions. Discharges of dewatering water could introduce contaminants and sediments into local water bodies if not properly managed. The highest risk from dewatering is likely to be associated with the Ballard and Fremont/Wallingford storage tanks, because the larger facilities require deeper excavations, which could be more likely to encounter groundwater. *Neighborhood West Ship Canal Tunnel:* (See Shared West Ship Canal Tunnel Option below – impacts would be similar)
	Shared Storage Option	Impacts would be similar to the Neighborhood Storage Option but would occur in fewer locations in the Ship Canal and Lake Washington neighborhoods. This option reduces the overall number of facilities, but results in larger facilities with a greater potential for site runoff and dewatering impacts because of longer duration of construction and larger construction sites.
	Shared West Ship Canal Tunnel Option	This option involves construction of a deep tunnel shared with King County. Deep tunnels have less surface disruption than storage tanks and pipes, but would likely have dewatering impacts. The shared tunnel would eliminate impacts associated with construction of the City's proposed Ballard and Fremont/Wallingford facilities, as well as King County's 3rd Ave W regulator. Portal locations would be the focal point for potential surface water runoff impacts. These locations are not yet known but could include areas near Portage Bay and

Table 1-2. Summary of Construction Impacts

		Salmon Bay.
	Shared Ship Canal Tunnel Option	The shared tunnel would eliminate impacts associated with construction of the City's proposed Ballard, Fremont/Wallingford, Portage Bay, Montlake, and Leschi facilities, as well as King County's 3rd Ave W, Montlake, and University Regulators. Portal locations would be the focal point for potential surface water runoff impacts because of the duration of construction and larger construction area. While portal locations have not been determined, areas near the shorelines of Portage Bay, Union Bay, and Salmon Bay could be affected.
Integrated Plan Alternative		In addition to the impacts described for the LTCP Alternative, construction of the South Park Water Quality Facility could include increased potential for runoff into the Duwamish River and would require construction control measures. As noted above, the potential for impacts is low because the projects would comply with applicable regulations and permit conditions.
No Action Alternative		Construction activity associated with ongoing sewer system improvements and NDS projects is not expected to result in surface water impacts due to the limited construction areas.
Measures to reduce or minimize potential impacts		Compliance with the requirements of the Construction Stormwater General Permit issued by Ecology and the City of Seattle's stormwater code and manual would minimize potential surface water runoff and sedimentation. Dewatering impacts would be minimized by compliance with the King County Wastewater Discharge Permit requirements. Additional measures to minimize surface water runoff, dewatering, and spills include the following: • Limiting the area of construction disturbances. • Implementing stormwater best management practices identified in the City of Seattle's Stormwater Code (SMC 22.800 – 22.808), Director's Rule: 2009-004 SPU/16-2009 DPD, and Volume 2 Construction Stormwater Control Technical Requirements Manual to control erosion and sediment transport from the project sites. Typical measures include silt fencing, plastic sheeting, and straw wattles to prevent sediment discharge and wheel washing stations to prevent sediment from entering nearby roadways. • Providing water quality treatment as necessary to improve the quality of intercepted stormwater flows from adjacent impervious surfaces. • Developing and implementing a Construction Stormwater and Erosion Control Plan, including a Stormwater Pollution Prevention Plan and Spill Prevention and Countermeasures Plan, to reduce the potential for sediment, waste materials, construction-related leaks, and spills to contaminate surface water, groundwater, and stormwater runoff.

Table 1-2. Summary of Construction Impacts		
Biological Resources		
Long Term Control Plan Alternative	Key Findings	No direct impacts to aquatic habitats, plants, and invertebrates would occur, and no indirect impacts to fish, including federally listed salmonids, are anticipated because no in-water construction would occur, or work within sensitive or critical aquatic habitats. The potential for direct losses of terrestrial habitat associated with facility construction would be minimal under both Plan alternatives, because the facilities are likely to be located in developed areas with low habitat value. Indirect impacts to wildlife would be associated with increased level of noise and human activity during construction. The primary differences in potential effects of the LTCP options are related to amount of construction activity (surface disturbance) and proximity to mapped priority habitats or species.
	Neighborhood Storage Option	*Neighborhood (Tanks/Pipes):* CSO control projects would be constructed in urbanized areas. The potential for direct losses of terrestrial habitat associated with facility construction would be minimal. Indirect impacts to wildlife would be associated with increased level of noise and human activity during construction. Construction would occur in areas adjacent to mapped priority habitats in the Magnolia, Leschi, and Delridge neighborhoods. The total amount of surface disturbance and potential for direct impacts to habitat is second highest of all the storage options. This storage option has the most individual project locations compared to the other options, dispersed through a number of neighborhoods. *Neighborhood West Ship Canal Tunnel*: (See Shared West Ship Canal Tunnel Option below – impacts would be similar)
	Shared Storage Option	The total amount of surface disturbance that would occur is the highest of all options, which suggests a higher potential for habitat impacts. However, this option has the second to least number of individual project locations, and therefore, a lower potential to cause indirect impacts to wildlife through construction-related noise and activity. Impacts to priority species would potentially be higher under this option due to construction activity in proximity to priority habitats along the Lake Washington shoreline and Union Bay Natural Areas; however, impacts are not expected because all construction would comply with applicable permit requirements to protect habitat.
	Shared West Ship Canal Tunnel Option	In general, impacts would potentially be low under this option due to the concentration of construction in the Ship Canal Neighborhoods at fewer locations and the lower amount of surface disturbance than other options.
	Shared Ship Canal Tunnel Option	Overall disturbance would potentially be lower compared to all other options because this option eliminates the greatest number of City and King County independently constructed CSO storage facilities. However, impacts to priority species could potentially be higher due to construction activity lasting up to seven years in proximity to priority habitats along the Lake Washington shoreline and Union Bay Natural Area. It may be difficult to avoid siting portals in areas with high habitat value.

Table 1-2. Summary of Construction Impacts

Integrated Plan Alternative		Impacts would primarily be related to the LTCP option selected for implementation. Additional impacts associated with the Integrated Plan Alternative would be minimal. Most NDS partnering projects would likely occur in paved or developed rights-of-way in residential areas and would not affect wildlife habitat. The potential for direct losses of terrestrial habitat associated with NDS Partnering projects and South Park Water Quality Facility construction would be minimal. Indirect impacts to wildlife would be associated with short-term increased level of noise and human activity during construction, and are not expected to be significant.
No Action Alternative		Construction activities associated with ongoing sewer system improvements would temporarily cause elevated levels of noise and human activity that could disturb wildlife, if present, near the project. Naatural Drainage System program projects and roadside rain gardens have minimal direct impact on wildlife and habitat due to their small footprint and location within public rights-of-way or private property, both of which are typically developed or landscaped.
Measures to reduce or minimize potential impacts		The City would undertake the following measures: • Site projects away from mapped priority habitats and species locations where possible. • Follow federal, state, and local permit conditions for managing construction site runoff and protecting habitats for federally listed species. • Retain site vegetation as much as possible. • Provide prompt revegetation with native species after construction is complete. • Adhere to development conditions within City of Seattle's Director Rule 5-2007 for construction within Great Blue Heron Management Areas and Colony Nesting Areas.
Energy and Climate Change		
Long Term Control Plan Alternative	Key Findings	None of the LTCP options would have a significant impact on energy resources in the Seattle area. The primary difference in energy consumption and greenhouse gas (GHG) emissions between the options relates to the type of storage facility (e.g., tank or tunnel) and whether it is part of the Neighborhood Storage Option or one of the shared options. While the shared options would have higher energy consumption and GHG emissions per facility, there would be fewer new storage facilities built by the City and King County. Therefore, overall emissions would likely be lower.
	Neighborhood Storage Option	*Neighborhood (Tanks/Pipes):* Construction-related energy consumption and GHG emissions would be lower than those estimated for the Shared Storage or Shared Ship Canal Tunnel Options. *Neighborhood West Ship Canal Tunnel:* Energy consumption would be similar, but GHG emissions would be slightly higher than those estimated for the Shared West Ship Canal Tunnel Option.

<table>
<tr><th colspan="3">Table 1-2. Summary of Construction Impacts</th></tr>
<tr><td rowspan="3"></td><td>Shared Storage Option</td><td>Construction-related energy consumption and GHG emissions would be higher than those estimated for the Neighborhood Storage Option. However, overall impacts would be reduced under this option because the shared tanks reduce the number of King County independently constructed CSO control facilities.</td></tr>
<tr><td>Shared West Ship Canal Tunnel Option</td><td>Construction-related energy consumption and GHG emissions would be lower than those estimated for the Shared Storage or Shared Ship Canal Tunnel Options. Overall impacts would be reduced under this option because the shared tunnel reduces the number of King County independently constructed CSO control facilities.</td></tr>
<tr><td>Shared Ship Canal Tunnel Option</td><td>Construction-related energy consumption and GHG emissions associated with this option would be higher than those estimated for the Neighborhood Storage and Shared West Ship Canal Tunnel Options. However, overall impacts from both the City and King County projects would be the most reduced under this option because the shared tunnel reduces the greatest number of King County independently constructed CSO control facilities.</td></tr>
<tr><td colspan="2">Integrated Plan Alternative</td><td>Construction of CSO storage pipes, tanks, and tunnels under the Integrated Plan Alternative would have the same energy use and GHG emissions as under the LTCP Alternative, but construction would be delayed in some neighborhoods. Construction of NDS Partnering projects and the South Park Water Quality Facility would add incrementally to the overall energy required for construction of the Plan.</td></tr>
<tr><td colspan="2">No Action Alternative</td><td>Project construction under ongoing programs to implement sewer system improvements and NDS projects would have minor energy consumption and GHG emissions.</td></tr>
<tr><td colspan="2">Measures to reduce or minimize potential impacts</td><td>The City would undertake the following measures to mitigate energy and GHG impacts:
Incorporating specifications into construction contracts that encourage the use of fuel-efficient construction equipment.
Minimizing engine idling during construction.</td></tr>
<tr><td colspan="3">Environmental Health and Public Safety</td></tr>
<tr><td rowspan="2">Long Term Control Plan Alternative</td><td>Key Findings</td><td>Ground excavations and dewatering have the potential to encounter contaminated materials, and may require special handling methods depending on the site and type of materials encountered. Discharges of dewatering water could introduce contaminants and sediments into local waterways if not properly managed. In general, environmental health risks associated with construction under the LTCP options are low, and the potential for the public to encounter contaminated soils or groundwater is also low.

Larger projects, such as storage tanks and tunnels, have a greater potential for environmental health and public safety impacts than smaller projects constructed in the right-of-way, such as storage pipes and flow diversions.</td></tr>
<tr><td>Neighborhood Storage Option</td><td>Neighborhood (Tanks/Pipes): Under this option, there is a higher potential for impacts in Ballard, Fremont/Wallingford, and the Duwamish/East Waterway neighborhoods from large excavations and dewatering outside of the right-of-way in potentially contaminated areas (typically industrial lands). Risks would be greatest for construction workers, and would generally be low for the public. Pre-design studies would be conducted to determine the extent of contamination and appropriate measures to minimize health risks.

Neighborhood West Ship Canal Tunnel: (See Shared West Ship Canal Tunnel Option below</td></tr>
</table>

Table 1-2. Summary of Construction Impacts		
		– impacts would be similar)
	Shared Storage Option	The larger, shared storage facilities under this option in Fremont/Wallingford, North Union Bay, and Montlake would require higher volumes of excavation compared to the Neighborhood Storage Option. However, the geographic extent of the impact is limited because fewer facilities would be constructed. Construction required to implement flow diversions under this option would have a very low potential to cause environmental health and public safety impacts because excavation volumes would be minimal and dewatering would not be significant.
	Shared West Ship Canal Tunnel Option	Potential construction-related impacts in the Ship Canal Neighborhoods would be concentrated at the tunnel portals in the Fremont/Wallingford and Ballard neighborhoods. Potential impacts in other neighborhoods would be similar to those described for the Neighborhood Storage Option.
	Shared Ship Canal Tunnel Option	Potential impacts would be concentrated at the tunnel portals potentially located on the south side of the Ship Canal and in the North Union Bay neighborhood, areas that do not have known high levels of contamination. Potential impacts in other neighborhoods would be similar to those described for the Neighborhood Storage Option.
Integrated Plan Alternative		Construction of CSO storage pipes, tanks, and tunnels under the Integrated Plan Alternative would have the same potential for environmental health impacts as under the LTCP Alternative. In addition to the impacts outlined for the LTCP Alternatives, ground excavation and dewatering for the South Park Water Quality Facility would have the potential to encounter contaminated materials, with accompanying environmental health considerations, based on the history of industrial land uses in the Duwamish basin. Pre-design investigations would determine the potential for contamination at the construction site. Overall, potential public health impacts are expected to be low.
No Action Alternative		Construction activity associated with ongoing sewer system improvements and NDS programs is not expected to result in environmental health or safety impacts. The locations of sewer system improvement projects have largely been previously excavated; therefore, the risk of encountering contaminated soil is minimal. Excavation for rain gardens is unlikely to encounter contaminated material, but spills from construction equipment are possible. Overall, potential public health impacts are low.
Measures to reduce or minimize potential impacts		Measures would include: • Site-specific investigations and clean-up or pollution prevention plans. • Plans for sediment and groundwater handling, testing, and disposal. • Spill prevention and control plans.

Table 1-2. Summary of Construction Impacts

Noise and Vibration		
Long Term Control Plan Alternative	Key Findings	Construction of projects under the Plan alternatives would result in short-term moderate to substantial increases in noise, lasting from one to as much as seven years, depending upon the option selected. The primary differences in potential noise and vibration effects of the LTCP options are related to the amount of noise-generating earthwork and the length of construction period. In general, storage pipes/tanks would result in shorter duration, but more geographically distributed impacts, while the tunnels would result in longer duration impacts in relatively smaller areas.
	Neighborhood Storage Option	*Neighborhood (Tanks/Pipes):* Construction of projects would result in short-term moderate to substantial increases in noise. This option would have the most dispersed noise and vibration impacts throughout the Plan area. Construction would occur in every CSO neighborhood, but would last longest in Ballard, Fremont/Wallingford, and East Waterway, where construction durations would range from one to five years. *Neighborhood West Ship Canal Tunnel:* (See Shared West Ship Canal Tunnel Option below – impacts would be similar)
	Shared Storage Option	Impacts would be similar to the Neighborhood Storage Option, but potentially higher intensity noise would be concentrated at fewer locations in Fremont/Wallingford, North Union Bay, and Montlake, for construction durations from three to 4.5 years.
	Shared West Ship Canal Tunnel Option	Potential construction-related impacts in the Ship Canal Neighborhoods would largely be concentrated at the tunnel portals in the Ballard and Fremont/Wallingford neighborhoods. After initial tunnel portal site construction, most work would occur underground, which would not produce noticeable street-level noise or vibration other than from trucks hauling tunnel spoils on roadways. The duration of these impacts would be 3.5 years. Potential for vibration impacts along the tunnel routes is likely to be a concern to property owners. Potential impacts in other neighborhoods would be similar to those described for the Neighborhood Storage Option.
	Shared Ship Canal Tunnel Option	Noise-generating construction sites in the Ship Canal and Lake Washington neighborhoods would largely be consolidated at the two tunnel portals, and would last for as long as seven years. Most activities would occur at the launch portal along the south side of the Ship Canal (near the Fremont Cut). Noise impacts could be experienced in the vicinity of the portal locations, particularly during night time construction. Potential for vibration impacts along the tunnel routes would likely be a concern to property owners.
Integrated Plan Alternative		Construction of CSO storage pipes, tanks, and tunnels under the Integrated Plan Alternative would have the same noise impacts as under the LTCP Alternative, but construction would be delayed in some neighborhoods. Noise and vibration impacts from the stormwater projects specific to the Integrated Plan Alternative would be minor. Construction of NDS Partnering projects is not likely to require high-impact noise equipment and construction noise would be of short duration. The South Park Water Quality Facility would generate typical construction noise similar to projects implemented under the LTCP Alternative.
No Action Alternative		Construction activity associated with ongoing sewer system improvements and NDS programs is not likely to require high-impact noise equipment, and construction noise would be of short duration.

Table 1-2. Summary of Construction Impacts

Measures to reduce or minimize potential impacts		Mitigation would include: • Identify potentially impacted receptors and buildings and determination of whether noise and vibration levels at those sites would exceed permitted levels. • Encourage noise-reducing measures, such as using sound-control devices on equipment, prohibiting equipment with unmuffled exhaust, minimizing idling time of equipment and vehicles, and installing acoustic barriers around stationary sources of construction noise. • Conduct on-site noise monitoring to ensure compliance with SMC provisions, if necessary. • Coordinate with Seattle City Light to ensure electrical power is available to construction sites during construction dewatering (to avoid using diesel powered generators). Mitigation for vibration impacts would be determined on a site-by-site basis depending on impacts. Mitigation measures could include shoring of impacted buildings, coordination of vibration-causing construction with sensitive activities in impacted buildings, or onsite vibration-minimizing practices.
Land Use and Visual Quality		
Long Term Control Plan Alternative	Key Findings	CSO control projects included under the LTCP range from those that would be located in the public right-of-way or streets and cause little or no land use or visual impact to major infrastructure projects that could require acquisition of property or easements over the course of construction, which would range from approximately one to seven years, depending upon the project. The acquisitions/easements could be temporary to accommodate access to a site or a location for project staging, or they could be permanent for locating storage tanks or tunnels. Impacts to visual quality during construction would be minor under all LTCP options. The primary differences in potential effects of the LTCP options are related to the types of projects and their potential location and the length of construction.
	Neighborhood Storage Option	*Neighborhood (Tanks/Pipes):* Due to the largest number of distributed CSO storage facilities, this option has the greatest number of areas that would experience temporary land use impacts. Construction could intermittently disrupt access to residences, businesses, and institutions, including (potentially) the University of Washington during the multi-year construction duration. Access disruption could affect businesses. Staging areas would prevent other uses during construction; however, uses could be restored following construction completion. Temporary easements would be needed from some private landowners, depending on the project. Acquisition-related impacts would potentially be greatest under this option because it would require the greatest number of project locations. *Neighborhood West Ship Canal Tunnel:* (See Shared West Ship Canal Tunnel Option below – impacts would be similar)

Table 1-2. Summary of Construction Impacts		
	Shared Storage Option	Impacts would be similar to the Neighborhood Storage Option, but construction-related land use and visual quality impacts would be concentrated at fewer, larger project sites in the Ship Canal and Lake Washington neighborhoods of Fremont/Wallingford, North Union Bay, and Montlake. Construction could intermittently disrupt access to residences, businesses, and institutions, including (potentially) the University of Washington during the up to four years or longer construction duration.
	Shared West Ship Canal Tunnel Option	This option would reduce the number of areas affected by construction, but would concentrate construction-related land use impacts in fewer areas of the city (Ballard and Fremont/Wallingford). The tunnel is estimated to require 3.5 years to construct and up to four acres for construction staging. Much of this area could be sold back to private ownership following construction. In addition to land use and visual quality impacts from tunnel portal activity, dispersed impacts and disrupted access from microtunnel and open-cut construction in roadways throughout the Ship Canal Neighborhoods would occur.
	Shared Ship Canal Tunnel Option	Compared to the other options, the number of large storage facility construction sites would be reduced because this option would eliminate the greatest number of City and King County independently constructed CSO storage facilities. Overall, the need for property acquisition and the amount of interference with access to residences and businesses would be reduced. However, construction-related land use impacts would potentially be higher in the Ship Canal and Lake Washington Neighborhoods under this option because most of the construction activity during the up to seven-year construction period would be consolidated to the two tunnel portal sites located on the south side of the Ship Canal and in the North Union Bay neighborhood. As much as 6 acres could be required for construction staging, which would preclude other uses during the construction period. Much of this area could be sold back to private ownership following construction. In addition to land use and visual quality impacts from tunnel portal activity, dispersed impacts and disrupted access from microtunnel and open-cut construction in roadways throughout the Lake Washington and Ship Canal Neighborhoods would occur.
Integrated Plan Alternative		Construction impacts associated with certain CSO control facilities in the Delridge, East Waterway, Duwamish, Portage Bay, and Montlake neighborhoods would occur later (after 2028) under the Integrated Plan Alternative. As a result, these neighborhoods would experience fewer near-term land use and visual quality-related construction impacts, but these impacts would occur after 2028. Additional impacts specific to stormwater projects associated with the Integrated Plan Alternative are not expected. Most NDS Partnering projects are expected to occur within the Single Family zone, but could occur in other zones. Prior to installation of rain gardens, the City would need to apply for and obtain applicable land use permits and approvals. Depending on the site, easements could be required on a temporary basis to accommodate access to a site or a location for project staging. The South Park Water Quality Facility is expected to be located on City-owned property in an industrial-zoned area. Therefore, it is anticipated that a suitable site is available that would result in minimal land use and visual quality impacts during construction.
No Action Alternative		Construction activity would be limited to ongoing sewer system improvements and NDS programs. Construction related impacts to land use and visual resources are not anticipated from these ongoing programs.

Table 1-2. Summary of Construction Impacts		
Measures to reduce or minimize potential impacts		Mitigation measures would include: • Prioritizing project locations on public property and in public rights-of-way; • Complying with federal, state, and local regulations regarding property acquisition and relocation assistance; • Following conditions of the Master Use Permit; and • Providing access to property and businesses during construction.
Recreation		
Long Term Control Plan Alternative	Key Findings	For all LTCP options, temporary impacts to recreation could occur if a facility is sited within a park, although the City would attempt to avoid siting facilities in parks. If construction or staging areas are located adjacent or nearby to a park, recreational use of the park could be disrupted by restricted access, noise, dust, and truck trips during peak construction periods. The primary differences in potential effects of the LTCP options are related to the types of projects and their potential location, amount of construction disturbance, and the length of construction.
	Neighborhood Storage Option	*Neighborhood (Tanks/Pipes):* Temporary loss of recreational opportunities could occur if the CSO facility is located within the park. If construction or staging areas are located adjacent or nearby to a park, recreational use of the park could be disrupted by restricted access, noise, dust, and truck trips during peak construction periods. Because this option has the highest number of projects located throughout the city, it has a higher likelihood of having projects located adjacent to a park or recreational facility. This option would include construction of multiple storage pipes/tanks in the Lake Washington Neighborhoods, which have a higher concentration of parks than other neighborhoods. *Neighborhood West Ship Canal Tunnel:* (See Shared West Ship Canal Tunnel Option below – impacts would be similar)
	Shared Storage Option	Potential construction-related impacts to recreation would be lower than the Neighborhood Storage Option because fewer project sites would be required. Due to the larger area required for larger tanks, however, shared storage tanks could have a greater potential to impact recreation if located within or near parks. However, the use of shared storage tanks would reduce the overall number of parks that could potentially be affected by construction in the Ship Canal and Lake Washington Neighborhoods. In other neighborhoods, storage pipes or tanks would be replaced by flow diversions, which would have less potential to impact parks but could still impact informal recreation such as walking and biking.
	Shared West Ship Canal Tunnel Option	Impacts to recreation from construction would be similar to the Neighborhood Storage Option for most neighborhoods, but impacts in the Ballard and Fremont/Wallingford neighborhoods would be concentrated at portal locations, and construction durations would be up to 3.5 years. If located in or adjacent to a park or recreational facility, impacts from tunnel portal construction on recreation would be substantial and truck trips could disrupt access to the park. If located in a park, multiple acres of the park could be closed to recreation for several years. A substantially higher number of truck trips would be required as compared to storage tanks, which would have a greater likelihood of disrupting access to nearby parks and informal recreation opportunities.

Table 1-2. Summary of Construction Impacts		
	Shared Ship Canal Tunnel Option	This option requires the fewest number of large construction sites, but the sites would be impacted during a relatively longer construction period, estimated at seven years. Tunnel portals have the potential to affect parks or athletic fields, particularly on the south side of the Ship Canal and in North Union Bay (University District). Potential impacts to parks or recreation facilities would be as described above for the Shared West Ship Canal Tunnel.
Integrated Plan Alternative		Construction impacts associated with certain CSO control facilities in the Delridge, East Waterway, Duwamish, Portage Bay, and Montlake neighborhoods would occur later (after 2028) under the Integrated Plan Alternative. As a result, these neighborhoods would potentially experience fewer near-term recreation impacts. Construction related impacts to recreation specific to stormwater projects under the Integrated Plan are expected to be minimal. NDS Partnering projects would be constructed within public rights-of-way, primarily along or in roadways, and could temporarily interfere with informal recreation such as walking and biking due to restricted access. The South Park Water Quality Facility is expected to be located in an industrial area on City-owned property, with no public access or recreational opportunities.
No Action Alternative		Recreation impacts from construction of ongoing programs under the No Action Alternative would be minor. Construction in the right-of-way for both sewer system improvements and for right-of-way rain garden projects could temporarily interfere with informal recreation due to restricted access.
Measures to reduce or minimize potential impacts		If a CSO facility were located in a park, impacts to recreation would be unavoidable. The City would attempt to avoid siting projects in parks. If locating outside of a park is not possible, impacts to recreational facilities could be further minimized through coordination with Seattle Parks, including coordinating construction timing with special events at the park; construction staging methods and siting; scheduling to avoid overlap with the construction of other projects in the vicinity; and advance public notice and signage. Parks and recreation features would be restored to the extent possible.
Historic, Cultural, and Archaeological Resources		
Long Term Control Plan Alternative	Key Findings	Construction under any of the LTCP options could have a potential adverse effect on historic, cultural, or archaeological resources in the Plan area. The primary difference in impacts relates to the amount of excavation in geological layers and their potential to encounter cultural resources. All options include similar, minimal potential for impacts on aboveground historic resources.
	Neighborhood Storage Option	*Neighborhood (Tanks/Pipes):* Construction could have a potential adverse effect on historic, cultural or archaeological resources in the Plan area. This option would have a greater amount of excavation in geological layers with greater potential to encounter cultural resources than the tunnel options. Only a minimal potential for impacts to aboveground resources is anticipated. *Neighborhood West Ship Canal Tunnel:* (See Shared West Ship Canal Tunnel Option below – impacts would be similar)

Table 1-2. Summary of Construction Impacts		
	Shared Storage Option	Potential for construction impacts to belowground historic and cultural resources would be similar to those described for the Neighborhood Storage Option. The Montlake neighborhood (where a shared storage tank would be constructed) contains known precontact and historic archaeological sites in proximity to the waterfront. Unknown belowground resources may also exist, and impacts resulting from tank construction would be permanent and irreversible if resources are encountered during construction. Impacts to aboveground resources would be the same as for the Neighborhood Storage Option.
	Shared West Ship Canal Tunnel Option	Because excavation for the tunnel portals would be deeper and therefore in geological layers with lower potential for encountering cultural resources, the tunnel options would have less potential to encounter cultural resources than the Neighborhood Storage Option or the Shared Storage Option. This option has the potential for temporary impacts to historic properties along the proposed tunnel alignment (vibration, dust, noise, and visual integrity). Historic structures may be more susceptible to damage from vibration.
	Shared Ship Canal Tunnel Option	This option has a similar potential for construction impacts on historic properties as the Shared West Ship Canal Tunnel Option.
Integrated Plan Alternative		Impacts are primarily associated with the LTCP option selected for implementation as described above. Additional impacts associated with the Integrated Plan alternative are minimal. Construction of the NDS Partnering projects would occur within previously disturbed public rights of way, and would not be likely to impact cultural or historic resources. For construction of the South Park Water Quality Facility, there is a potential to affect cultural resources. Site specific studies would be conducted as necessary to determine the potential for this impact.
No Action Alternative		Ongoing programs for sewer system improvements have the potential for construction impacts to historic properties depending on the locations of the improvements. Sewer system improvements and NDS projects generally would be anticipated to have very low potential to impact belowground resources because they would generally be constructed in previously disturbed areas.
Measures to reduce or minimize potential impacts		The City would conduct project-level cultural resource surveys prior to construction and consult with stakeholders to avoid, minimize, and mitigate potential impacts to identified resources.

Table 1-2. Summary of Construction Impacts		
Transportation		
Long Term Control Plan Alternative	Key Findings	Construction of projects under the LTCP options would result in moderate to substantial adverse transportation impacts for temporary periods ranging from one to seven years. Potential construction-related transportation impacts would be highly visible and are of concern to local residents, business owners, and commuters. Transportation impacts would include increases in traffic volumes due to construction-generated truck trips and commute trips of construction workers, and roadway lane and sidewalk closures where construction activities take place. The primary differences in potential transportation impacts of the LTCP options are related to the length of construction period, estimated number of truck trips, and the road network in the affected neighborhood.
	Neighborhood Storage Option	*Neighborhood (Tanks/Pipes):* Potential construction-related transportation impacts would be highly visible and would be of concern to local residents, business owners, and commuters in affected neighborhoods. Transportation impacts would include increases in traffic volumes due to construction-generated truck trips and commute trips of construction workers, and roadway lane and sidewalk closures where construction activities take place. Neighborhoods with limited number of route alternatives could experience adverse impacts from lane or road closures. The Neighborhood Storage Option would have the most dispersed transportation impacts because it would require roadway lane and sidewalk closures at a number of locations throughout the city to accommodate storage pipe and tank construction from City (and King County) independently constructed CSO storage facilities. Localized impacts would occur in certain areas (including Leschi, Montlake, and Magnolia) where the ability to accommodate lane closures for storage pipe construction is highly constrained due to a limited number of route alternatives. *Neighborhood West Ship Canal Tunnel:* (See Shared West Ship Canal Tunnel Option below – impacts would be similar)
	Shared Storage Option	Impacts would be similar to the Neighborhood Storage Option but concentrated at fewer locations. This option would eliminate or reduce transportation impacts in the Leschi neighborhood but would have increased transportation impacts in Fremont/Wallingford, North Union Bay, and Montlake. Arterials in the Montlake area are limited, so existing congestion levels would be exacerbated by lane closures and truck trips.
	Shared West Ship Canal Tunnel Option	Impacts in the Ship Canal Neighborhoods would be concentrated at two tunnel portal locations in Ballard and Fremont/Wallingford. Elements of the West Ship Canal Tunnel construction that would generate truck trips include tunnel excavation as well as construction of supporting pipeline, pump station, and micro-tunnels. Total construction trips are expected to be over 60,000 truck round trips for the West Ship Canal Tunnel Option, generated primarily in Ballard. Overall, this option would result in substantially more truck trips over a longer period in Ballard compared to the Neighborhood Storage and Shared Storage Options. With expected construction duration of 3.5 years, trucks generated by the tunneling are expected to average 60 per day. Anticipated increase in truck traffic is relatively low compared to typical background traffic on city arterials and is not expected to adversely affect roadway operations. However, at peak construction times, the truck trips could be noticeable to drivers.

Table 1-2. Summary of Construction Impacts		
		Localized impacts in other neighborhoods would be the same or similar to those described for the Neighborhood Storage Option.
	Shared Ship Canal Tunnel Option	Total construction trips are expected to be over 100,000 truck round trips for the Shared Ship Canal Tunnel Option, generated primarily on the south side of the Ship Canal at the launch portal. With estimated construction duration of seven years, truck trips generated by the tunneling are expected to average 70 per day. Anticipated increase in truck traffic is relatively low compared to typical background traffic on city arterials and is not expected to adversely affect roadway operations. However, at peak construction times, the truck trips could be noticeable to drivers. Overall, this option would result in substantially more truck trips over a longer period south of the Ship Canal, where the launch portal would likely be located, compared to the other options. Impacts would be similar to the Neighborhood Storage Option for the Longfellow Creek/Duwamish and Elliott Bay Neighborhoods.
Integrated Plan Alternative		Construction impacts associated with certain CSO control facilities in the Delridge, East Waterway, Duwamish, Portage Bay, and Montlake neighborhoods would occur later (after 2028) under the Integrated Plan Alternative. As a result, these neighborhoods would experience fewer near-term transportation impacts. There would be localized impacts to the neighborhoods implementing NDS Partnering. These would include neighborhoods in the Piper's Creek, Thornton Creek, and Longfellow Creek areas. Neighborhoods would voluntarily sign up for the project, and impacts would be short-lived and localized, including generation of a small number of construction vehicle trips, and lane or sidewalk narrowings or closures adjacent to construction activities. The South Park Water Quality Facility is expected to be constructed on City-owned property in an industrially zoned neighborhood with adequate access. Construction related impacts should be minimal.
No Action Alternative		Project construction under ongoing programs to implement sewer system improvements and NDS projects requires only a small number of truck trips for each project. No impacts to transportation are anticipated under the No Action Alternative.
Measures to reduce or minimize potential impacts		Transportation-related mitigation measures would depend on the exact type and size of the proposed improvement, but could include the following. • Develop a Traffic Control Plan for any work within the public right-of-way that affects vehicular, transit, bicycle, or pedestrian traffic. • Avoid creating additional delay at congested intersections either by choosing construction truck routes that avoid these locations, or constructing during nonpeak times of day. • Maintain access for driveways and private roads. • Provide adequate off-street parking areas at designated staging areas for construction-related vehicles. • Provide onsite loading areas for removal and delivery of material. • Provide plan for construction workers to commute via alternative modes or ridesharing, to minimize added vehicle trips and parking demand at the site. • Maintain pedestrian and bicycle access and circulation during project construction. If construction encroaches on a sidewalk, a safe detour should be provided for

Table 1-2. Summary of Construction Impacts	
	pedestrians at the nearest crosswalk. If construction encroaches on a bike lane, post warning signs that indicate bicycles and vehicles are sharing the roadway. • Provide traffic controls such as flaggers as appropriate. • Maintain access to transit services and coordinate with transit agencies (King County Metro, Sound Transit, Community Transit) if transit stop closures or route detours are needed. • Coordinate with the Seattle School District to ensure that access to school buses is maintained. • Post standard construction warning signs in advance of the construction area and at any intersection that provides access to the construction area. • Provide access for emergency vehicles at all times. • Provide written notification to contractors regarding appropriate routes to and from construction sites and weight and speed limits for local roads used to access construction sites. • Coordinate with the local neighborhoods to ensure that access to residences and businesses is adequately maintained, and that any additional potential issues unique to the neighborhood are identified and addressed. • Repair or restore the roadway right-of-way to its original condition or better upon completion of the work. • Comply with Seattle Department of Transportation requirements to schedule work on arterial streets and sidewalks outside of peak traffic hours unless otherwise authorized by the City Traffic Engineer. • Follow the Holiday Moratorium for construction, which indicates that no work shall be scheduled on streets or sidewalks within the Central Retail District and Pioneer Square from Thanksgiving Day through New Year's Day. Barge Transport of Excavated Materials for Tunnel Options: For the Shared West Ship Canal Tunnel Option and the Shared Ship Canal Tunnel Option, if the tunnel portals are located near Lake Washington, Elliott Bay, or the waterway that connects them, it could be possible to transport excavated material by barge rather than by truck. This could eliminate an estimated 16,000 construction truck trips) in Ballard with the Shared West Ship Canal Tunnel Option, and an estimated 32,000 construction truck trips south of the Ship Canal under the Shared Ship Canal Tunnel Option. Using barging as mitigation would require additional evaluations at the project level to determine feasibility of constructing ancillary facilities, including a conveyor system and a dock to support the barge, and to assess agency permit/approval feasibility.

Table 1-2. Summary of Construction Impacts		
Utilities		
Long Term Control Plan Alternative	Key Findings	Construction of storage tanks, pipes, tunnels, pump stations, and appurtenant facilities would occur in areas highly constrained by existing underground and overhead utilities and would require extensive coordination with existing utilities to avoid conflicts. The primary difference in impacts between the options relates to the number of new storage facilities constructed and the amount of new conveyance (pipelines) required to transport flows to the new storage facilities. Several of the options include flow diversions to King County facilities, which would necessitate coordination with King County to ensure that there are minimal impacts to King County facilities during construction. It would also be important to coordinate with the City's drinking water line of business to ensure that construction impacts to major water mains are avoided.
	Neighborhood Storage Option	*Neighborhood (Tanks/Pipes):* This option has the greatest potential for construction-related impacts to utilities due to the number of new storage tanks to be constructed and the amount of conveyance required to transport flows to storage facilities. The storage facilities and associated conveyance lines would be located in areas and at underground elevations with existing utilities. The Ballard, Fremont, East Waterway, and Delridge neighborhoods have the largest number of proposed facilities, but all proposed facilities are located in areas with existing underground utilities. Coordination with all potentially affected facilities would be required. *Neighborhood West Ship Canal Tunnel:* (See Shared West Ship Canal Tunnel Option below – impacts would be similar).
	Shared Storage Option	Large storage facilities would be constructed in neighborhoods with existing utilities, resulting in potential conflicts during construction. This option would include three shared storage facilities with King County as well as a proposed flow diversion to a King County facility, which would require close coordination to ensure that there are minimal impacts to King County facilities during construction.
	Shared West Ship Canal Tunnel Option	This option involves the City and King County sharing a deep tunnel. This option requires a high level of coordination with King County to avoid potential construction-related impacts. Deep tunnels tend to be constructed below many underground utilities, reducing the potential for utility conflicts. However, temporary electrical substations to power the tunnel boring machine and construction of tunnel portals and other associated facilities would require utility coordination and reconfiguration. This option would also include two flow diversions to King County facilities, necessitating close coordination with King County to ensure that there are minimal impacts to King County facilities during construction.
	Shared Ship Canal Tunnel Option	This option involves the City and King County sharing a deep tunnel, and includes four flow diversions to King County facilities. This option requires the highest level of coordination with King County, to avoid potential construction-related impacts.
Integrated Plan Alternative		Impacts to public utilities would be associated with localized below ground utilities potentially affected by conveyance line construction for the South Park Water Quality Alternative. There may be minor utility conflicts associated with NDS Partnering projects.
No Action Alternative		Construction-related impacts to utilities would occur under ongoing programs; however, impacts are expected to be lower than those expected to occur under the LTCP or Integrated Plan Alternatives.

Table 1-2. Summary of Construction Impacts		
Measures to reduce or minimize potential impacts		Impacts to utilities would be reduced by early and ongoing coordination with all potentially affected utilities. The measures would include, but are not limited to, those listed below: • Coordinate with other utilities and transportation departments to plan for shared construction to avoid consecutive construction projects (CSO control projects, road construction, other underground utilities). • Provide advance notice and coordinate with affected utilities to minimize disruption of services. • Adhere to the City's design criteria for the clearance of water mains and other utilities as outlined in Section 1-07.17 of the City of Seattle's Standard Specifications for Road, Bridge and Municipal Construction. • For all LTCP options, the City would work together with King County to analyze and mitigate downstream operational and capital impacts to the King County System. If downstream impacts cannot be successfully mitigated, then there is the potential that the County will be required to build new or larger downstream capital facilities to accommodate the LTCP options. Even with adequate mitigation though, there would likely be an increase in the County's operations and maintenance (O&M) costs to account for the additional flows from the City's system.
Socioeconomics and Environmental Justice		
Long Term Control Plan Alternative	Key Findings	Construction of the LTCP options could cause construction disturbance and modified access to community resources and businesses, resulting in temporary reduction in neighborhood cohesion. Temporary disruptions may be a particular hardship for some residents – particularly transit-dependent persons – due to disruptions to access and public transportation in project areas. There could be short-term impacts on existing economic conditions in the construction areas due to construction disturbance and temporary changes in the use of the land during construction. In some cases, these changes would be permanent, while in other cases, economic activity would largely be restored following construction. Although construction effects may be substantial, none of the LTCP options would cause disproportionately high and adverse effects on minority and low-income populations.
	Neighborhood Storage Option	*Neighborhood (Tanks/Pipes):* Construction may cause construction disturbance and modified access to community resources and businesses, resulting in temporary reduction in neighborhood cohesion. The Neighborhood Storage Option has the greatest number of City and King County independently constructed CSO storage facilities, and therefore the greatest number of areas that would experience construction disturbance and modified access to community resources and businesses during the construction period. The neighborhoods that would be most affected include the Ballard, Fremont/Wallingford, Leschi, and Longfellow Creek/Duwamish neighborhoods. Although construction activity may be substantial, no potential disproportionately high and adverse effects on minority and low-income populations have been identified. *Neighborhood West Ship Canal Tunnel: (*See Shared West Ship Canal Tunnel Option below

Table 1-2. Summary of Construction Impacts		
		– impacts would be similar).
	Shared Storage Option	The Shared Storage Option would reduce the total number of new storage facilities required in the city (by both the City and King County) and would reduce the number of storage facilities that would be constructed as compared to the Neighborhood Storage Option. Fewer areas would experience construction disturbance and modified access to community resources or businesses, and there would be fewer areas where property acquisition is required. However, it would concentrate impacts at shared tank locations. The neighborhoods that have the highest potential to be affected include Fremont/Wallingford, North Union Bay, and Montlake. Disproportionate impacts to minority or low income populations are not expected.
	Shared West Ship Canal Tunnel Option	The Shared West Ship Canal Tunnel would eliminate the need for the City (and King County) independently constructed storage facilities in the Ship Canal Neighborhoods, and therefore fewer areas would experience construction disturbance and modified access to community resources or businesses. However, it would concentrate impacts at fewer locations in the Ship Canal Neighborhoods. The neighborhoods that have the highest potential to be affected include Ballard and Fremont/Wallingford. Disproportionate impacts to minority or low income populations are not expected.
	Shared Ship Canal Tunnel Option	The Ship Canal Tunnel Option would affect the fewest neighborhoods throughout the city, but it would also concentrate impacts in the Ship Canal and Lake Washington Neighborhoods. Overall, the potential to impact businesses and local economic activity would be reduced city-wide. Disproportionate impacts to minority or low income populations are not expected.
Integrated Plan Alternative		Construction impacts associated with certain CSO control facilities in the Delridge, East Waterway, Duwamish, Portage Bay, and Montlake neighborhoods would be delayed until (after 2028) under the Integrated Plan Alternative. As a result, these neighborhoods would experience fewer near-term socioeconomic impacts. Construction associated with NDS Partnering would cause minor and temporary impacts to the communities in which they're located, and could alter access to community resources. Project construction associated with the South Park Water Quality Facility could also alter access to community resources and result in short-term noise and other impacts in affected neighborhoods. However, the potential for impacts is minimal as the project is anticipated to be located in an industrial area.
No Action Alternative		Project construction under ongoing programs to implement sewer system improvements and NDS projects could alter access to community resources and result in short-term noise and other impacts in affected neighborhoods. However, these impacts would be very short term and would not affect the integrity of the neighborhoods. The No Action Alternative would require fewer disruptions in industrial and commercial areas, and fewer property acquisitions and displacements than would the LTCP or Integrated Plan Alternatives.
Measures to reduce or minimize potential impacts		The City would undertake the following measures to mitigate socioeconomic impacts: • Prioritizing project locations on public property and in public rights-of-way, • Complying with federal, state, and local regulations regarding property acquisition and relocation assistance, • Providing advance notification of construction activities, including any sidewalk and

Table 1-2. Summary of Construction Impacts	
	street lane closures, to nearby residents, and • Preparing a traffic control plan including measures to address residential access, emergency vehicle access, road closures and detours, and temporary bus route changes. Additional measures to minimize impacts to environmental justice populations and organizations and businesses that serve them would include communicating information and obtaining feedback about construction activities, impacts, and mitigation at low-income housing sites and through social service providers. The project would also focus outreach to populations with limited English proficiency and to other populations susceptible to construction-related impacts.

Table 1-3 summarizes operational impacts associated with the LTCP, Integrated Plan, and No Action Alternatives. As previously described, impacts are described for those projects and programs proposed by the City independently or working jointly with King County. Independent King County projects are identified but not discussed in this document. Impacts will be assessed by King County in accordance with their SEPA requirements.

Table 1-3. Summary of Operational Impacts		
Earth		
Long Term Control Plan Alternative	Key Findings	Overall, the operational effects from the LTCP Alternative are expected to be minor. With the implementation of site-appropriate design, potential adverse impacts would be avoided and minimized.
	Neighborhood Storage Option	*Neighborhood (Tanks/Pipes):* This option would have the most tanks and pipes located throughout the Plan area potentially at risk during a seismic event. However, storage facilities would be designed in accordance with seismic design standards, which are intended to minimize the long-term risks to the system. *Neighborhood West Ship Canal Tunnel:* (See Shared West Ship Canal Tunnel Option below – impacts would be similar).
	Shared Storage Option	Impacts would be similar to the Neighborhood Storage Option but there would be fewer storage tanks and pipes potentially at risk during a seismic event.
	Shared West Ship Canal Tunnel Option	Impacts would be similar to the Neighborhood Storage Option but there would be fewer storage tanks and pipes potentially at risk during a seismic event. Tunnels are generally designed to avoid other underground developments and take advantage of stable glacial till layers. Operational effects are anticipated to be minor.
	Shared Ship Canal Tunnel Option	This option would have similar potential for impacts as the Shared West Ship Canal Tunnel Option. Additional flow diversions under this option would further reduce the number of storage facilities at potential risk.
Integrated Plan Alternative		In addition to the operational impacts of the selected LTCP option, the operational impacts of the stormwater projects specific to the Integrated Plan Alternative are anticipated to be minor. Depending on location selected, the South Park Water Quality Facility could be at risk for liquefaction in saturated soils; however, the facility would meet seismic design standards. NDS Partnering projects could cause erosion if not properly maintained. Street sweeping operations would not be expected to affect earth or groundwater.
No Action Alternative		Projects completed as part of the ongoing Natural Drainage System program and roadside rain garden programs could cause erosion if they are not properly maintained. Projects included in the City's NPDES Waste Discharge Permit and the 2010 Plan Amendment will meet seismic design standards.
Measures to reduce or minimize potential impacts		The City would undertake the following measures: • All sites would be maintained to prevent erosion. • Projects would be sited and designed to minimize seismic risk and potential for earth subsidence.

<table>
<tr><th colspan="3">Table 1-3. Summary of Operational Impacts</th></tr>
<tr><th colspan="3">Air Quality</th></tr>
<tr><td rowspan="5">Long Term Control Plan Alternative</td><td>Key Findings</td><td>The net operational effects of the LTCP Alternative on air quality and odors would be minor in the Plan area. All facilities would be designed and maintained to minimize emissions of odorous compounds and would include odor control components as necessary.</td></tr>
<tr><td>Neighborhood Storage Option</td><td>Neighborhood (Tanks/Pipes): This option would have the highest number of potential odor-producing tanks and pipes located throughout the Plan area, including in or near residential areas in the Ship Canal, Lake Washington, and Longfellow Creek/Duwamish Neighborhoods. All facilities would be designed and maintained to minimize emissions of odorous compounds. Therefore, operational effects of the CSO control facilities on air quality and odors would be minor in the Plan area.

Neighborhood West Ship Canal Tunnel: (See Shared West Ship Canal Tunnel Option below – impacts would be similar).</td></tr>
<tr><td>Shared Storage Option</td><td>Impacts would be similar to the Neighborhood Storage Option but there would be fewer potential odor-producing tanks and pipes in the Ship Canal Neighborhoods.</td></tr>
<tr><td>Shared West Ship Canal Tunnel Option</td><td>The large tunnel would reduce the number of potential odor-producing storage facilities in the Ballard and Fremont/Wallingford neighborhoods. The large tunnel would have the greatest potential for odors at the downstream tunnel portal (likely located along the Ship Canal in the vicinity of Ballard), which would be controlled by an odor control facility. In neighborhoods where flow diversions would replace storage tanks/pipes, there would be less potential for odor impacts.</td></tr>
<tr><td>Shared Ship Canal Tunnel Option</td><td>This option would have similar potential for impacts to the Shared West Ship Canal Tunnel Option, except that storage facilities with odor-producing potential would largely be eliminated in the Lake Washington Neighborhoods of Montlake, Portage Bay, and Leschi. The large tunnel would have the greatest potential for odors at the downstream tunnel portal (likely located along the south side of the Ship Canal), which would be controlled by an odor control facility. Additional flow diversions in Duwamish and Delridge would further reduce the number of potentially odor-producing storage facilities in those neighborhoods.</td></tr>
<tr><td colspan="2">Integrated Plan Alternative</td><td>In addition to the operational impacts of the selected LTCP option, the air quality impacts of the stormwater projects specific to the Integrated Plan Alternative are anticipated to be minor. Similar to CSO storage facilities, the South Park Water Quality Facility has the potential to generate odors. However, this impact is expected to be minimal because stormwater has fewer odor generating compounds than wastewater or combined sewer overflows. Street sweeping has the potential to temporarily increase localized dust and emissions, but increases would be minimal and occurring at night. There are no operational air-related impacts associated with NDS Partnering.</td></tr>
<tr><td colspan="2">No Action Alternative</td><td>No air quality impacts or increased odors are anticipated from the ongoing sewer system improvements and NDS programs.</td></tr>
</table>

Table 1-3. Summary of Operational Impacts	
Measures to reduce or minimize potential impacts	The City would undertake the following measures: • All storage facilities would be designed with state-of-the-art odor control systems. • The City would operate storage facilities to minimize the potential for odors by limiting how long combined sewage is stored in the facilities, maintaining air space at slightly negative pressures, and scheduling maintenance of odor control systems during cold temperatures and periods of low flow.
Surface Water	
Long Term Control Plan Alternative	The LTCP Alternative would result in substantial pollutant loading reduction from existing uncontrolled CSO outfalls when compared with the No Action Alternative. Pollutant loadings from control of 22 currently uncontrolled CSOs would be substantively reduced and would come into compliance with the Clean Water Act and the requirements of the Consent Decree. The Ship Canal/Lake Union, Lake Washington, Duwamish River, Longfellow Creek, Elliott Bay and Puget Sound would receive reduced discharges from CSOs. The Integrated Plan Alternative would result in greater pollutant loading reductions than the LTCP Alternative.
Integrated Plan Alternative	Reduced pollutant loadings would be greater than those achieved by the LTCP alone because of the additional reductions achieved by stormwater projects. The Integrated Plan would provide greater reductions in total suspended solids, PCBs, total copper, total zinc, total phosphorus, and fecal coliform. Relative reductions would be highest for the Duwamish Waterway, which was identified as the highest priority water body by the Integrated Plan team because of the sensitivity of its resources within those water bodies. Deferral of six CSO projects would result in delayed reduction of loads that constitute less than 10 percent of the total CSO loads currently being discharged. These CSOs were identified for deferral primarily because they are already close to being controlled and have relatively low average annual discharge volumes. Discharges from the deferred CSOs into Portage Bay and the Duwamish Waterway would continue until the projects are constructed between 2028 and 2030.
No Action Alternative	Under the No Action Alternative, pollutant loadings to receiving water bodies would not be reduced beyond levels provided from construction of projects included in the 2010 CSO Control Plan and currently planned NDS projects. This alternative does not comply with the Consent Decree, and it would result in significant fines for the City. This alternative is not consistent with the City's Plan to Protect Seattle's Waterways.
Measures to reduce or minimize potential impacts	The Plan Alternatives are intended to reduce surface water impacts and comply with the Clean Water Act and the Consent Decree. Additional water quality benefits will be achieved through ongoing watershed management efforts, stormwater management programs, and other cooperative efforts with watershed managers throughout the region.
Biological Resources	
Long Term Control Plan Alternative	The LTCP Alternative would result in negligible to minor impacts from operation of the storage facilities in the Plan area. There would be long-term beneficial effects on fish and aquatic life from reducing CSOs. Implementation of the LTCP would reduce the volume of untreated sewage and stormwater runoff, thereby reducing the potential for related impacts on aquatic life. Implementation of the LTCP would comply with the Consent Decree as well as other federal and state requirements.

Table 1-3. Summary of Operational Impacts		
Integrated Plan Alternative		In addition to the benefits associated with the LTCP CSO control facilities, there would be additional pollutant reductions to the Duwamish waterway, Thornton Creek, Piper's Creek, and Longfellow Creek. The expanded Street Sweeping program would also benefit Lake Union/Ship Canal, Elliott Bay and Puget Sound. Reductions in pollutant loading would benefit aquatic resources in these waterways. NDS Partnering would help reduce high flow pulses that can adversely affect aquatic life in the creeks.
No Action Alternative		The No Action Alternative would result in no additional improvements to CSO reductions in the Plan area, which could have long term adverse effects on fish and aquatic life including listed species.
Measures to reduce or minimize potential impacts		Because none of the Plan alternatives are expected to cause adverse impacts to biological resources, no mitigation measures are proposed.
Energy and Climate Change		
Long Term Control Plan Alternative	Key Findings	The LTCP would have minor operational effects on energy use in the city. The greenhouse gas (GHG) emissions produced by operating and maintaining CSO facilities are not expected to cause appreciable climate change impacts. The City has incorporated climate change modeling in its development of Plan alternatives and would incorporate additional modeling in the design of individual CSO facilities to minimize risks from anticipated changes in precipitation and sea level rise.
	Neighborhood Storage Option	*Neighborhood (Tanks/Pipes):* The CSO control facilities would have minor operational effects on energy use as a result of pumping and electrical equipment requirements. Although operating the CSO equipment can be energy intensive, most of the equipment operates infrequently, only during storm events. Therefore, the CSO equipment is expected to have a minor impact on energy use or demand in the Plan area. The GHG emissions produced by operating and maintaining CSO control facilities are expected to be minor. The City has incorporated climate change modeling in its development of Plan alternatives and would incorporate additional modeling in the design of individual CSO control facilities to minimize risks from anticipated changes in precipitation and sea level rise. *Neighborhood West Ship Canal Tunnel:* (See Shared West Ship Canal Tunnel Option below – impacts would be similar).
	Shared Storage Option	The CSO facilities included in the Shared Storage Option would have somewhat higher electrical requirements than the City independent CSO facilities included in the Neighborhood Storage Option because of the greater energy requirements of the larger shared storage tanks. However, overall energy use would be expected to be lower because the shared tanks eliminate 10 City and 3 King County independently constructed CSO facilities.
	Shared West Ship Canal Tunnel Option	The Shared West Ship Canal Tunnel Option would potentially have a higher electrical requirement than the City neighborhood CSO facilities included in the Neighborhood Storage Option and the shared storage tanks included in the Shared Storage Option because of the electricity needed to pump the deeply stored water. However, overall energy use would still be minor and would be expected to be further reduced as this option eliminates 4 City and 1 King County independently constructed CSO facilities.

Table 1-3. Summary of Operational Impacts		
	Shared Ship Canal Tunnel Option	The Shared Ship Canal Tunnel Option would have slightly higher than the West Ship Canal Tunnel because of the electrical energy requirements of the larger tunnel. However, overall energy use would be expected to be the most reduced under this option compared to the Neighborhood Storage Option because it eliminates 15 City and 3 King County independently constructed CSO facilities, the most of all the options.
Integrated Plan Alternative		In addition to the CSO control facilities under the LTCP, the South Park Water Quality Facility would use energy on an intermittent basis.
No Action Alternative		Energy requirements from operation of projects implemented under ongoing programs are minimal. Existing CSO control facilities located in areas prone to sea level rise could be flooded, reducing their ability to effectively handle CSO events.
Measures to reduce or minimize potential impacts		The City would undertake the following measures to reduce the impacts of CSO control facilities on energy and to protect the facilities from the risks of climate change: • Comply with state and city requirements related to energy efficiency of the new CSO control facilities. • Include evaluations of GHG emissions as required by the City in project-level SEPA analyses. • Incorporate climate change modeling into design of CSO control facilities. • Utilize the adaptation planning pathways incorporated in the City's *Sea Level Rise Planning Guidance for Capital Projects* (City of Seattle, 2011d) to design and locate CSO control facilities.
Environmental Health and Public Safety		
Long Term Control Plan Alternative		Overall, the LTCP Alternative is expected to reduce environmental health risks associated with CSOs by reducing untreated discharges. Reductions of CSO discharges to water bodies where water contact recreation occurs, including Lake Union, the Ship Canal, Lake Washington, and the Duwamish Waterway, would reduce the potential for CSO-related environmental health risks in those water bodies.
Integrated Plan Alternative		In general, reduction in environmental health risks would be greatest under the Integrated Plan Alternative. Pollutant load and human exposure evaluations conducted as part of the Integrated Plan indicated that pathogens and toxic organic and inorganic constituents would be reduced to a greater level under the Integrated Plan Alternative than the LTCP Alternative. Once the deferred CSO projects are implemented, they will add to the long term loading reduction achieved by the Integrated Plan Alternative. Residents have expressed concerns about health risks associated with rain gardens, including safety risks associated with ponded water, and potential for mosquito breeding. With proper design and maintenance, these issues are not expected to occur.
No Action Alternative		Under the No Action Alternative, water quality in surface waters throughout the Plan area would continue to be negatively impacted by CSO releases from uncontrolled outfalls. Contaminated water could continue to affect swimming beaches and fishing areas, causing environmental health impacts. The No Action Alternative is not compliant with the Consent Decree, and is not consistent with the City's Plan for Protecting Seattle's Waterways.
Measures to reduce or minimize potential impacts		As part of ongoing programs, the City undertakes the following measures to minimize impacts of NDS projects:

<table>
<tr><th colspan="3">Table 1-3. Summary of Operational Impacts</th></tr>
<tr><td colspan="2"></td><td>The City maintains roadside rain gardens to prevent standing water and reduce the potential for mosquito breeding.
The City provides education and incentives to encourage property owners to maintain rain gardens.</td></tr>
<tr><td colspan="3">Noise and Vibration</td></tr>
<tr><td rowspan="5">Long Term Control Plan Alternative</td><td>Key Findings</td><td>The net operational effects of the LTCP Alternative would be minor in the Plan area. Noise would be intermittently generated under all options by pump stations and odor control facilities. All facilities would be designed and maintained to reduce noise to permissible levels.</td></tr>
<tr><td>Neighborhood Storage Option</td><td>Neighborhoods (Tanks/Pipes): Because the Neighborhood Storage and Shared Storage Options would have the most pump stations and other facilities, they would have a higher potential for noise impacts. Some pump stations and mechanical facilities could be located in residential areas, particularly in the Lake Washington, Longfellow Creek/Duwamish, and Ship Canal Neighborhoods.

Neighborhood West Ship Canal Tunnel: (See Shared West Ship Canal Tunnel Option below – impacts would be similar).</td></tr>
<tr><td>Shared Storage Option</td><td>Impacts would be similar to the Neighborhood Storage Option but there would be additional noise-generating pump stations and mechanical facilities.</td></tr>
<tr><td>Shared West Ship Canal Tunnel Option</td><td>Because the Shared West Ship Canal Tunnel Option and the Shared Ship Canal Tunnel Option would have fewer pump stations and mechanical facilities than the Neighborhood and Shared Storage Options, they would have a lower potential for noise impacts.</td></tr>
<tr><td>Shared Ship Canal Tunnel Option</td><td>Because the Shared West Ship Canal Tunnel Option and the Shared Ship Canal Tunnel Option would have fewer pump stations and mechanical facilities than the Neighborhood and Shared Storage Options, they would have a lower potential for noise impacts.</td></tr>
<tr><td colspan="2">Integrated Plan Alternative</td><td>CSO storage pipes, tanks, and tunnels constructed under the Integrated Plan Alternative would have the same operational noise impacts as under the LTCP Alternative, but implementation would be delayed in some neighborhoods. Operation of the elements specific to the Integrated Plan Alternative would have minimal noise impacts. Natural drainage systems would not generate noise. Street sweeping, which would occur at night, would only occur on arterial streets and would not generate noise in excess of typical vehicle noise. The South Park Water Quality Facility could generate some operational noise from ventilation fans and maintenance activities. However, the facility would be located in an industrial area and operational noise would not impact residences or other sensitive receptors.</td></tr>
<tr><td colspan="2">No Action Alternative</td><td>Operation of sewer system improvements and NDS projects implemented under ongoing programs would not generate noise.</td></tr>
<tr><td colspan="2">Measures to reduce or minimize potential impacts</td><td>A noise analysis for each project would be performed during final design. Information on sensitive noise receiving properties and site-specific characteristics will be used to determine location-specific mitigation measures. Potential mitigation measures could include:</td></tr>
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<tr><th colspan="3">Table 1-3. Summary of Operational Impacts</th></tr>
<tr><td colspan="2"></td><td>Pump station and odor control facility designs would include attenuation measures for fan noise and pump and motor noise as needed to comply with noise levels specified by the City of Seattle and to address location-specific factors as determined during project design.
Facility vault access hatches would be designed to be relatively thick and to have seals at the perimeters to contain noise within the vault.
Pumps, standby generators, and odor control equipment would be located in below ground structures.</td></tr>
<tr><td colspan="3">Land Use and Visual Quality</td></tr>
<tr><td rowspan="3">Long Term Control Plan Alternative</td><td>Key Findings</td><td>Potential land use impacts associated with CSO control projects include conversion of land in residential, commercial, or industrial areas to public utility uses. These impacts differ between the options because of different property requirements of tanks as compared to tunnels. The completed facilities would primarily be constructed below ground; aboveground facilities would have minimal visual impacts with the use of site appropriate design and screening.</td></tr>
<tr><td>Neighborhood Storage Option</td><td>Neighborhood (Tanks/Pipes): This option would have the most storage tanks located throughout the Plan area with the potential to cause permanent land use changes. Private property or permanent easements could be acquired for any of the LTCP options, but would likely be greatest under the Neighborhood Storage (and Shared Storage Options). Current land uses would be permanently changed to become storage facilities, however, the tanks and associated equipment would primarily be underground. The presence of underground storage tanks would restrict certain future uses on top of the facility. While there is the potential to redevelop the surface area into certain beneficial uses, the previous land use at the site could be permanently altered. Typical uses for the tops of storage tanks include passive recreation, athletic fields and parking facilities. More area would be retained in ownership or by permanent easement by the City for a storage tank than for a tunnel.

Ballard would have the largest storage tank (occupying an estimated 60,000 square feet (SF)). The completed facilities would be designed to visually blend with the surroundings, but it is likely that they would have a different appearance from pre-construction conditions. Storage pipes would be constructed in street rights-of-way, and would have less potential for land use changes.

Neighborhood West Ship Canal Tunnel: (See Shared West Ship Canal Tunnel Option below – impacts would be similar).</td></tr>
<tr><td>Shared Storage Option</td><td>The impacts would be similar to the Neighborhood Storage Option. While fewer sites in the Ship Canal Neighborhoods would be used for storage tanks, and no tank would be sited in the East Waterway area, potential land use impacts from siting larger shared tanks could occur in the Lake Washington Neighborhoods. These tanks would occupy an estimated 35,000 SF (North Union Bay) and 40,000 SF (Montlake). There is a greater potential for conversion of residential lands for storage tanks in the Lake Washington Neighborhoods under this option. As noted above, more area would be retained in ownership or by permanent easement by the City for a storage tank than for a tunnel, and the presence of an underground tank restricts certain future uses of the site.</td></tr>
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Table 1-3. Summary of Operational Impacts		
	Shared West Ship Canal Tunnel Option	This option would have less potential for long-term land use impacts than both the Neighborhood Storage and Shared Storage Options since the tunnel would replace the need to site several storage tanks in the Ship Canal Neighborhoods (Ballard and Fremont/Wallingford), and less property would need to be retained following construction. In contrast to storage tanks, the City would be able to sell or lease approximately 75 percent of the tunnel launch portal lands in Ballard required for construction back to private ownership where it could be developed for zoned uses (e.g., industrial, commercial). Approximately 0.5 acre of the launch portal would be retained by the City to house the pump station, odor control, and permanent shaft for access and maintenance. All of the area used for the smaller, recovery end of the tunnel in Fremont/Wallingford would be retained by the City. Some additional areas would be retained for permanent shafts as required to accept flows from each contributing City and King County CSO area.
	Shared Ship Canal Tunnel Option	Similar to the Shared West Ship Canal Tunnel, less property would need to be retained following construction of the tunnel compared to the Neighborhood and Shared Storage Options. The City would be able to sell or lease approximately 75 percent of the tunnel launch portal lands on the south side of the Ship Canal required for construction back to private ownership where it could be developed for zoned uses (e.g., industrial, commercial). Approximately 0.5 acre would be retained by the City to house the pump station, odor control, and permanent shaft for access and maintenance. All of the area used for the smaller, recovery end of the tunnel in North Union Bay would be retained by the City. Compared to the Shared West Ship Canal Tunnel Option, the Ship Canal Tunnel would result in less potential for land use impacts in Ballard and more potential for land use impacts on the south side of the Ship Canal and in North Union Bay.
Integrated Plan Alternative		Stormwater projects constructed under the Integrated Plan are not expected to cause major long term impacts to land use. Long term land use impacts from NDS Partnering would be minimal, because the projects would be implemented in neighborhoods on a voluntary basis, and would be installed to blend with neighborhood character. The South Park Water Quality Facility would likely be sited in an industrial-zoned area, surrounded by industrial and commercial land uses. The visual impact of the facility is expected to be minimal.
No Action Alternative		Operation of sewer system improvements and NDS projects implemented under ongoing programs are not expected to result in land use or visual quality impacts. The planned CSO projects included in the City's NPDES Waste Discharge Permit and the 2010 Plan Amendment would have minor land use impacts. Visual quality impacts would be limited to the aboveground support facilities needed for the CSO projects and are also expected to be minor.
Measures to reduce or minimize potential impacts		The City would undertake the following measures to mitigate land use and visual quality impacts for all proposed projects: • Minimize the size of permanent aboveground facilities and design them to blend with the surroundings. • Locate and aim any artificial lighting away from adjacent roadways, residential areas, and water bodies. Use the minimum wattage necessary to provide the necessary illumination. • Sell or lease portal land in excess of what is needed back to private ownership.

Table 1-3. Summary of Operational Impacts

Recreation		
Long Term Control Plan Alternative	Key Findings	Overall, the operational effects from the LTCP Alternative on recreational activities are expected to be minor. Reductions in pollutant loading would benefit long term water quality and help maintain beneficial uses at area beaches. Water contact recreation in area water bodies would be enhanced by improved water quality in Lake Washington, Portage Bay, the Duwamish River, and Lake Union, in particular. Locating storage facilities in a park would constrain certain future uses of that area for park purposes. However, there is a potential to provide recreational facilities on top of storage tanks following construction.
	Neighborhood Storage Option	*Neighborhood (Tanks/Pipes):* The Neighborhood Storage and Shared Storage Options would have the highest potential to cause park and recreation impacts because these options have the most tank facilities. Locating storage facilities in a park or its associated uses (such as parking) would constrain certain future uses of that area for park purposes. However, there is a potential to provide recreational facilities on top of storage tanks following construction. *Neighborhood West Ship Canal Tunnel:* (See Shared West Ship Canal Tunnel Option below – impacts would be similar).
	Shared Storage Option	The impacts would be similar to the Neighborhood Storage Option. While fewer sites in the Ship Canal Neighborhoods would be used for storage tanks, potential recreation impacts from siting larger shared tanks could occur in the North Union Bay and Montlake neighborhoods if a tank is located in a park. The Montlake neighborhood, because of the relatively higher amount of parkland, including Montlake Boulevard (an Olmsted Park), has a greater potential to be affected under this option. The storage tank in North Union Bay would be located in proximity to the University of Washington Athletic Complex (including fields, a golf course, a ballpark, and an outdoor track) and the Union Bay Natural Area.
	Shared West Ship Canal Tunnel Option	This option would have less potential for long-term impacts to recreation than both the Neighborhood Storage and Shared Storage Options since the tunnel would replace the need to site several storage tanks in the Ship Canal Neighborhoods (Ballard and Fremont/Wallingford), with less potential for recreation impacts.
	Shared Ship Canal Tunnel Option	Compared to the Shared West Ship Canal Tunnel Option, the Ship Canal Tunnel would result in less potential for recreation impacts in Ballard and more potential for impacts on the south side of the Ship Canal and in North Union Bay if the tunnel portals are sited in a park or recreation area. Parks and recreation areas in these areas include athletic fields owned and operated by Seattle Pacific University and the University of Washington, as well as the Burke Gilman Trail, and numerous neighborhood parks.
Integrated Plan Alternative		Storage pipes, tanks, and tunnels constructed under the Integrated Plan Alternative would have the same recreation impacts as under the LTCP Alternative, but implementation would be delayed in some neighborhoods. Operation of the stormwater projects specific to the Integrated Plan Alternative is not expected to result in any additional adverse recreation impacts. Additional water quality improvements in the Plan area water bodies would have indirect benefits to recreation at swimming beaches, particularly in Lake Washington and Lake Union.

Table 1-3. Summary of Operational Impacts		
No Action Alternative		The No Action Alternative would result in no additional improvements to water quality in the Plan area water bodies, with ongoing potential for adverse indirect effects on recreation at swimming beaches.
Measures to reduce or minimize potential impacts		The City would comply with the conditions of Initiative 42 (Ordinance No. 118477) related to siting public facilities in parks. Additional site-specific measures, including mitigation for project-related impacts, would be identified during project design.
Historic, Cultural, and Archaeological Resources		
Long Term Control Plan Alternative		Operation of projects implemented under the LTCP Alternative is anticipated to have no effect on historic, cultural, and archaeological resources within the Plan area.
Integrated Plan Alternative		No additional effects on historic, cultural, and archaeological resources within the Plan area are anticipated under the Integrated Plan Alternative.
No Action Alternative		Operation of projects implemented under ongoing programs is anticipated to have no effect on historic, cultural, and archaeological resources within the Plan area.
Measures to reduce or minimize potential impacts		No mitigation would be required.
Transportation		
Long Term Control Plan Alternative		Overall, the operational effects from vehicle trips generated by facility maintenance under the LTCP Alternative are expected to be minor.
Integrated Plan Alternative		Operation of the additional projects implemented under the Integrated Plan Alternative would have minimal transportation impacts. The South Park Water Quality Facility could generate occasional vehicle trips with minimal effect on roadway operations. Street sweeping would primarily occur at night when traffic volumes are low, and would not affect roadway operations or parking.
No Action Alternative		Completed projects under the No Action Alternative are not expected to cause transportation impacts.
Measures to reduce or minimize potential impacts		Because there would be no impacts to transportation, no mitigation measures are proposed.
Utilities		
Long Term Control Plan Alternative	Key Findings	Implementation of the LTCP will require close coordination with numerous utilities, in particular, wastewater and stormwater utilities within the service area. Because the City's collection system network sends wastewater to King County for treatment, coordination with King County will be particularly important. King County's West Point Treatment Plant would receive additional sewage flows as a result of Plan implementation. The high variability in flow rates within the sewer system associated with heavy storms could be challenging to manage at the King County West Point Treatment Plant. Based on City modeling, these additional flows will have little effect on the peak loading to King County's West Point Treatment Plant and may potentially reduce peak loading. However, annual average flows will increase, resulting in greater operational and maintenance costs. Seattle and King County will address the incremental cost of these flows in their sewage disposal agreement.

Table 1-3. Summary of Operational Impacts

		The potential implications to King County's combined sewer system vary depending upon the option implemented, as described below. In general the operational implications associated with shared options will require greater coordination with King County than the Neighborhood Storage Option.
	Neighborhood Storage Option	*Neighborhood (Tanks/Pipes):* This option would generally have minimal operational impacts to utilities once construction is complete. However, this option would require the greatest length of sewer pipe construction, with accompanying maintenance requirements. Sewer system improvements in North Union Bay could have operational implications to King County, which would be resolved according to agreements negotiated with King County. Selection of this option would necessitate the need for King County to construct the largest number of independent storage facilities to meet regulatory requirements. *Neighborhood West Ship Canal Tunnel:* Impacts would be the same as described above.
	Shared Storage Option	Impacts would be similar to those described for the Neighborhood Storage Option. However, flow diversion projects in cooperation with King County would result in potential operational considerations for both King County and the City. Potential operational implications would be coordinated with King County to ensure than detrimental impacts do not occur.
	Shared West Ship Canal Tunnel Option	As described above, shared storage and flow diversion projects have operational implications to King County and the City. A large shared tunnel and flow diversions to King County in the East Waterway and Magnolia neighborhoods would be implemented in accordance with operational agreements between the City and King County. The Shared West Ship Canal Tunnel Option may reduce the operational complexity of controlling neighborhood storage tanks or shared storage tanks, as it provides one large storage facility for all flows to be managed through a single pump station discharging to King County's West Point Treatment Plant. Close coordination with King County would be needed to optimize operational benefits.
	Shared Ship Canal Tunnel Option	This option involves the City and King County sharing a deep tunnel, and includes four flow diversions to King County facilities. This option requires the highest level of coordination with King County, to reduce the potential for impacts. Extensive coordination between the City and King County would be conducted to develop operational agreements that are workable and efficient for both entities.
Integrated Plan Alternative		Impacts to public utilities would primarily be related to selection of an LTCP option. No additional impacts are expected to occur related to the implementation of Integrated Plan stormwater projects.
No Action Alternative		Implementation of the No Action Alternative would not comply with the Consent Decree, and could potentially result in significant fines for the City, with potential impacts to City ratepayers.
Measures to reduce or minimize potential impacts		For all LTCP options, the City would work together with King County to analyze and mitigate downstream operational and capital impacts to the King County System. If downstream impacts cannot be successfully mitigated, then there is the potential that the County will be required to build new or larger downstream capital facilities to accommodate the LTCP options. Even with adequate mitigation though, there would likely be an increase in the County's operations & maintenance (O&M) costs to account for the additional flows from the City's system.

Table 1-3. Summary of Operational Impacts	
Socioeconomics and Environmental Justice	
Long Term Control Plan Alternative	The operational effects of the LTCP Alternative would be minor to moderately beneficial associated with improved water quality in area receiving waters, and there would be no adverse operational effects that would be predominantly borne by minority or low-income populations and underserved communities.
Integrated Plan Alternative	The operational effects of the additional Integrated Plan stormwater projects would be minor to moderately beneficial, and there would be no adverse operational effects that would be predominantly borne by minority or low-income populations and underserved communities.
No Action Alternative	CSO discharges would not be reduced beyond levels outlined in the City's NPDES Waste Discharge Permit and 2010 CSO Control Plan, so no further improvements in current environmental health risks would occur. These health risks are predominantly borne by low-income, tribal, and subsistence fishing communities. Sewer system improvements and NDS programs included in the No Action Alternative are not expected to cause socioeconomic or environmental justice impacts.
Measures to reduce or minimize potential impacts	The City would continue public participation efforts as projects are advanced consistent with the City's social and racial justice initiative.

1.12 Selection of a Preferred Alternative

Foremost in the development of the Plan is the need to comply with the Consent Decree and meet federal and state regulatory requirements. In order to comply with the Consent Decree, The City must select and implement an LTCP option. It is possible that the final option selected may include a combination of options or facilities presented in the EIS. An Integrated Plan is an optional approach that is not required by EPA, but can be used to satisfy the Consent Decree.

The Plan for Protecting Seattle's Waterways, which consists of the following four volumes, will be submitted to EPA and Ecology for review and comment:

- Volume 1: Executive Summary
- Volume 2: CSO Long Term Control Plan
- Volume 3: Integrated Plan
- Volume 4: Programmatic EIS

The City will also continue to implement a public process and outreach to solicit input from the public and other stakeholders, including input received during a public hearing for the EIS and a public meeting on the Plan. The City will weigh the results of its multiple objective decision analysis (MODA) for the LTCP and the Integrated Plan, address EPA and Ecology comments, and consider costs and input from the public and other stakeholders to identify a preferred alternative. Identification of a preferred alternative is expected to occur in early 2015 following release of the Final EIS.

CHAPTER 2
Introduction and Background

Seattle is served by a complex system of pipes that handle the stormwater and wastewater flows generated by businesses and residents. The pipes are part of one of three basic types of systems: a separate storm sewer system that carries stormwater only; a sanitary sewer system (SSS) that carries sewage only; and a combined sewer system (CSS), which conveys a mixture of sewage and stormwater (Figure 2-1).

During heavy rains, sewer pipes that carry a combination of untreated sewage and stormwater can be overwhelmed by stormwater, causing overflows into creeks, lakes, rivers, and Elliott Bay. These overflows are called “combined sewer overflows” or CSOs. These CSOs contribute pollutants to surrounding water bodies, impacting their quality and uses. In addition, stormwater runoff from streets, parking lots, and buildings in separate pipes contributes a wide range of pollutants to the city’s waters.

As part of its **Plan to Protect Seattle’s Waterways** (the Plan), the City of Seattle (City) is preparing a comprehensive strategy to reduce overflows and discharge of pollutants from combined sewers and stormwater runoff, in order to protect public health and the environment and to comply with federal and state regulations. When implemented, the Plan will bring Seattle into compliance with State of Washington CSO regulations and EPA requirements to have a Long Term Control Plan for reducing CSOs. Specifically, the Plan will achieve the following objectives:

- Identify areas of Seattle where projects are needed to reduce combined sewer overflows.
- Evaluate alternatives for reducing combined sewer overflows in these areas.
- Identify additional areas where projects to control and reduce polluted stormwater runoff will improve water quality.
- Recommend a schedule for designing and constructing projects.
- Estimate program costs and associated impacts on customer bills.
- Consider regulatory, public and stakeholder input.

As part of this process, the City is preparing a plan-level or “programmatic” environmental impact statement (EIS). This programmatic EIS evaluates the environmental impacts associated with the following three alternatives:

- The Long Term Control Plan (LTCP) Alternative, which is focused on reducing combined sewer overflows;
- The Integrated Plan Alternative, which includes reduction of both combined sewer overflows and stormwater pollution; and
- A No Action Alternative, as required by the State Environmental Policy Act (SEPA).

The alternatives are discussed in more detail in Chapter 3.

2.1 Seattle's Sewer System

Early sewer systems in Seattle and many other cities were designed to carry combined flows of sanitary sewage and stormwater runoff in the same pipe. The City's first combined sewer system was built in the early 1890s, in an effort to reduce the threat of waterborne diseases caused by sewers and cesspools that were discharging into lakes and Puget Sound. Many of these combined sewer systems remain in service today.

Beginning in the 1950s, new additions to Seattle's sewer system were designed as separated systems, with separate networks of pipes for sewage and stormwater. Since the 1960s, the City has undertaken a number of efforts to partially separate previously combined systems. In partially separated systems, stormwater from streets and parking lots is diverted into separate storm drains, but stormwater from other sources, mostly building roofs, still enters a combined system.

Today, Seattle's wastewater collection system is a combination of combined, partially separated, and separated areas (see Figure 2-1). About two-thirds of Seattle is served by a combined or partially separated sewer system (968 miles of pipe). Separated systems serve the other one-third (448 miles of pipe). The City conveys most of its wastewater to King County sewers for conveyance to County-operated treatment facilities.

2.2 Why are CSOs a problem?

Flows within both the sanitary sewer system and combined sewer system are sent to the West Point Wastewater Treatment Plant and are treated before being discharged to Puget Sound. Under dry weather conditions in Seattle, the combined sewer system typically has adequate capacity to handle the flows. During wet weather conditions, however, stormwater runoff from streets, parking lots, and roof drains is considerable and can cause the capacity of the sewer system to be exceeded. As long as the flow rates are within the capacity of the sewer system, all of the flows are conveyed to the wastewater treatment plant. However, if flow rates in the combined sewer exceed the capacity of the system, the excess flow of stormwater and untreated sewage is discharged into water bodies through permitted outfalls, resulting in a CSO.

The first image in Figure 2-2 depicts what occurs under heavy rain conditions in combined sewer systems. The separated and partially separated systems discharge mostly untreated stormwater into local water bodies.

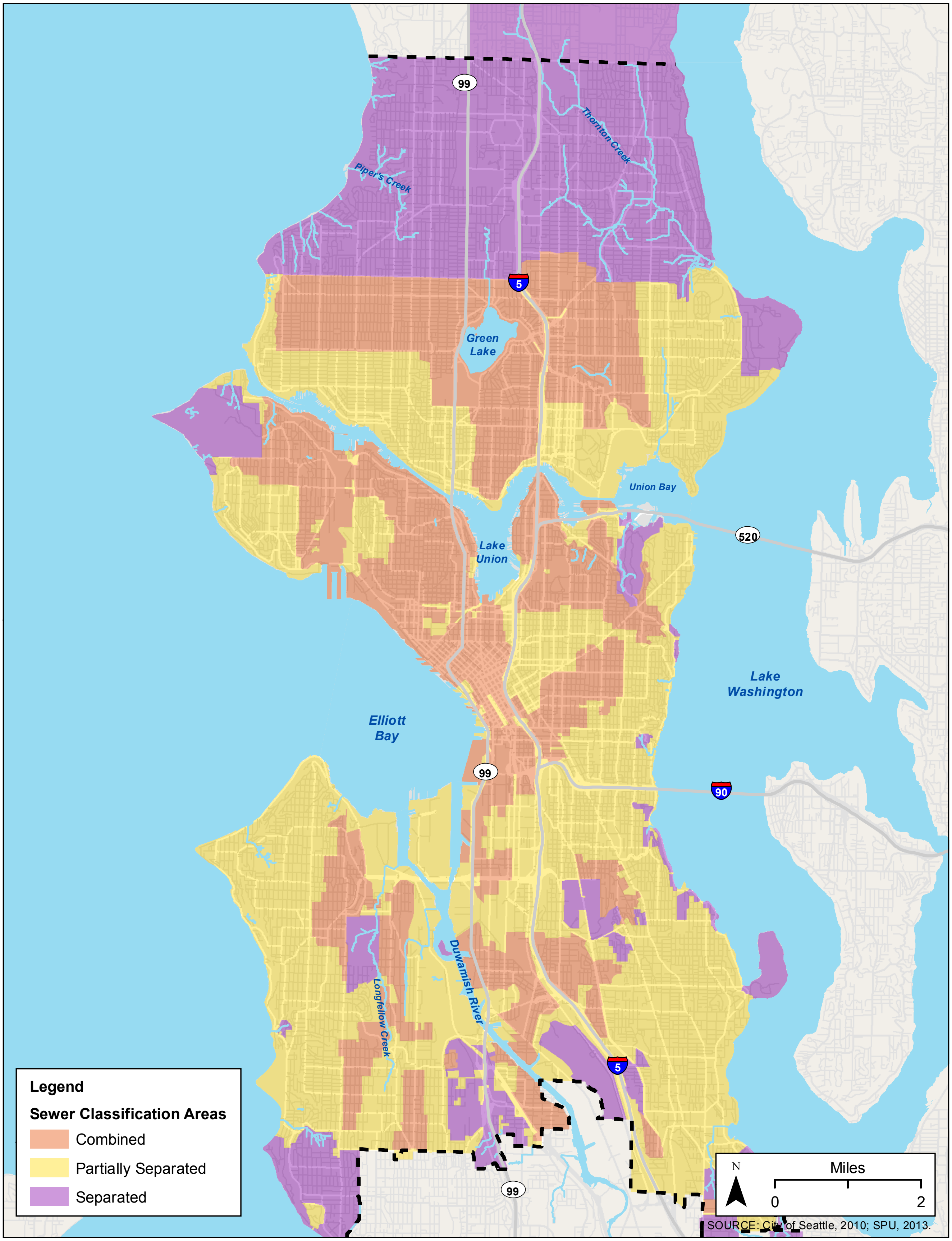
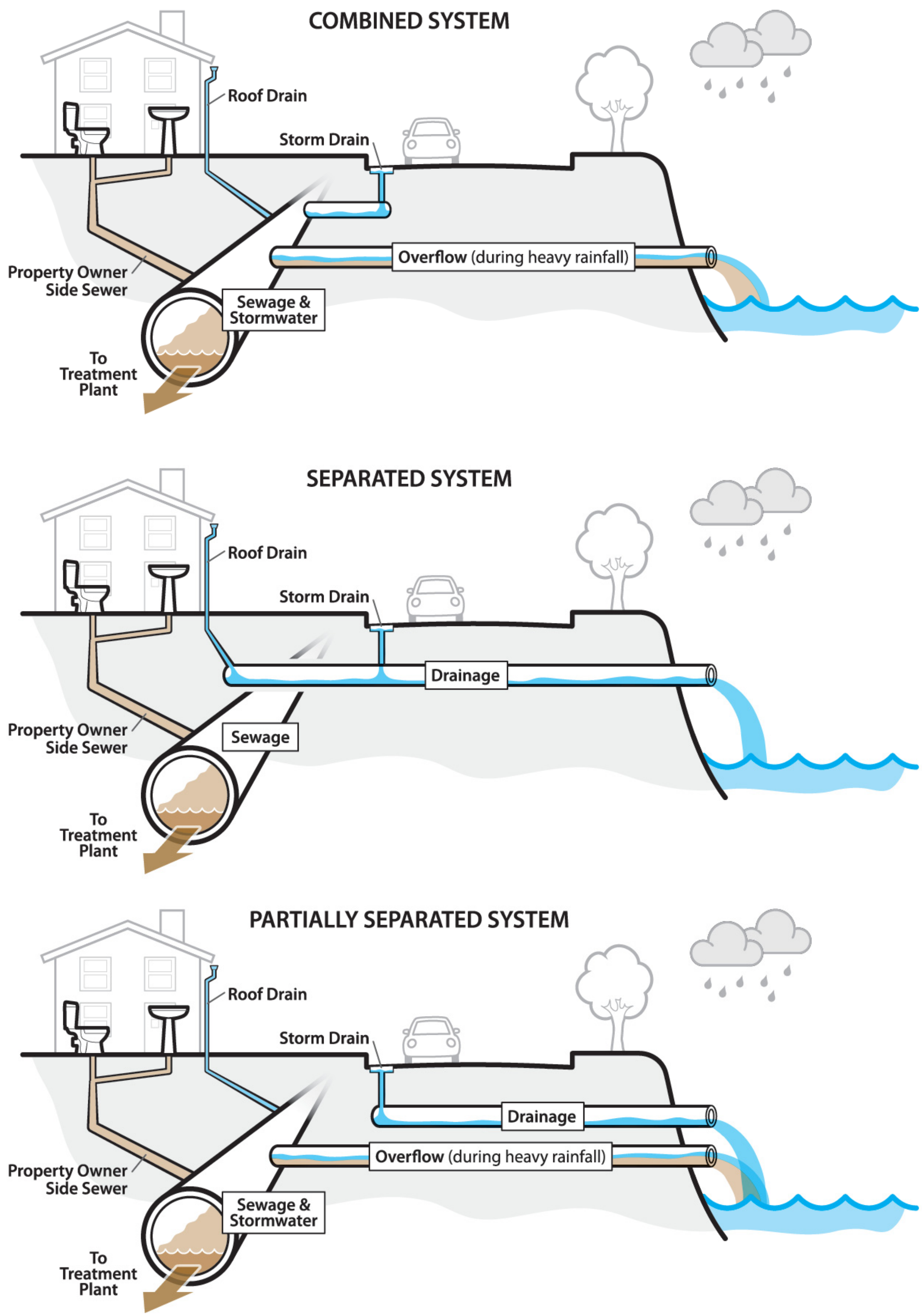


Figure 2-1 Seattle's Sewer and Drainage System.



SOURCE: SPU, 2014.

FILE NAME: Fig02-02_SewerSystemSchematics.ai / CREATED BY: JAC / DATE LAST UPDATED: 03/13/14

Figure 2-2. Sewer System Schematics.

CSOs release untreated wastewater and stormwater into a water body. Pollutants in these discharges include dissolved and particulate heavy metals and chemicals adsorbed (attached) to particles that settle to the bottom. Evidence suggests that CSOs can cause contamination of sediments near outfalls (King County, 2010) that could affect humans and/or fish coming in contact with those sediments. Additional information about potential environmental health risks associated with untreated CSO and stormwater discharges, and methods used to evaluate risks of exposure to contaminants of concern is included in Chapter 6 of *Volume 3, Integrated Plan.*

Human health risks can occur through swimming, scuba diving, wading, or fishing in waters that receive untreated CSO and stormwater discharges. People can be exposed to pathogens or other pollutants through direct contact with contaminated water or sediments (e.g., swimming or wading), ingestion of pathogen-containing water, or eating contaminated fish or shellfish. Pathogens of particular importance when considering CSOs include bacteria and viruses, which are present in untreated wastewater. Potentially toxic pollutants such as petroleum products or metals conveyed in stormwater are also important environmental health concerns in CSOs. CSO releases can contain pharmaceuticals, personal care products, and endocrine-disrupting chemicals.

2.3 Why is stormwater a problem?

Stormwater is rain and melting snow that runs off surfaces that cannot readily absorb water, such as streets, rooftops, and parking lots. As stormwater runs across these hard surfaces, it picks up pollutants such as oil, grease, and metals, carrying them through the City's storm drain system to lakes, streams, rivers, and Puget Sound. It also flows into the combined sewer system and can cause overflows of raw sewage and polluted stormwater into Seattle waterways. Recent scientific studies have determined that polluted stormwater runoff poses a significant impact to local water quality.

Both stormwater discharges and CSOs contain similar contaminants, but in different concentrations. As described for CSOs, stormwater contains bacteria, petroleum byproducts, toxic organics and metals, and other pollutants deposited on streets and other impervious surfaces. Stormwater discharges occur nearly every time it rains, while CSO events generally occur only during larger storms. Combined sewage includes the pollutants contained in stormwater but typically much higher levels of bacteria and other disease-causing pathogens, because the stormwater is mixed with sewage. In terms of overall volume of discharge, stormwater has a substantially greater volume on a regional scale, and a higher annual contribution to total pollutant loading in water bodies and environmental health considerations and similar to those described for CSOs. Additional information on constituents of concern in stormwater is included in Chapter 6 of *Volume 3, Integrated Plan.*

2.4 What is the regulatory framework for CSO control?

The regulatory basis for controlling CSOs stems from the federal Clean Water Act, EPA CSO Control Policy, state requirements, and the July 2013 federal court-ordered Consent Decree. Background on these requirements is included below.

2.4.1 Clean Water Act/NPDES Requirements

The federal Clean Water Act (33 United States Code 1251) requires water quality sufficient to allow people to swim, boat, fish, and enjoy our waterways. The law's requirements are intended to protect the environment, human health, and quality of life. Municipalities must obtain authorization to discharge wastewater, CSOs, and stormwater into surface water bodies. The Clean Water Act established the National Pollutant Discharge Elimination System (NPDES) program. The program limits the discharge of pollutants in order to meet water quality criteria. In Washington, the NPDES program is administered by the Washington State Department of Ecology (Ecology). Ecology's regulations in the Washington Administrative Code (Chapter 173-220) govern individual NPDES permits, such as the City's wastewater collection system permit.

The City manages sewage and stormwater throughout Seattle. Stormwater is managed in accordance with NPDES municipal stormwater permit requirements, administered by Ecology. The City reports progress on its compliance activities annually to Ecology. The stormwater permit applies to the municipal separate storm sewers operated by the City within the geographic boundaries established by the permit.

The City's most recent wastewater NPDES permit (WA0031682) was issued on October 27, 2010 and modified on September 13, 2012; it allows wet weather discharges from permitted CSO outfalls. The permit also requires implementation of the "Nine Minimum Controls" to ensure adequate capacity and maintenance of the sewer system, defines monitoring requirements, establishes requirements for detailed reporting to Ecology, and allows discharges only as a result of precipitation events. The NPDES permit also defined the performance requirements for a controlled CSO outfall as one untreated discharge per year per outfall, on a moving 20-year average. In addition, the City must identify any improvements that have occurred since the last permit authorization. The City's next CSO NPDES permit will be issued in October 2015.

2.4.2 U.S. Environmental Protection Agency CSO Control Policy

EPA's Combined Sewer Overflow Policy is the national framework for control of CSOs through the NPDES permitting program. Published on April 19, 1994, the policy provides guidance on how communities with combined sewer systems can meet Clean Water Act goals in as flexible and cost-effective a manner as possible.

The policy has the following three main elements:

- Nine Minimum Controls;
- Long Term Control Plans; and
- Requirement to Meet Water Quality Standards.

The Nine Minimum Controls are measures that can reduce the prevalence and impacts of CSOs and that are not expected to require significant engineering studies or major construction. The CSO Policy included a deadline of January 1, 1997, for implementing the Nine Minimum Controls, which are listed below:

1. Proper Operation and Maintenance
2. Maximum Use of Collection System for Storage
3. Review and Modify Pretreatment Requirements
4. Maximize Flow to the Treatment Facility
5. Eliminate Dry Weather Overflows
6. Control of Solid and Floatable Materials in CSOs
7. Pollution Prevention
8. Public Notification Regarding CSO Occurrences and Impacts
9. Monitoring to Characterize CSO Impacts and Efficacy of CSO Controls

The next CSO control milestone established by the policy is the development of long-term CSO control plans. Long-term control plans are tools to help municipalities comply with the Clean Water Act, and they include the following elements:

1. Characterization, monitoring, and modeling of the combined sewer system;
2. Public participation;
3. Consideration of sensitive areas;
4. Evaluation of alternatives to meet Clean Water Act requirements using either the "presumption approach" or the "demonstration approach."
5. Cost/performance considerations;
6. Operational plan;
7. Maximizing treatment at the existing treatment plant;
8. Implementation schedule; and
9. Post-construction compliance monitoring program.

2.4.3 State Requirements

Washington state law (Revised Code of Washington 90.48.4802) requires local governments to achieve the greatest reasonable reduction in CSOs at the earliest possible date. The Washington Administrative Code (173-245-240) defines the "greatest reasonable reduction" as a long-term average of no more than one untreated discharge per year per outfall.

As stipulated in the City's most recent wastewater NPDES permit, the deadline agreed to by Ecology and the City for achieving the greatest reasonable reduction is December 31, 2025. On an annual basis, the City is required to report the duration and volume of each CSO discharge during the most recent year, steps taken during the most recent year to reduce CSOs, the CSO outfalls now meeting the definition of greatest reasonable reduction (a 20-year moving average of no more than one untreated discharge per year per outfall), and work planned for the next year to reduce CSOs. In 2015, the City is required to submit an updated plan to Ecology (the Long Term Control Plan), describing the remaining projects that will be implemented to reduce and bring CSOs under control.

2.4.4 Consent Decree

In July 2013, the City of Seattle entered into a Consent Decree with the Washington State Department of Ecology, the U.S. Environmental Protection Agency, and the U.S. Department of Justice. Requirements listed in the Consent Decree describe the actions that the City must take to address CSO overflows that violate the Clean Water Act. CSO outfalls must meet a performance standard to achieve the "greatest reasonable reduction" to be considered "controlled" in accordance with WAC 173-245-020(22). A "controlled" CSO has an average of not more than one untreated discharge event annually on a 20-year moving average. The Consent Decree has established a deadline of December 2025 for completion of all control measures.

What is the Consent Decree?

The Consent Decree is a written agreement between the City of Seattle, Washington State Department of Ecology, EPA, and the U.S. Department of Justice that describes the actions that the City of Seattle must take to address violations of the Clean Water Act.

The Consent Decree includes a number of requirements for control of CSOs, including implementation of early action CSO control program and measures, and the development and implementation of a long-term control plan and post-construction monitoring plan. Additional information on the Consent Decree and specific deadlines for meeting requirements is included in Chapter 1 of *Volume 2, LTCP.*

Until recently, EPA and Ecology have focused primarily on combined sewer systems when administering NPDES CSO discharge requirements. Seattle and other cities across the country have asked EPA for greater flexibility to make smart investments, using a range of tools to achieve federal and state water quality requirements, allowing jurisdictions to customize approaches to their specific situations. Recognizing the contribution of stormwater to water quality issues in local water bodies, and recognizing the overall benefits that can be achieved from a blend of stormwater and CSO control projects, the City's negotiated Consent Decree allows the City to propose a more flexible and integrated approach for Seattle's compliance with the Clean Water Act and state regulations. The Consent Decree still requires the City to submit an LTCP by 2015, but it allows the City to develop, as an alternative, an "Integrated Plan" that proposes stormwater control projects to be implemented by the City prior to construction of some CSO facilities.

The Consent Decree also includes a number of additional requirements for the Integrated Plan, including a pollutant load reduction analysis and an evaluation of projected benefits to water quality, ecology, and human health that would result from implementing the identified stormwater projects. The Integrated Plan must demonstrate that the proposed stormwater projects will provide greater water quality benefits compared to those CSO projects that would be deferred, and that they would meet the requirements of the Clean Water Act, the City's NPDES and municipal separate storm sewer system (MS4) permits, and EPA's CSO Control Policy.

The Consent Decree encourages the use of Green Infrastructure (referred to as natural drainage systems in this EIS) as appropriate to reduce or replace certain CSO control measures included in the LTCP based on demonstrated effectiveness, together with the traditional engineered measures, as long as these combined measures provide substantially the same or greater levels of control than the traditional CSO control measures alone. The Consent Decree requires construction to be completed on all CSO control measures included in the approved LTCP by December 2025, unless EPA and Ecology approve a different schedule as part of approving an Integrated Plan.

2.5 Seattle's Previous CSO Reduction Efforts

Planning for CSO control is a dynamic process that must respond to changing regulations and conditions. To date, the City has completed projects from five CSO control plans, beginning in 1980. Some of the projects involved maintenance or modification of existing sewer facilities. Others involved construction of diversion structures to direct flows away from CSO outfalls, or construction of storage facilities to store excess wastewater until flows decrease enough for the stored wastewater to be returned to the conveyance system. The major CSO reduction planning efforts are summarized in Table 2-1.

Table 2-1. Seattle's Previous CSO Reduction Efforts

Recent CSO Reduction Efforts	Description
1980 Facility Plan (201 Facilities Planning)	Included storage facilities for CSO reduction in high-priority areas (Longfellow Creek, Lake Washington and Puget Sound beaches) based on human contact potential and environmental protection.
1988 CSO Reduction Plan	Included storage facilities for CSO reduction in Portage Bay, Lake Union, the Ship Canal, Elliott Bay and the Duwamish River.
2001 CSO Reduction Plan Amendment	Proposed the implementation of various best management practices as a way to reduce the volume of CSOs prior to the implementation of additional storage projects. Reevaluated previously studied areas of Seattle and expanded the evaluation to include other areas.
CSO Reduction Plan Amendment 2005 Update	Evaluated the effectiveness of best management practice projects from the 2001 Amendment that had been completed, and revised cost estimates and schedules for remaining projects from the 2001 Amendment.
2010 CSO Reduction Plan Amendment	The 2010 CSO Reduction Plan Amendment was a regulatory requirement under WAC 173-245-090(2) and required as part of the City's wastewater NPDES permit (issued on November 30, 2005, and expired on November 30, 2010). Per the regulation, the plan must include three elements: (1) an assessment of the effectiveness of the CSO reduction plan to date; (2) a reevaluation of the CSO sites' projects priority ranking; and (3) a listing of projects to be accomplished in the next 5 years. The focus of the 2010 CSO Reduction Plan Amendment was CSO reduction projects in the timeframe of 2010-2015. The plan identified that by 2015, the City will accomplish the following projects: • Complete the construction of the Windermere CSO reduction project. • Substantially complete the construction of the Genesee CSO reduction project. • Initiate construction on the Henderson North CSO reduction project. • Construct green stormwater infrastructure projects in the Ballard CSO basin to measure the effectiveness of green solutions. • Complete the 2015 CSO Reduction Plan Amendment (the LTCP). The 2010 CSO Reduction Plan Amendment provided revised CSO baseline frequency and volume estimates and described CSO control alternatives (SPU, 2010).

2.6 Why do we need more CSO reduction efforts?

The City manages 87 CSO outfalls. Because of previous CSO reduction efforts, 52 are now characterized as "controlled," meeting the Washington state standard of one overflow per year, on average. While Seattle has made great progress in reducing the number of CSOs over the years, a number of CSOs remain. In 2013, 38 MG of untreated sewage and stormwater discharged at CSOs managed by the City. Combined sewer overflows from the City's combined sewer system currently discharge into Puget Sound, Elliott Bay, Lake Washington, Longfellow Creek, Duwamish Waterway, and Lake Union/Ship Canal.

Addressing the Remaining CSOs

Over the last 25 years, the City of Seattle has successfully reduced CSO discharge volumes into surrounding receiving waters by nearly 70 percent. However, there is still work to be done to control the remaining CSOs, and the final reduction in CSO volume is the most challenging.

CSOs present a range of public health and environmental concerns. Pollutants conveyed in CSOs can create human health risks from contact with water or consumption of fish/shellfish from areas of recent CSO discharge and can cause impacts to aquatic life. In extreme rainfall events, localized backups can occur. The high variability in flow rates within the sewer system associated with heavy storms can also cause operational problems at the wastewater treatment plant.

In addition to the environmental and public health concerns, the City of Seattle is required to control CSOs in order to comply with federal and state regulatory requirements. These requirements are further described below.

2.7 What is the Long Term Control Plan?

As part of its regulatory compliance efforts, the City must update its CSO Reduction Plan every five years. As described above, the City prepared its first plan in 1988 with amendments in 2001, 2005, and 2010, and has undertaken a number of CSO control efforts under those plans, including recent projects such as the Windermere, Genesee, and Henderson CSO control projects. The Long Term Control Plan (LTCP) is the City's next update and presents a comprehensive program and schedule to reduce the remaining uncontrolled CSO discharges. The City must address these CSOs to protect public health and the environment, and to comply with the July 2013 Consent Decree and meet state and federal regulations for CSO control.

What is the LTCP?

The LTCP is an EPA-required Plan that defines a comprehensive program and schedule for implementing projects and measures to control overflows at the City's remaining 22 uncontrolled CSO outfalls.

In 2013, 38 MG of untreated sewage and stormwater discharged from the City's 87 managed outfalls, 35 of which are uncontrolled. Some of these uncontrolled CSO outfalls are being addressed separately through the 2010 CSO Reduction Plan Amendment projects (7 CSO outfalls to be controlled) and Consent Decree-required early action projects in the Henderson Basins (6 CSO outfalls to be controlled). Consistent with the Consent Decree, the remaining 22 uncontrolled outfalls will be controlled through implementation of the LTCP. The City used the previously approved 2010 CSO Reduction Plan Amendment as the foundation to prepare the LTCP. The Consent Decree indicates that the LTCP shall build upon the alternative analysis work that was performed as part of the amendment.

Figure 2-3 provides an overview of the surface water bodies in Seattle along with the location of the City's uncontrolled and controlled CSO outfalls. The uncontrolled CSO outfalls are addressed in this Plan and EIS.

The LTCP puts forth a cost-effective blend of both traditional storage and retrofit solutions to achieve reductions in the remaining uncontrolled CSO outfalls. The LTCP also explores opportunities to partner with King County on collaborative projects to control both agencies' CSOs.

Specifically, the LTCP will achieve the following objectives:

- Identify areas of the city where CSO control projects are required;
- Evaluate alternatives for reducing CSOs in affected areas;
- Select a preferred alternative (solution) for each affected area;
- Recommend a schedule for designing and constructing projects from 2016 to 2025;
- Estimate program costs and associated rate impacts;
- Provide an updated post-construction monitoring plan and schedule; and
- Consider public and stakeholder input.

A **"controlled"** CSO outfall has an average of not more than one untreated discharge event annually on a 20 year moving average.

An **"uncontrolled"** CSO is an outfall where the 20 year average exceeds the requirements of a controlled outfall.

The draft LTCP will be submitted to Ecology and EPA in late May 2014, accompanied by the Draft EIS, and the final LTCP will be submitted to EPA and Ecology in May 2015 as required by the Consent Decree. The LTCP will also be submitted as the 2015 CSO Reduction Plan Amendment to Ecology as required by the City's current NPDES permit. The solutions identified in the LTCP are to be approved by Ecology and EPA, and will be constructed in the years following 2015. Upon approval of the LTCP, projects to be completed between 2015 and 2020 will be included as requirements in the City's next wastewater NPDES permit.

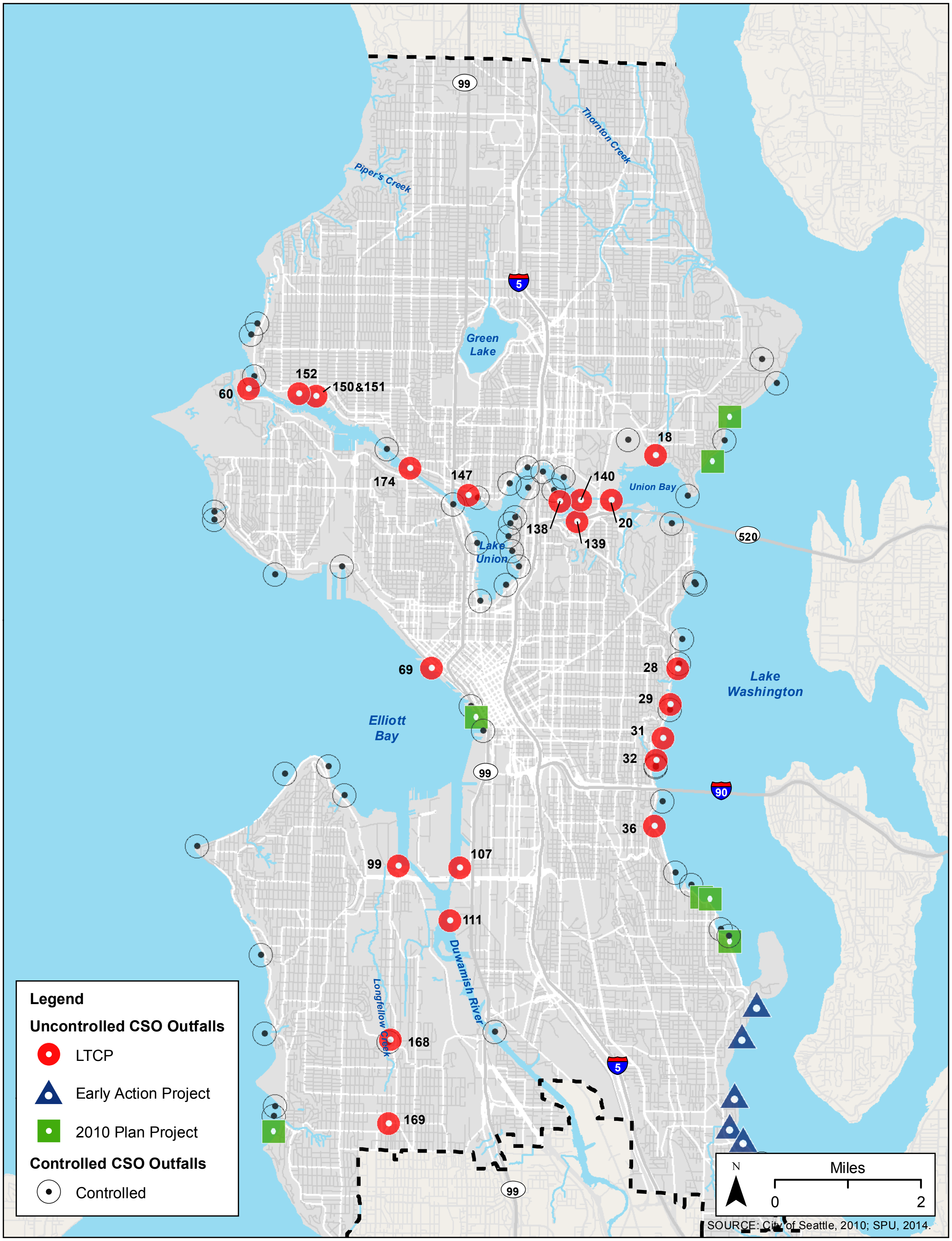


Figure 2-3 City Outfalls and Controlled Sites.

2.7.1 How does the LTCP fit in with other regional CSO control efforts?

Ownership, operation, and maintenance responsibilities for the sewage system in Seattle have been shared by the City and King County. The City is responsible for the sewage collection system within the city limits, serving contributing areas (basins) up to 1,000 acres in size, while King County is responsible for sewer trunk lines serving areas greater than 1,000 acres, and for regional treatment plants (Figure 2-4). Seattle's system of generally smaller pipelines feeds into King County's system of larger pipelines. King County and Seattle have established an agreement regarding ownership of each CSO outfall depending on its location within the conveyance network. The CSO outfalls and their control status are listed in each agency's respective NPDES permit.

King County has 14 remaining uncontrolled CSO sites in the city that discharge to Elliott Bay, the Duwamish River, and the Lake Washington Ship Canal. Because Seattle discharges its wastewater to King County for conveyance and treatment, and because both systems can affect one another hydraulically, the City and King County coordinate their CSO reduction efforts. Previous coordinated efforts have significantly reduced the volume of CSOs from both agencies' systems.

The LTCP continues to emphasize this coordinated approach and evaluates potential larger, shared City-King County projects in addition to smaller, neighborhood-specific projects. The City considers shared CSO control projects with King County if the projects are deemed to be cost-effective for ratepayers, provide a better environmental outcome, or if they have the potential to minimize disruption to nearby communities during construction. The City and King County are currently developing a Joint Operations and System Optimization Plan in accordance with the Consent Decree. A final plan is to be submitted for approval no later than March 1, 2016.

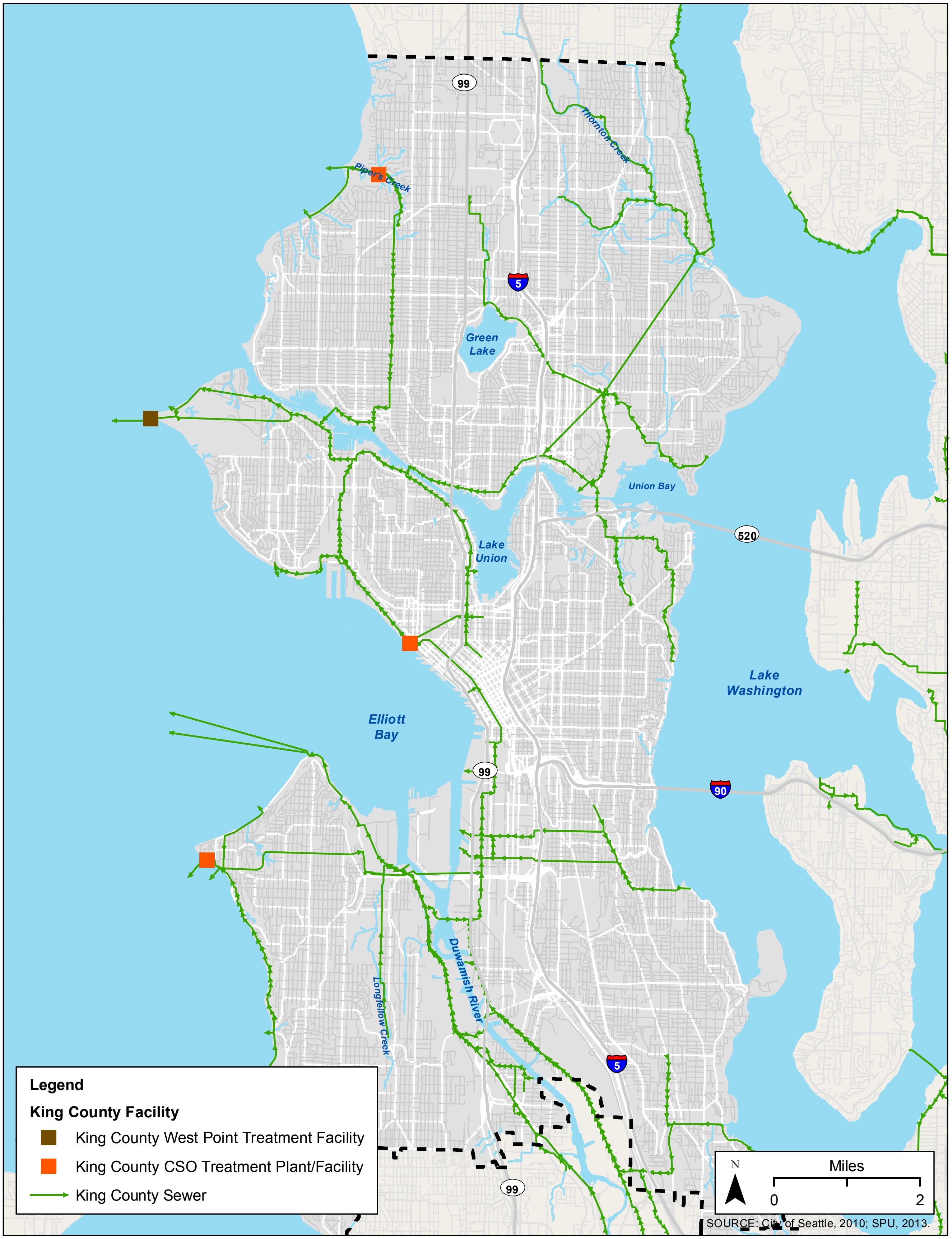


Figure 2-4 King County Wastewater Facilities.

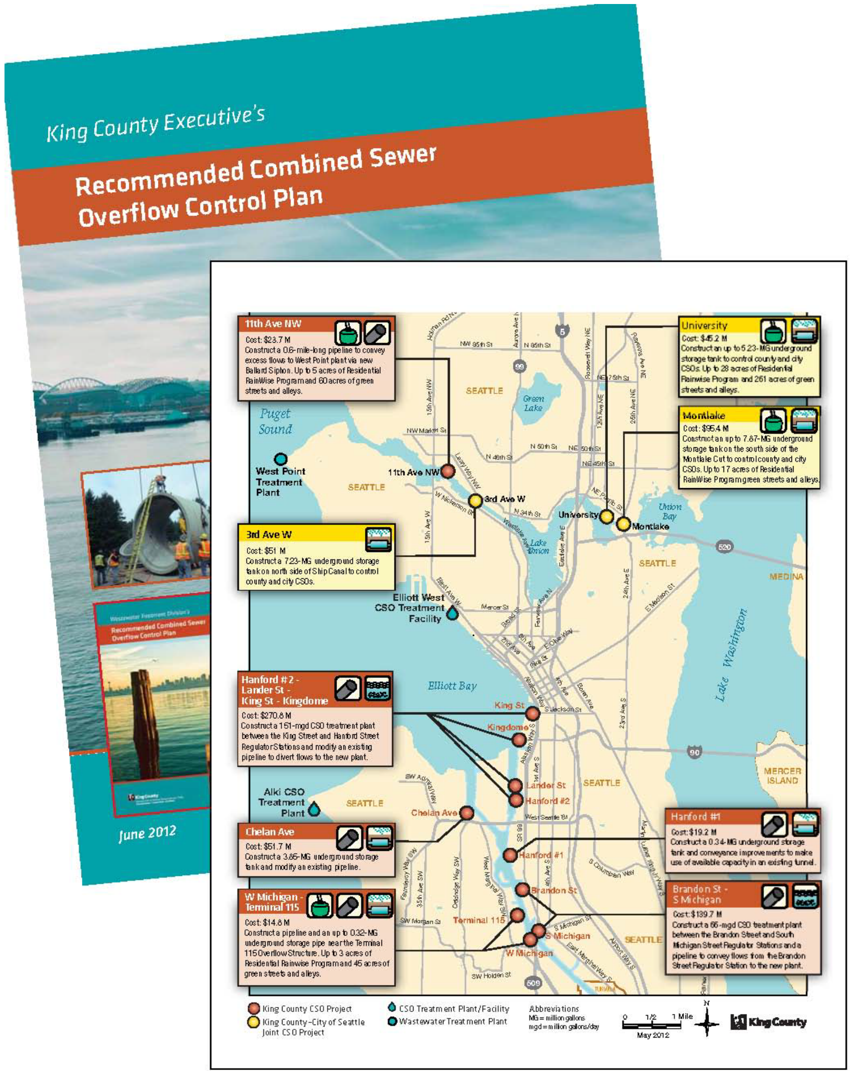


Figure 2-5. King County Combined Sewer Overflow Control Plan

King County has also amended its CSO control plan. The County's Long- Term Combined Sewer Overflow Control Plan Amendment (King County, 2012a), presents nine CSO control projects that will meet federal and state regulations by controlling the last remaining King County CSO locations to no more than one overflow per year on average at each location. King County's 2012 CSO Control Plan was approved on March 7, 2013. These final projects in the County's CSO control program are some of the most complex and expensive, which is also the case for the final projects included in the City's LTCP. The County's CSO program includes three potential shared projects with the City, in the Lake Washington and Ship Canal Neighborhoods.

In addition to the nine control projects, the County's plan includes a water quality assessment/environmental benefit study to confirm or possibly adjust some of the future recommended projects and schedules. As results from ongoing studies and monitoring efforts become available, King County and the City will continue to coordinate regarding the optimal shared approaches to CSO control. Once approved by EPA and Ecology, it is anticipated that King County will construct the control projects included in its Long-Term Combined Sewer Overflow Control Plan Amendment between 2015 and 2030, as specified in their Consent Decree.

2.8 What is the Integrated Plan?

The Integrated Plan is being evaluated in the EIS as an alternative to the LTCP. Whereas the LTCP focuses solely on reducing CSOs, the Integrated Plan meets the U.S. EPA's guidelines for integrating stormwater management and CSO control in one plan.

The Consent Decree allows the City to submit a plan that proposes stormwater projects and defers some CSO control projects, provided that the stormwater projects will result in significant benefits to water quality beyond those that would be achieved by implementation of CSO controls alone, and the CSO control projects deferred would be completed on a compliance schedule. In this way, the City would be able to focus first on investments that achieve the greatest environmental benefits. These stormwater projects would be in addition to the CSO control measures included in the approved LTCP.

The Integrated Plan identifies stormwater projects that will be completed by 2025, in addition to the CSO control projects that will be completed by 2025 and those CSO control projects to be deferred until after 2028. By prioritizing and sequencing projects in this way, greater water quality benefits may be achieved than by CSO control projects alone.

Why consider an Integrated Plan?

An Integrated Plan allows municipalities to prioritize sewage and stormwater reduction projects to obtain maximum water quality benefits more quickly. Often, the focus is on meeting each Clean Water Act requirement individually. As a result, we sometimes solve one problem at a time without full consideration of all Clean Water Act requirements. This can prevent municipalities from addressing the most serious water quality issues first.

2.9 How was this EIS developed?

Seattle Public Utilities is preparing this "programmatic EIS" to analyze the environmental impacts of the **Plan to Protect Seattle's Waterways** (the Plan). This draft programmatic EIS was prepared in compliance with the State Environmental Policy Act (SEPA), contained in Chapter 43.21C of the Revised Code of Washington, and the state SEPA rules, contained in Chapter 197-11 of the Washington Administrative Code.

SEPA requires state and local agencies to consider the likely environmental consequences of a proposal before approving or denying the proposal. The final programmatic EIS will be used to assist decision makers in assessing the environmental costs and benefits associated with adoption and implementation of the alternatives developed for the Plan.

The Plan will identify the general location, strategy, size, and number of facilities to reduce the remaining CSOs throughout the city. As a planning-level document, it is considered a "non-project proposal" under SEPA. Non-project review allows consideration of the "big picture" and will form the basis for subsequent project-specific review. A "programmatic EIS" examines the broad program-level issues related to the general location of CSO control projects, and how combinations of projects may collectively impact the environment. It differs from a "project-specific EIS" in that it does not focus on specific project locations, design details, or precise footprints for individual CSO control projects.

The programmatic EIS is the first step in a phased environmental review for the Plan. Once the Plan is approved, the City will move forward with the identification and design of individual projects. Additional project-specific environmental review associated with these future projects would occur as appropriate during project level design. Projects proposed independently by King County will be evaluated by the County, in accordance with their SEPA policies and requirements.

2.10 How has the public been involved with the development of the Plan and EIS?

Public involvement is an important part of both the Plan and SEPA processes. In 2010, a Sounding Board was formed to guide the development of the LTCP. Sounding Board members consisted of city residents and other stakeholders who were recruited throughout the city to provide a diverse set of perspectives. The 13 members included six residents and seven stakeholders, who developed and applied criteria to make decisions about alternatives, reviewed and commented on elements of the LTCP, and provided guidance on public involvement activities.

In coordination with the Ballard District Council, the City also established a Stakeholder Advisory Group in 2013 to provide focused and detailed input on the elements of the LTCP that affect Ballard, Fremont, and Wallingford, including selecting an underground storage solution for sewage overflow control in Ballard, Fremont, and Wallingford and the appropriate role of natural drainage projects in Ballard. The nine-member group includes stakeholders in Ballard, Fremont, and Wallingford, including residents and residential property owners, small business owners, industrial businesses, and environmental and neighborhood groups. The group met five times in 2013 and 2014.

Consistent with the City of Seattle's SEPA Policy and Procedures (Seattle Municipal Code 25.05), scoping was held to determine the range or "scope" of issues to study in the programmatic EIS. The purpose of scoping is to narrow the focus of the EIS to significant environmental issues, to eliminate insignificant impacts from detailed study, and to identify alternatives to be analyzed in the EIS. During scoping, the public is asked to comment on the range of proposed alternatives and the probable environmental issues.

Initial scoping was held in late 2011, and focused on the LTCP options. Scoping included an official comment period from September 26 through November 7, 2011. During initial scoping, the City hosted four scoping meetings/open houses and an online scoping meeting.

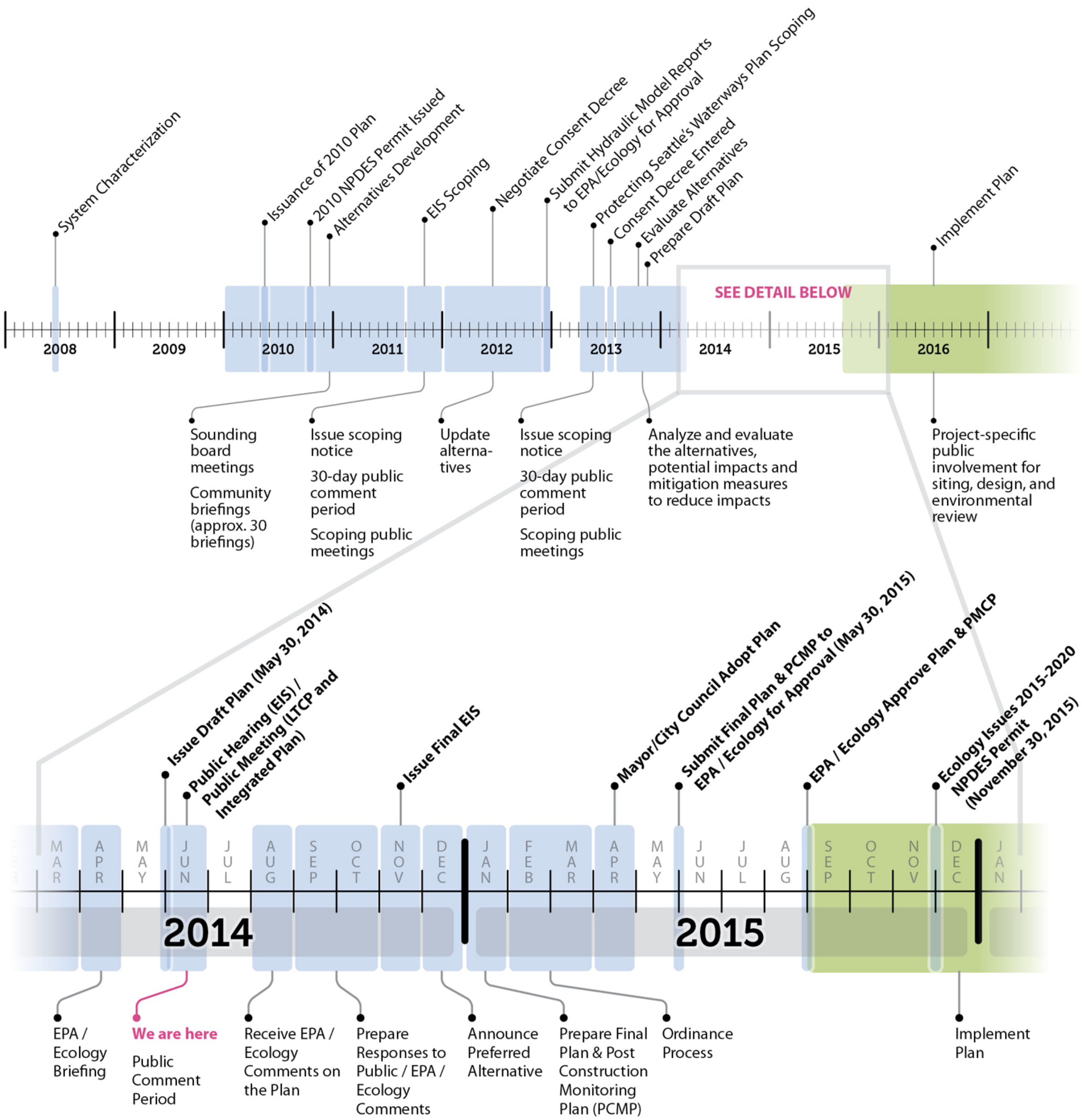
Subsequent Consent Decree negotiations expanded the Consent Decree to allow development of an Integrated Plan Alternative. As a result, the City reopened the SEPA scoping process in May 2013, to allow public and agency comment on the inclusion of the Integrated Plan as an alternative in the Plan. Scoping was conducted from May 20 through June 20, 2013, and included a scoping meeting/open house and an online survey/comment form. The 2012 and 2013 Scoping Reports are included in Appendix A along with a summary of how the comments have been incorporated into the EIS.

The purpose of these public meetings, webinars, and outreach materials was to develop a shared understanding of the problem the City needs to address, the options, and the potential impacts, and to gather public input on the options, potential project locations, and the scope of the EIS. In addition to the EIS, the City has released three

Community Guides, to provide information about the LTCP, the EIS process, and the Integrated Plan, and a video describing the alternatives and the EIS process. These Community Guides and video can be found on the City's website at www.seattle.gov/cso. The City also conducted more than 50 briefings for community organizations and stakeholder groups.

Issuance of this draft EIS initiates a 30-day public comment period. A public hearing for the EIS per Seattle Municipal Code will be held in June, 2014, as described in the Fact Sheet. Comments on the draft EIS will be addressed in the final EIS, along with appropriate changes to the EIS as needed. The final EIS is expected to be released in late 2014.

The final Plan will be submitted to EPA and Ecology for approval in May 2015. After approval of the LTCP, the City will work with local neighborhoods to select specific sites where facilities will be built. As part of the project siting process, Seattle Public Utilities will perform project-level environmental reviews. The project-level environmental review will help to inform decision makers about site-specific, project-level environmental impacts and mitigation measures.



SOURCE: Wayworks, 2014; SPU, 2014.

Figure 2-6. Plan Schedule

2.11 How is this programmatic EIS organized?

The **Plan to Protect Seattle's Waterways** covers numerous neighborhoods throughout Seattle. There are also numerous terms used to describe the potentially affected areas in the four Plan Volumes, For the EIS, the potentially affected areas are referred to as "Neighborhoods." Many of these neighborhoods are the locations of the "uncontrolled" CSO basins that are the subject of the LTCP. Basins are the areas that drain to identified CSO outfalls. Other neighborhoods are locations of potential stormwater projects that are part of the Integrated Plan.

Since many of the projects that would be constructed under the Plan are located in proximity to each other, these areas are organized by their larger “Neighborhood” area as shown in Table 2-2 and in Figure 2-6. Because specific project locations have not yet been determined, this EIS analyzes potential impacts by the larger Neighborhood area, or the individual neighborhood as appropriate.

Table 2-2. Quick Review of Plan Locations as used in this Document

Neighborhood	CSO Basin (Area)
Ship Canal Neighborhoods	
Ballard	CSO Outfall 150/151 CSO Outfall152
Fremont/Wallingford	CSO Outfalls 147 & 174
Magnolia	CSO Outfall 060
Lake Washington Neighborhoods	
North Union Bay	CSO Outfall 018
Madison Park	CSO Outfall 024
Portage Bay	CSO Outfall 138
Leschi	CSO Outfalls 028; 029, 031, 032, 034, 035, 036
Longfellow Creek/Duwamish Neighborhoods	
Delridge	CSO Outfalls 099, 168, 169
Duwamish	CSO Outfall 111
East Waterway	CSO Outfall 107
Elliott Bay/Lake Union Neighborhoods	
Central Waterfront	CSO Outfall 069
Piper’s Creek Neighborhoods	
	Integrated Plan Alternative only
Thornton Creek Neighborhoods	
	Integrated Plan Alternative only

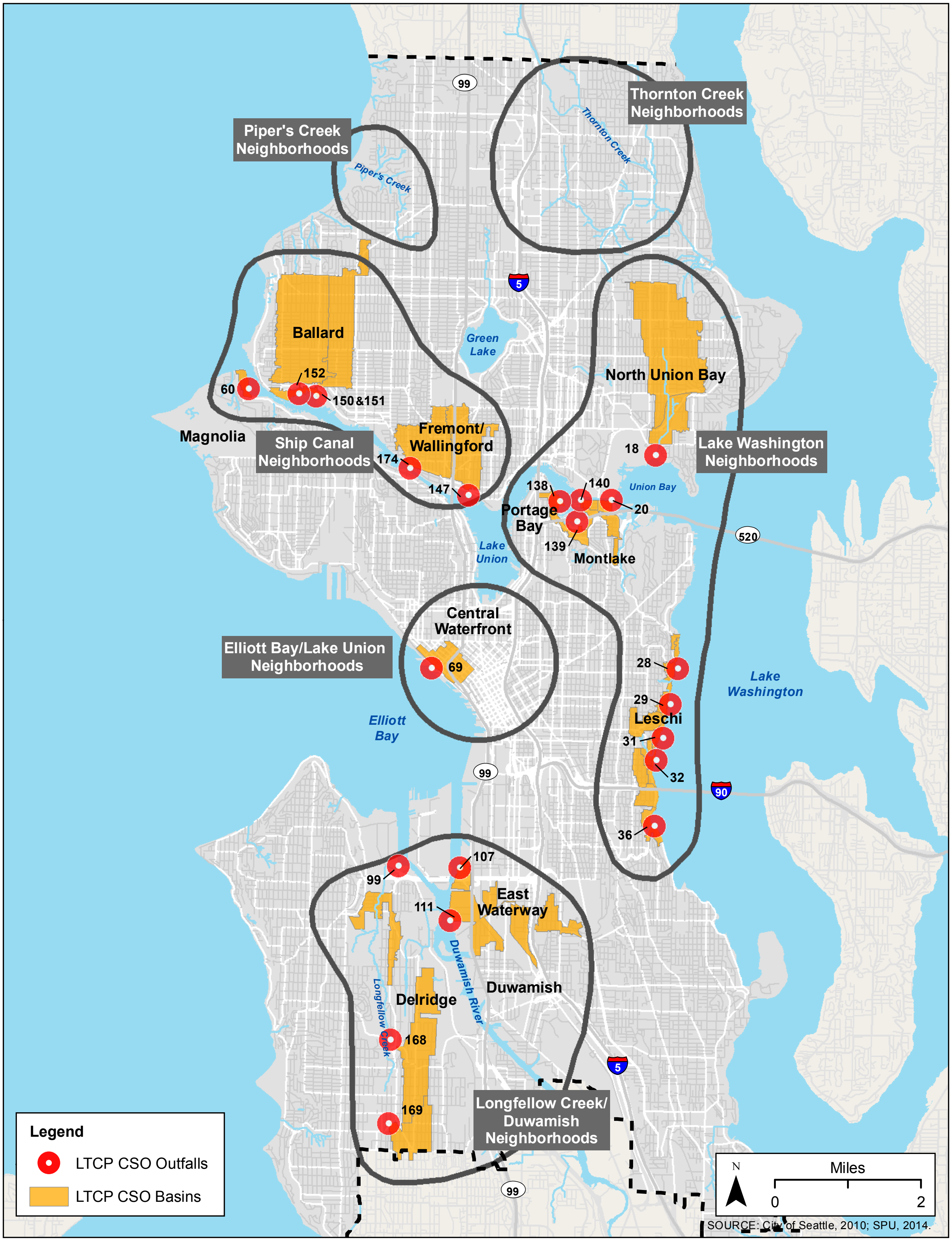


Figure 2-7 Plan Area Neighborhoods.

The following provides a Chapter by Chapter guide for how to access information in this document.

Table 2-3. Quick Road Map Through This Document

If You Want to:	Check Here:	Description and Other Related Information
Review a summary	Chapter 1	This stand-alone summary provides an understanding of why the City has prepared the Draft EIS, summary-level descriptions of the Plan alternatives, and a summary of the potential impacts of these actions, and potentially applicable mitigation measures.
Understand the background	Chapter 2	This chapter provides the background to understand the Plan's purpose and need, including a description of regulatory requirements.
Find out about the Plan Alternatives	Chapter 3	This chapter is the heart of the EIS and provides a description of the LTCP Alternative, Integrated Plan Alternative, and No Action Alternative. Additional information on the LTCP Alternative and options can be found in the LTCP, available in Volume 2 of the Plan. Additional information on the Integrated Plan Alternative can be found in the Integrated Plan, available in Volume 3 of the Plan.
Find out about existing conditions in the Plan area	Chapter 4	This chapter provides a general description of existing conditions (the affected environment) in the Plan Neighborhood areas. This description provides the basis for identifying the potential impacts described in Chapters 5 and 6.
Find out about potential impacts from construction in the Plan area, including your neighborhood	Chapter 5	This chapter provides a general description of the potential construction impacts under implementation of any of the Plan alternatives, as well as potentially applicable mitigation measures.
Find out about potential impacts from the ongoing operation of projects in the Plan area, including your neighborhood	Chapter 6	This chapter provides a general description of the potential operational impacts under implementation of any of the Plan alternatives, as well as potentially applicable mitigation measures.
Find out about cumulative impacts of Plan implementation in the Plan area.	Chapter 7	This chapter provides a general description of the impacts that may arise from the implementation of the Plan alternatives when added to other past, present, and reasonably foreseeable future actions.

CHAPTER 3

Plan Alternatives

The City is considering two different approaches in its Plan to Protect Seattle's Waterways (the Plan). These approaches are called alternatives and are considered at a programmatic level in this environmental impact statement (EIS).

One alternative would address combined sewer overflows only, referred to as the **Long Term Control Plan (LTCP) Alternative**. All LTCP Alternative projects would be constructed by 2025 to comply with the July 2013 Consent Decree and meet state and federal regulations for CSO control.

Alternatives Considered in the EIS

No Action Alternative

Long Term Control Plan Alternative

Integrated Plan Alternative

The second alternative, referred to as the **Integrated Plan Alternative**, would address both CSOs and stormwater pollution. This alternative meets the Consent Decree requirements for integrating stormwater management and CSO control into one plan, called an Integrated Plan. If the City chooses the Integrated Plan Alternative, it may delay completion of some CSO reduction projects until 2030. Both alternatives include implementation of CSO control projects.

Consistent with the State Environmental Policy Act (SEPA) requirements, the EIS also evaluates a **No Action Alternative**, which describes what would occur if the action alternatives are not implemented.

This chapter describes the alternatives, how the alternatives were developed, and the types of strategies that would be implemented under each, including descriptions of the general types of facilities and their locations.

3.1 No Action Alternative

SEPA requires that EISs must "present a comparison of the environmental impacts of the reasonable alternatives, and include the no action alternative" (Washington Administrative Code 197-11-440-(5) and SMC 25.05.440.D)). For this EIS, the No Action Alternative is defined as implementation of actions that have already been identified, evaluated, and funded for implementation through earlier planning efforts.

Under the No Action Alternative, substantial progress will be made in controlling CSOs through implementation of previously planned CSO control projects. These projects include those identified in the City's wastewater NPDES Permit (WA0031682) and include projects identified in the 2010-2015 Implementation Plan for the *2010 CSO Reduction Plan Amendment* (2010 Plan Amendment) and 'Early Action' projects identified by Consent Decree in the Henderson CSO

The **No Action Alternative** is included in the draft EIS to provide an understanding of what would occur if the proposed action is not implemented, and to serve as a comparison to the action alternatives. The State Environmental Policy Act (SEPA) requires the evaluation of a No Action Alternative in an EIS, which at times may be more environmentally costly than the action alternatives, or may not be considered "reasonable" by other criteria. Still, it provides a benchmark to which the other alternatives may be compared.

basin. These projects are currently funded and are scheduled for implementation, and they will occur regardless of whether the Plan is implemented.

The City would also continue to implement a portion of two of its CSO reduction strategies, combined sewer system improvements and natural drainage systems (referred to as green infrastructure in the LTCP). However, the City would not implement any additional CSO reduction or stormwater control projects beyond those that are currently funded and slated for implementation.

Combined sewer system improvements and natural drainage systems alone will not be sufficient to reduce the volume and frequency of CSOs to meet federal and state regulations. If the City does not make additional improvements in the remaining uncontrolled basins addressed by the Plan, untreated sewage and stormwater in excess of current regulations would continue to be illegally discharged into Lake Washington, the Lake Washington Ship Canal, the Duwamish River, and Puget Sound when the capacity of the existing combined sewer systems is exceeded. Under the No Action Alternative, the City would not be in compliance with the Consent Decree.

The current and ongoing combined sewer system improvements, natural drainage, and storage projects included in the No Action Alternative are described below and shown on Figure 3-1.

3.1.1 Sewer System Improvements

The City has several ongoing programs to implement system improvements that optimize use of the City's existing infrastructure, largely through retrofits of existing facilities. Current and ongoing sewer system improvement programs and projects include the following:

- 2010 Plan Amendment Projects;
- CSO Retrofit Program;
- Outfall Rehabilitation Program.

The City's 2010 Plan Amendment specifies multiple sewer system improvements, which the City plans to implement by 2015. The City's CSO Retrofit Program is planning several CSO reduction retrofits that will reduce overflows or bring uncontrolled basins into control. Retrofits include raising overflow or storage weirs, replacing old flow control devices with newer technology, or separating sewers. The City initiated the CSO Retrofit Program in 2002; currently the Retrofit Program is funded at $1 million to $3.5 million annually through 2016.

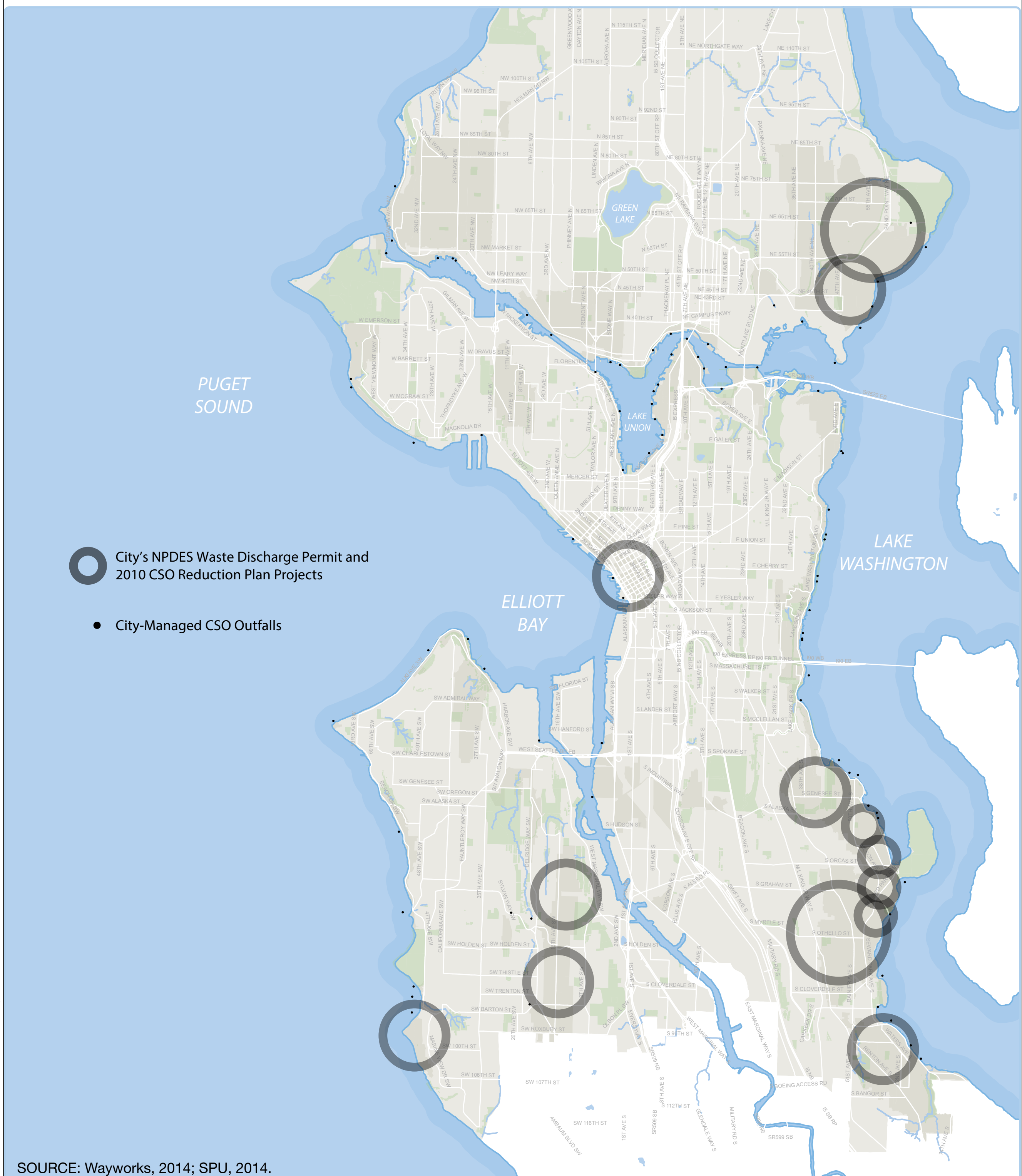


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Figure 3-1. No Action Alternative Locations.

Some of the major retrofit projects include:

- *Windermere Jr*. Construction was completed in August 2012. Post Construction monitoring started Sept 2012 and will continue until September 2014. This retrofit will bring NPDES Basin 15 into compliance.
- *Basin 95 Retrofit*. Construction was completed in June 2013. Post Construction monitoring started July 2013 and will continue for 1 year. This retrofit will bring NPDES Basin 95 into compliance.
- *Delridge Retrofit*. Construction will be complete in December 2014. Post construction monitoring will start January 2015 and continue for 2 years. This project will bring basins 168 and 169 into compliance.

CSO outfalls are also being improved under the City's current program. Many of the outfalls in the combined sewer system have been in service since the first half of the 20th century. Although some have been taken out of service over time as system improvements have been made, others will need to remain in service and be maintained in good, operable condition. Because the outfalls are located in water bodies and sensitive areas, their management presents unique challenges different from the rest of the sewer system. To address this, the City is implementing an Outfall Rehabilitation Program to assess and prioritize the cleaning and renewal of outfalls where deficiencies are identified. The program will include planning, design, construction, and monitoring services focused on the repair, rehabilitation, replacement, and improvement of priority outfalls.

3.1.2 Natural Drainage Systems (Green Infrastructure)

In some areas, opportunities exist to use soil to infiltrate stormwater to groundwater or slow the rate of stormwater entering the sewer system. These strategies are referred to as natural drainage systems (NDS), (also referred to as green infrastructure (GI) in the LTCP.

Figure 3-2. Natural Drainage System Rain Garden

Natural drainage systems include options that can be installed in the public right-of-way and those that can be located on private property. These options include rain gardens, bioretention cells, cisterns, downspout disconnects, and pervious pavement in streets, alleys, and driveways. With the right type of soil and proper design, these solutions allow stormwater to soak into the ground and infiltrate into the groundwater, or slow the rate of stormwater entering the sewer system. The purpose is to reduce the amount of stormwater runoff and

Why use natural drainage systems?

Natural drainage systems (NDS), also referred to as green infrastructure (GI) in *Volume 2, LTCP* have several advantages because they:

- Reduce demand on existing pipes and sewage treatment facilities
- Avoid the need for (or reduce the size of) storage facilities
- Save energy and operating costs because stormwater does not need to be pumped to the treatment plant
- Provide opportunities for neighborhood improvements such as attractive landscaping, or pedestrian and bicycle safety projects

pollutants entering pipes and local water bodies. Natural drainage systems are consistent with the concept of sustainability and complement sewer system improvements as part of the City's approach to reducing pollution from stormwater and CSOs.

Reducing the volume of stormwater runoff frees up capacity in combined sewer systems, allowing more wastewater to be carried. This reduces CSO-related pollution from both untreated wastewater and stormwater. The ability of natural drainage systems to reduce the total volume of stormwater and the peak rate of flow is a significant benefit of natural drainage systems. Traditional strategies to manage stormwater in CSO basins, such as storage, address stormwater runoff only during heavy rains, whereas natural drainage systems receive stormwater runoff and provide benefits to the sewer system each time it rains. Reducing the volume of stormwater going into sewer pipes reduces the amount of pumping and treatment, saving energy and reducing the carbon footprint of the overall sewage system. It also allows more pipe capacity for conveying flows from other areas of the sewer network. If used in combination with CSO storage, natural drainage systems can reduce the size of structures needed to store stormwater.

The City is implementing a number of efforts to maximize the use of natural drainage systems, including development requirements to minimize impervious surfaces, stormwater rates to encourage reductions of impervious surfaces, and other voluntary programs.

RainWise Implementation Basins

SPU Basin Name	Potential Drainage Area for RainWise (acres)
Ballard	21.0
Fremont/ Wallingford	5.5
Interbay	2.4
North Union Bay	17.7
Portage Bay	0.8
Montlake	0.9
Madison Park	0.2
Leschi	0.1
Delridge	9.7
Duwamish	1.3
Henderson	10.5
Genesee	1.1
Windermere	1.3
Total	**71.7**

3.1.2.1 What kind of natural drainage system programs are already underway in the city?

Two NDS programs are already underway in the City.

Seattle's **RainWise program** is a voluntary, incentive-style program that offers rebates to property owners who install rain gardens or other natural drainage systems on their properties. RainWise rain gardens on private property are designed to collect rooftop, parking lot, or driveway drainage that is currently conveyed directly to the combined sewer system. The rain gardens are small vegetated depressions with designed soil mixes that retain runoff for subsequent infiltration or delayed release to the combined sewer system. Other natural drainage systems for private property are detention cisterns and green roofs. Detention cisterns are tanks designed to collect rooftop runoff and slowly meter it back into the combined sewer system. Green roofs are areas of living vegetation installed on tops of buildings.

The **Right-of-Way program** creates rain gardens in the public right-of-way, either in the existing planting strip adjacent to the sidewalk or by constructing curb bulb extensions into the street. This tool also includes retrofitting portions of alleys with permeable pavement.

Natural drainage systems have been implemented in the Ballard, North Union Bay, Delridge, and Windermere basins. Lessons learned from problems associated with previous installations in the Ballard neighborhood are being applied to all planned installations of natural drainage systems, to avoid similar problems. Current natural drainage system projects being planned include roadside rain gardens in the Ballard and Delridge neighborhoods with construction anticipated to start after 2015.

A more complete description of these programs can be found at www.seattle.gov/CSO.

3.1.2.2 How does the City decide when and where natural drainage systems will be implemented?

Factors that influence the choice of when and where to implement natural drainage systems include the type of sewer system currently in use; type of existing development; infiltration hazards; volume of overflow to be controlled; and local geological, topographic, or soil conditions.

Large-scale application of natural drainage systems is not appropriate in some areas because of existing conditions. For example, the existing plumbing system can be a significant limitation to using natural drainage systems within the right-of-way. Only those roadways that are physically plumbed to a combined sewer system can be retrofitted to potentially help with the CSO reduction strategy. Therefore, in areas with fully combined sewer systems, there is a larger suite of natural systems available that can be used in the right-of-way and on private property. In areas with partially separated systems, only private parcels contribute flows to the combined sewer system; therefore, natural drainage systems must be smaller scale facilities located on private property.

3.1.3 Storage Projects

Under the No Action Alternative, the City would not implement any new storage improvements in the CSO basins. Only construction of storage projects currently funded and scheduled for implementation under the City's NPDES Waste Discharge Permit No. WA0031682 and identified in the 2010 Plan Amendment and Consent Decree Early Action Program would proceed under the No Action Alternative.

Lake Washington was identified in the 2010 Plan Amendment as the number-one priority receiving water for CSO reduction, based on the volume of overflows into the lake and the potential for water quality improvements from CSO reduction. In particular, three basin areas – Windermere, Genesee, and Henderson – were identified as high priority to reduce the volume of overflows, and as such, were the first basins to be selected for implementation of storage facilities.

Table 3-1 lists the City's storage projects in the Windermere, Genesee, Henderson, and Central Waterfront basins that are currently scheduled for completion under the 2010 Plan Amendment, as summarized in the *2012 Annual CSO Report.* Together, these projects are expected to store approximately 5 million total gallons, with completion of the Windermere project in 2014, Genesee in 2015, Henderson in 2018, and Central Waterfront in 2018-2020. A more complete description of these projects can be found at www.seattle.gov/CSO.

Table 3-1. Storage Projects (2012 Annual CSO Report)		
CSO Basin/ Basin #	**Project Description**	**Estimated Completion Date**
Windermere		
13	Storage tank in Magnusson Park	2014
Genesee		
40/41	Storage tank at 49th Avenue South and Lake Washington Boulevard	2014
43	Storage tank at 53rd Avenue South and Lake Washington Boulevard	2014
Central Waterfront		
70, 71, 72	Increased conveyance to King County Elliott Bay Interceptor and storage	2018-2020
Henderson North		
44, 45	Storage tank in Seward Park	2018
Henderson South		
46, 47, 49, 171	Flow diversion project	2018 2015

3.2 Long Term Control Plan Alternative

The LTCP Alternative is focused solely on reducing CSOs under an approved Long Term Control Plan (LTCP). As a planning-level document, the LTCP presents a comprehensive strategy to reduce the remaining uncontrolled CSO discharges in the city. The City must address these CSOs to protect public health and the environment, and comply with the Clean Water Act and state regulations. The City would implement the projects identified in the LTCP Alternative from 2016 through 2025, to comply with federal requirements and the Consent Decree.

The LTCP Alternative would use a combination of three sewage overall reduction strategies – sewer system improvements (“Fix it First”), natural drainage systems (“Keep Stormwater Out”), and underground storage (“Store What’s Left”) – to reduce CSOs in 11 Seattle neighborhoods. Natural drainage systems (“Keep Stormwater Out”) are an integral part of Seattle’s comprehensive strategy to manage polluted runoff and CSOs, and as such, they are part of ongoing programs included in the No Action Alternative, and are described in Section 3.1.2.

The LTCP Alternative focuses solely on the combined sewer system and would reduce CSOs to an average of no more than one overflow per outfall per year on a 20-year rolling average by the year 2025. The LTCP also includes requirements for post construction monitoring, to determine if the performance standard has been met.

The City’s efforts to identify CSO reduction strategies were guided by a number of factors, including past use of CSO reduction strategies in the city, regional experience with CSO reduction strategies, and existing laws and regulations. Washington State’s CSO regulations provide an initial framework for the range of options that The

City is considering as part of its CSO reduction efforts. Within the framework provided by state and federal law, the City considered the results of extensive system modeling, public and stakeholder input, and the LTCP objectives and associated criteria. Using this information, the City evaluated the potential effectiveness of CSO reduction strategies for inclusion in the Plan and this EIS.

3.2.1 Sewer System Improvements – "Fix it First"

In some areas, the City can reduce CSOs by making minor modifications to the existing sewer system to make better and more reliable use of existing capacity. This type of modification (termed a retrofit) is generally significantly less expensive than other approaches and is relatively quick to implement.

Not all areas can be controlled using retrofits. In some areas, the sewer system is already operating under optimal conditions and the flow volume still exceeds the capacity of the system. In other areas, sewer system improvements may reduce CSOs in the basin but will not eliminate them.

The City has several ongoing sewer system improvement programs and projects. Many of these improvements would be implemented under any alternative and are further described in Section 3.1, No Action Alternative. The LTCP Alternative includes additional improvements to address the CSO basins that are not already addressed by these existing programs and projects.

The types of sewer system improvements being considered include adjusting flow-control structures, such as installing new gates that control combined sewer flow; redirecting flows to another City CSO area or facility; or increasing maintenance and monitoring activities. Sewer system improvements include improving existing structures, installing new sewer lines, and relocating underground structures.

Sewer system improvements have the potential to affect King County wastewater facilities, and as such will require close coordination with King County to ensure that the retrofits occur in accordance with agreed upon Guiding Principles adopted by the two agencies. Section 3.2.2.3 describes the process that the City will use to coordinate with the County.

3.2.2 Storage Projects –"Store What's Left"

Storage facilities, such as underground pipes, tanks, and tunnels, hold excess combined stormwater and sewage during heavy storms. Storage facilities are the most effective way to reduce CSO volumes remaining after sewer system improvements and natural drainage systems have been employed. Additional storage facilities would enable the system to hold more stormwater and sewage flows until the flows can be transferred to wastewater treatment plants operated by King County. Because this approach results in increased flows to the County's system, the City and the County would coordinate to reach agreement on the flows transferred.

Stormwater and sewage flows only enter the storage facilities during a storm event. Once an upstream monitoring device detects excessive flow from a storm event, excessive flows are diverted to the storage facility until it reaches capacity. After the storm event has passed, when there is capacity in the downstream sewers, the storage volume is pumped out of the storage facility and into the existing system for conveyance to the treatment plant. Stormwater and sewage flows are typically stored in the facility for the duration of the storm event and pumped as soon as possible into the downstream sewer system. The storage facility is designed to be emptied within 8-12 hours.

3.2.2.1 What types of underground storage facilities are being considered?

Underground storage facilities include traditional storage facilities such as oversized pipes, tanks, and tunnels as well as flow diversions. A flow diversion involves diverting flows from a City facility to a nearby King County facility through modifications within the pipe network such as new gravity interceptors, new pump station and forcemains, and new regulator/flow diversion structures.

Storage facilities can be located in the public right-of-way or on adjacent publicly owned or privately owned property. In general, tanks are used to store larger storage volumes (for example, 500,000 gallons or greater) while storage pipes are appropriate for smaller storage volumes (typically ranging from 10,000 to 500,000 gallons). Tunnels are typically more cost-effective to use for storage volumes greater than 5 MG. Storage tanks and tunnels require permanent dedicated sites, whereas a smaller storage pipe can more easily be built underneath the street in the right-of-way. The permanent sites for a tunnel are limited to areas retained at the tunnel construction (portal) sites. Following construction, approximately 75 percent of the tunnel construction sites can be restored after construction and surplussed for sale to private parties. The area above the tunnel would be held in easements only.

CSO storage pipes and tanks require associated infrastructure such as odor control, mechanical, electrical, and control systems; standby generator; pump station; air intakes; and odor control exhaust vents. These facilities may be placed in underground vaults or aboveground structures depending on the project and the local site characteristics. In general, the City prefers to place associated infrastructure underground where feasible. The actual infrastructure requirements will depend on the specific facility, and will be determined during project design. Minor modifications may be needed to the existing combined sewer system and new pipes may need to be added.

Figure 3-3. Storage Tunnel

CSO storage tunnels require drop shafts for flow connection to the tunnel between the tunnel portals, access shafts, and flow regulators to control the flow rate into the tunnel. Storage tunnels also require facilities for odor control and other systems, as described above for storage tanks. These are typically aboveground facilities, but may be located underground at added expense. Because a CSO storage tunnel is designed to both store and convey flows during storm events, they are designed to be drained and flushed following the storm event. Screens are installed at each drop structure to capture debris before it enters the tunnel, and would be cleaned periodically.

All storage facilities require at least some new pipelines to provide local connections to the facilities, and most require one or more pump stations. Larger facilities that would store flow from multiple neighborhoods would generally require more local connections and pump stations than smaller, neighborhood facilities.

In some neighborhoods, diversion of flow to a nearby existing King County interceptor or facility may be more cost-effective than construction of new storage. The diverted flows would be stored for treatment following the storm event. Since this approach would cause an increased volume of flow to the County's system, an agreement between the City and the County would be required. Flow diversions generally require new sewer pipelines and a diversion structure with a weir to divert the flows. In addition, pump stations, forcemains, and facilities housing electrical equipment and odor control may be required.

3.2.2.2 How will the City decide where storage facilities will be located and how they will be sized?

As described for the No Action Alternative, the City will continue to implement sewer system improvements and natural drainage systems in the city. It is anticipated that as sewer system improvements and natural drainage system opportunities are identified and successfully implemented, the positive effects of these measures may ultimately be reflected in reduced sizes of storage facilities constructed under the LTCP. Using data from these ongoing programs, and other information on CSO flows, location of the existing conveyance system, and surface and subsurface features, the City will determine the location and sizing of storage facilities. In some neighborhoods, it may be more effective to build one large underground storage facility to meet storage needs. In other areas, it may be more effective to build two or three smaller facilities. Actual locations of storage projects will be identified during project design.

The City will conduct a siting process to select the optimal sites for building an underground storage facility or facilities. The siting process will engage affected stakeholders to ensure that the interests of the community are thoroughly considered. The City will conduct project-specific environmental review during the siting process to evaluate site-specific construction impacts and long-term environmental impacts of the underground storage facilities.

Sites for the storage facilities may include a range of property types, including private and publicly owned property, street rights-of-way, and open space. During project implementation, the City will define specific site selection criteria and priorities along with financial, engineering, and environmental/social considerations to identify, screen, and select sites for CSO control projects.

The City's policy for facility site selection gives highest priority for City-owned property, followed by other City or publicly owned property, commercial/industrial property, and then schools, residential properties, and other properties. The property owner's willingness to sell or convert the property to a CSO facility is an important consideration in the site selection process. All factors will be considered along with community input during the facility siting process.

3.2.2.3 Are there shared storage opportunities with King County?

King County also has combined sewer systems within the City of Seattle. Because of the interconnectedness of the City and King County wastewater collection systems, individual CSO control measures for either agency can potentially impact an overflow for the other. Consequently, potential shared CSO control measures exist in some areas where both agencies could be served by a common solution. In other areas, no common benefit exists and independent CSO control measures are indicated. Whether the selected CSO control measure is shared or independent, the potential effect on the flows between agencies will be carefully considered during the evaluation process.

King County began its CSO long term control planning in early 2010. Because the two agencies were preparing similar plans during the same period and the two agency's combined sewer systems were geographically and hydraulically linked, King County approached the City to identify potential collaborative opportunities. The two agencies evaluated 40 potential shared projects and identified four feasible shared storage projects to evaluate in each agency's respective LTCP: shared City Fremont/Wallingford/King County 3rd Avenue W Regulator storage, shared City North Union Bay/King County University Regulatory storage, shared City Montlake/King County Montlake Regulatory storage, and a deep tunnel along the Ship Canal.

In addition to shared storage, the two agencies also looked at flow diversion opportunities for Montlake, Leschi, Magnolia, East Waterway, and Duwamish.

The City recognizes the importance of strong coordination with King County in controlling CSOs in the City. All of the proposed options have elements which may have an impact on King County's downstream wastewater system. Three of the proposed options include shared King County/City projects along the Ship Canal. Several of the proposed options include sewer system improvements which will convey additional wastewater volume to the downstream King County system. Regardless of which option is selected, coordination between the City and King County is critical to successfully designing, constructing, and eventually operating the proposed CSO control projects in the City.

The City and King County are continuing to work together closely to analyze and recommend options that are more cost-effective, produce better environmental outcomes, and minimize disruption to communities. King County must also reach its own independent conclusions about the benefits of a shared project to the regional system, and the implications of such a project to its own Long Term Control Plan and Consent Decree. Selection of a shared King County/City project will be dependent on the City's and County's analytical results as well as a number of joint factors mutually agreed upon in a City/County Coordination Plan. These factors include such things as which agency will be responsible for the design/construction/operations of the shared facility, each agency's project cost-share, operational and implementation roles and responsibilities, the process for dispute resolution, and the ability to fulfill regulatory and contractual obligations. If the City and King County choose to implement a shared City/King County project, then a shared project agreement between the two agencies will be necessary prior to designing and constructing the project. In addition, the City and King County will analyze the impacts of any recommended project on the downstream King County system and agree on an approach to addressing those impacts prior to constructing the project.

3.2.2.4 What are the LTCP Options?

The City evaluated numerous potential approaches to determine their effectiveness to meet the CSO performance standard, stay within budget and rate limits, and minimize environmental and community impacts. The result of this evaluation was four potential combinations of CSO control measures, referred to as "options," that could meet EPA requirements. These options vary in terms of the number, size, and potential location of storage facilities considered. These options were developed under one of two basic concepts: the City meets their Consent Decree-mandated control requirements through implementation of independent (City-only) control projects, or the City participates in one or more shared projects with King County to take advantage of potential cost/impact reduction opportunities.

SPU LTCP Storage Options:

Neighborhood Storage Option

Shared Storage Option

Shared West Ship Canal Tunnel Option

Shared Ship Canal Tunnel Option

Individual CSO control measures for each CSO neighborhood were developed by the City to support a **Neighborhood Storage Option** (City-only implementation). This option involves building the largest number of underground storage facilities throughout the city. The Neighborhood Storage Option would primarily include building storage tank and pipes throughout the city, but could include building a deep tunnel to cost-effectively combine flows from Ballard and Fremont/Wallingford in one storage facility, referred to as the *Neighborhood West Ship Canal Tunnel*.

One option under the shared project strategy is to combine facilities when both the City and King County must construct storage facilities in close proximity to one another. This is the **Shared Storage Option** (shared City/King County implementation). Under the Shared Storage Option, those CSO neighborhoods that are not part of the shared project will require implementation of City-only (neighborhood) control measures.

Another option under the shared project strategy is to consolidate CSO storage for six City storage facilities and three King County storage facilities in a deep tunnel. This is the **Shared Ship Canal Tunnel Option** (shared City/King County implementation). Under the Shared Ship Canal Tunnel Option, those CSO areas that are not part of the shared project will require implementation of City-only (neighborhood) control measures.

During development of the Shared Ship Canal Tunnel Option, the feasibility of another potentially cost-effective shared tunnel solution (combining storage volume requirements from Ballard, Fremont/Wallingford, and 3rd Avenue W Regulator) was identified and evaluated. This option became the **Shared West Ship Canal Tunnel Option** (shared City/King County implementation).

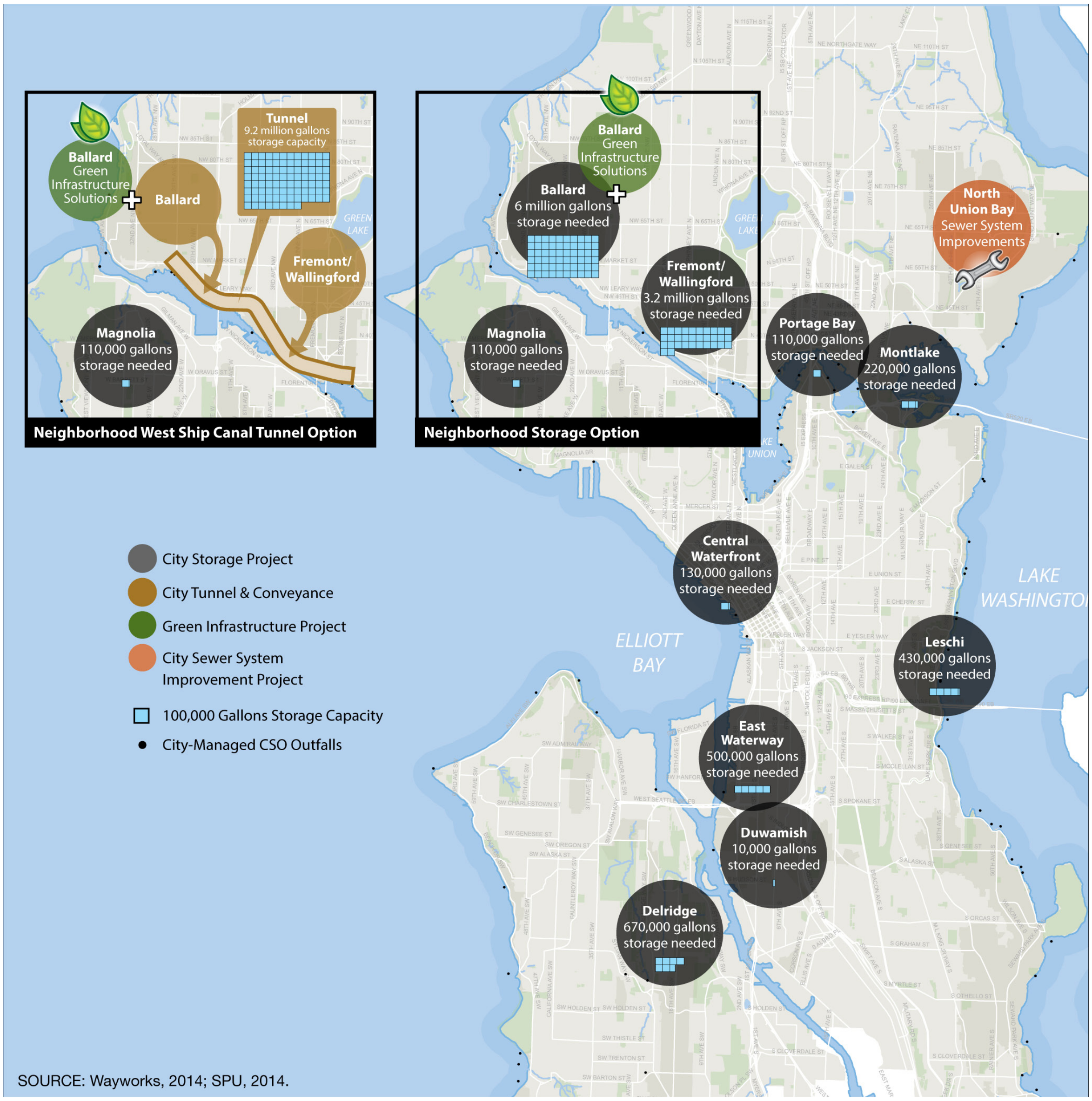
The following table (3-2) presents the Plan neighborhoods and illustrates how they fit into the four LTCP options. The LTCP options are graphically displayed on Figures 3-4 through 3-7. More detailed information can be found in *Volume 2, LTCP.*

Table 3-2. LTCP Options (2016 - 2025)

<table>
<tr><th rowspan="2">City LTCP CSO Neighborhood</th><th rowspan="2">Best Estimate Control Volume (MG)</th><th colspan="2">Neighborhood Storage</th><th rowspan="2">Shared West Ship Canal Tunnel (KC/City)[1]</th><th rowspan="2">Shared Ship Canal Tunnel (KC/City)[2]</th><th rowspan="2">Shared Storage (KC/City)[2]</th></tr>
<tr><th>Neighborhood Tanks/Pipes</th><th>Neighborhood West Ship Canal Tunnel</th></tr>
<tr><td>Leschi</td><td>0.43</td><td colspan="3">3 Storage Pipes and 1 Storage Tank</td><td rowspan="4">Storage Tunnel (27 MG)</td><td rowspan="2">King County/City Montlake Regulator Storage Tank (7.87 MG)</td></tr>
<tr><td>Montlake</td><td>0.22</td><td colspan="3">3 Storage Pipes</td></tr>
<tr><td>Portage Bay</td><td>0.11</td><td colspan="3">1 Storage Pipe</td><td>1 Storage Pipe</td></tr>
<tr><td>North Union Bay</td><td>1.63</td><td colspan="3">Sewer System Improvements</td><td>King County/City Storage Tank (5.23 MG)</td></tr>
<tr><td>Duwamish</td><td>0.01</td><td colspan="3">1 Storage Pipe and In-line storage (retrofit)</td><td>Flow Diversion to King County Duwamish Interceptor</td><td>2 Storage Pipes</td></tr>
<tr><td>East Waterway</td><td>0.50</td><td colspan="2">1 Storage Tank</td><td colspan="3">Flow Diversion to King County HLKK[4] Treatment Plant</td></tr>
<tr><td>Magnolia</td><td>0.11</td><td colspan="2">1 Storage Pipe</td><td colspan="2">Flow Diversion to King County North Interceptor</td><td>1 Storage Pipe</td></tr>
<tr><td>Central Waterfront[3]</td><td>0.13</td><td colspan="5">1 Storage Pipe[3]</td></tr>
<tr><td>Ballard</td><td>6.00</td><td>1 Storage Tank</td><td rowspan="2">Storage Tunnel: (9.2 MG)</td><td rowspan="2">Storage Tunnel (13.4 MG)</td><td rowspan="2">Storage Tunnel (27MG)</td><td>1 Storage Tank (or dual Storage Pipes)</td></tr>
<tr><td>Fremont-Wallingford</td><td>3.24</td><td>1 Storage Tank</td><td>King County/City Storage (7.4 MG)</td></tr>
<tr><td>North Delridge</td><td>0.17</td><td colspan="3">1 Storage Pipe</td><td>Flow Diversion to King County Harbor Trunk</td><td>1 Storage Pipe</td></tr>
<tr><td>South Delridge</td><td>0.50</td><td colspan="5">2 Storage Pipes</td></tr>
</table>

1. Eliminates King County Independent Storage Tank on South side of Ship Canal (3rd Ave West)
2. Eliminates King County Independent Storage Tanks on North and South sides of Ship Canal (3rd Ave West, University, and Montlake Regulator)
3. Will be constructed in coordination with the Seawall Phase 2 (2018 Earliest Start)
4. Handford , Lander, Kingdome, and King (HLKK)

3.2.2.4.1 Neighborhood Storage Option



SOURCE: Wayworks, 2014; SPU, 2014.

Figure 3-4. Neighborhood Storage Option

Under the **Neighborhood Storage Option**, the City would build underground storage facilities in Ballard, Fremont/Wallingford, Magnolia, Portage Bay, Montlake, Leschi, Central Waterfront, Duwamish, Delridge, and East Waterway CSO areas, and sewer system improvements in the North Union Bay CSO area. This option involved building the largest number of storage facilities throughout the city.

There are two variations in the Neighborhood Storage Option: one would provide storage in tanks/pipes only, and the other would include a tunnel (Neighborhood West Ship Canal Tunnel) in combination with tanks and pipes. The storage tank/pipe option involves the greatest number of affected locations. The Neighborhood West Ship Canal Tunnel Option was developed because the two CSO areas with the largest storage volumes (Ballard and Fremont/Wallingford) are relatively close to one another. The Neighborhood West Ship Canal Tunnel Option would likely require fewer facilities and result in fewer neighborhood impacts compared to tanks/pipes only.

Implementation of the North Union Bay sewer system improvements will require City coordination with King County because additional flows will be transferred to the King County system. Specifically, the City and King County will need to analyze the impacts of the proposed project on the downstream system and agree on an approach to address those impacts.

3.2.2.4.2 Shared Storage Option

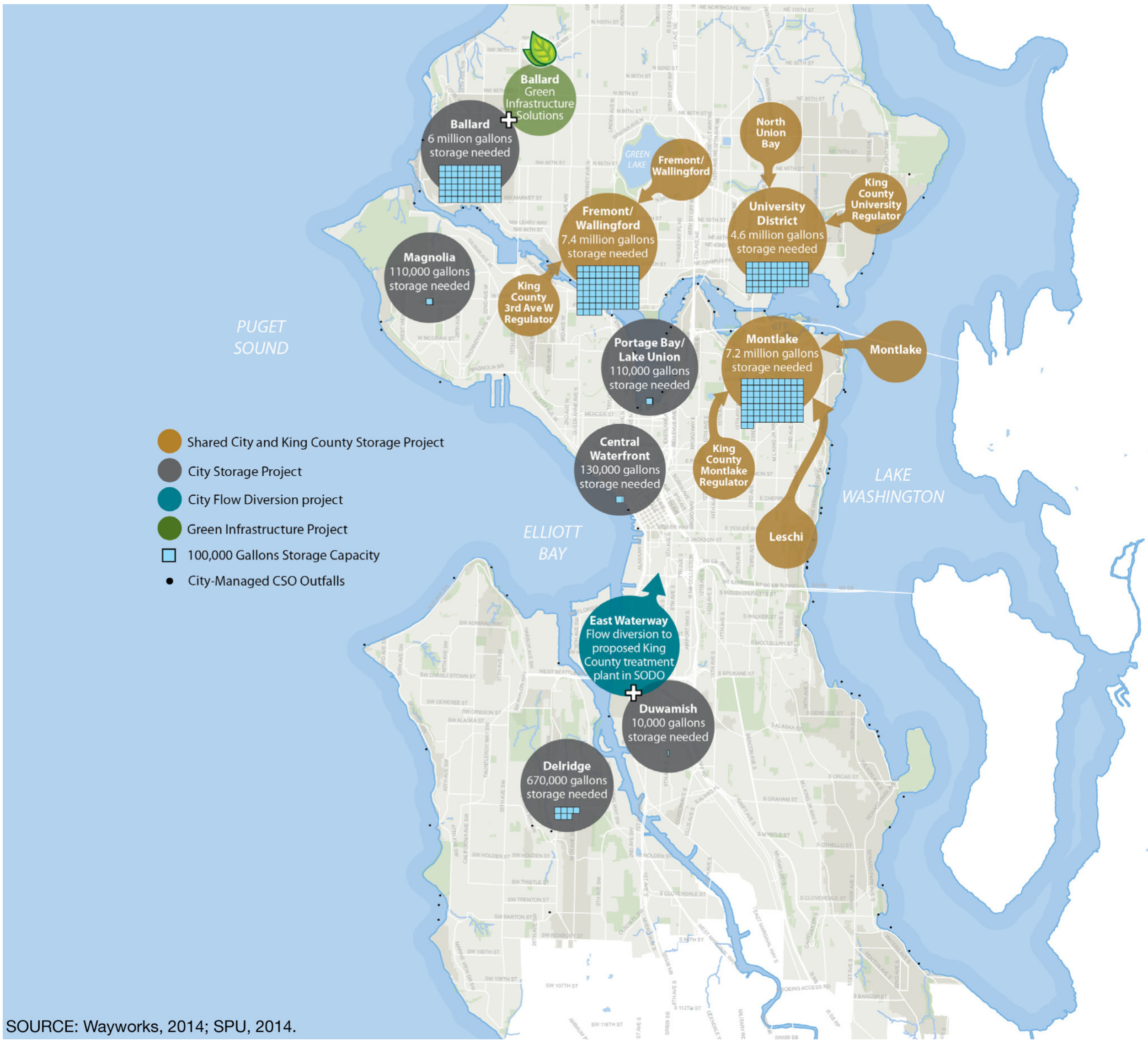


Figure 3-5. Shared Storage Option

Under the **Shared Storage Option**, the City and King County would jointly build larger but fewer storage tanks in three CSO areas: Fremont/Wallingford/King County 3rd Avenue West CSO; North Union Bay/King County University Regulator CSO: and Montlake/Leschi/King County Montlake Regulator. These three shared storage projects were recommended in the approved 2012 King County CSO plan. In the Duwamish CSO area, the City would divert flows to a treatment facility proposed by King County. All other CSO areas would have the same storage facilities as proposed under the Neighborhood Storage Option.

Prior to implementing any shared projects between the City and King County, a shared project agreement would need to be signed between the two agencies. Specifically, the City and King County would need to analyze the impacts of the proposed project on the downstream system and agree on an approach to address those impacts.

3.2.2.4.3 Shared West Ship Canal Tunnel Option

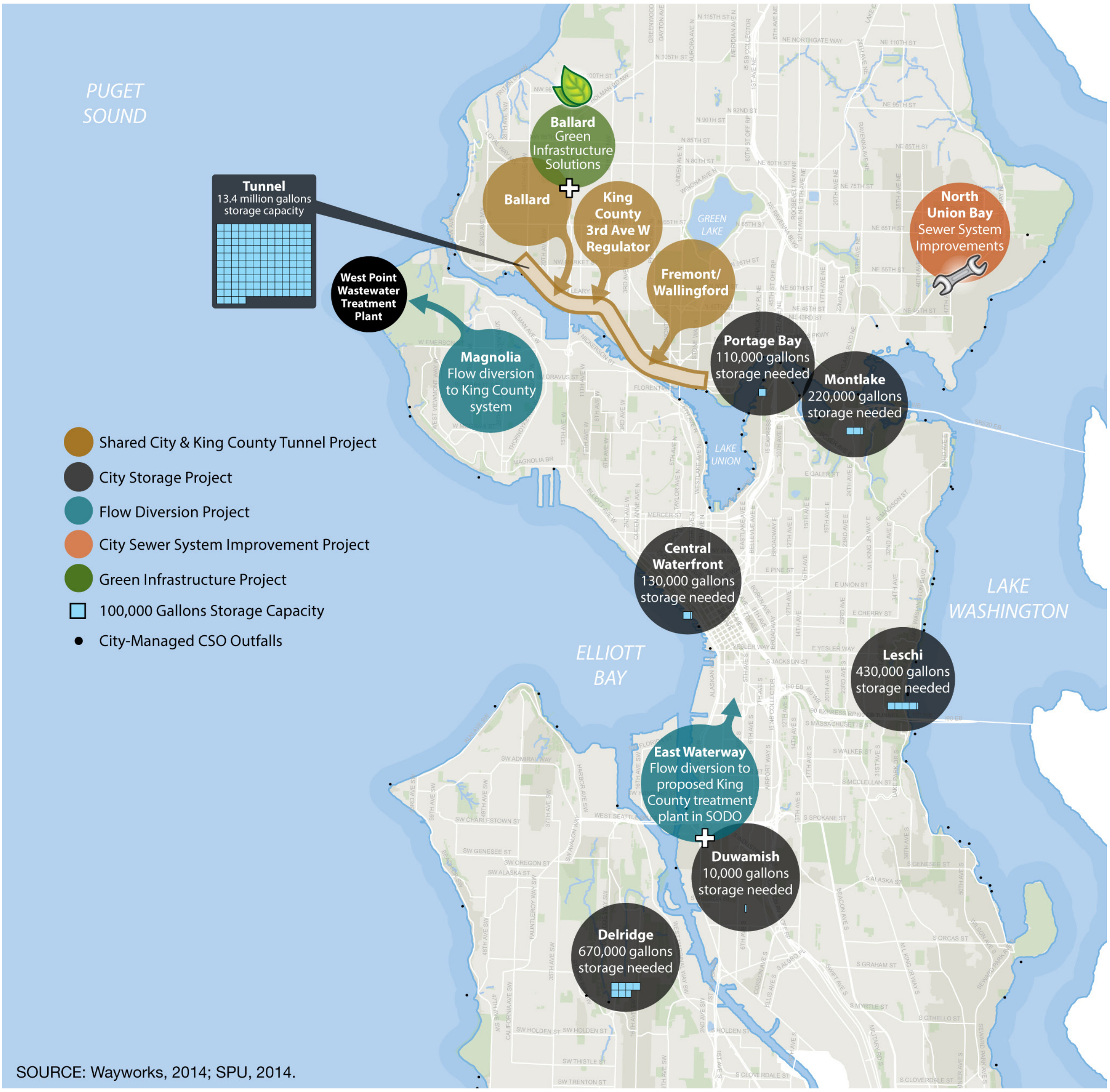


Figure 3-6. Shared West Ship Canal Tunnel Option

The **Shared West Ship Canal Tunnel Option** combines three of the largest CSO areas into a single deep tunnel. The West Ship Canal Tunnel is proposed as a shared option because the three CSO areas (two from the City and one from King County) with the largest control volumes are relatively close to one another. The tunnel would extend from Fremont/Wallingford to Ballard and would provide the storage needed to address sewage overflows in Ballard, Fremont/Wallingford, and King County's 3rd Avenue West CSO basins. The tunnel would eliminate the need for a separate King County CSO project at an outfall near 3rd Avenue West.

Prior to implementing any shared projects between the City and King County, a shared project agreement would need to be signed between the two agencies.

Within this option, the remaining CSO areas would be controlled by their respective neighborhood control measures except for Magnolia and East Waterway where flow diversions to King County's system are proposed. Any City flow diversion projects would require coordination with King County. Specifically, the City and King County would need to analyze the impacts of the proposed flow diversion projects on the downstream system and agree on an approach to address those impacts.

3.2.2.4.4 Shared Ship Canal Tunnel Option

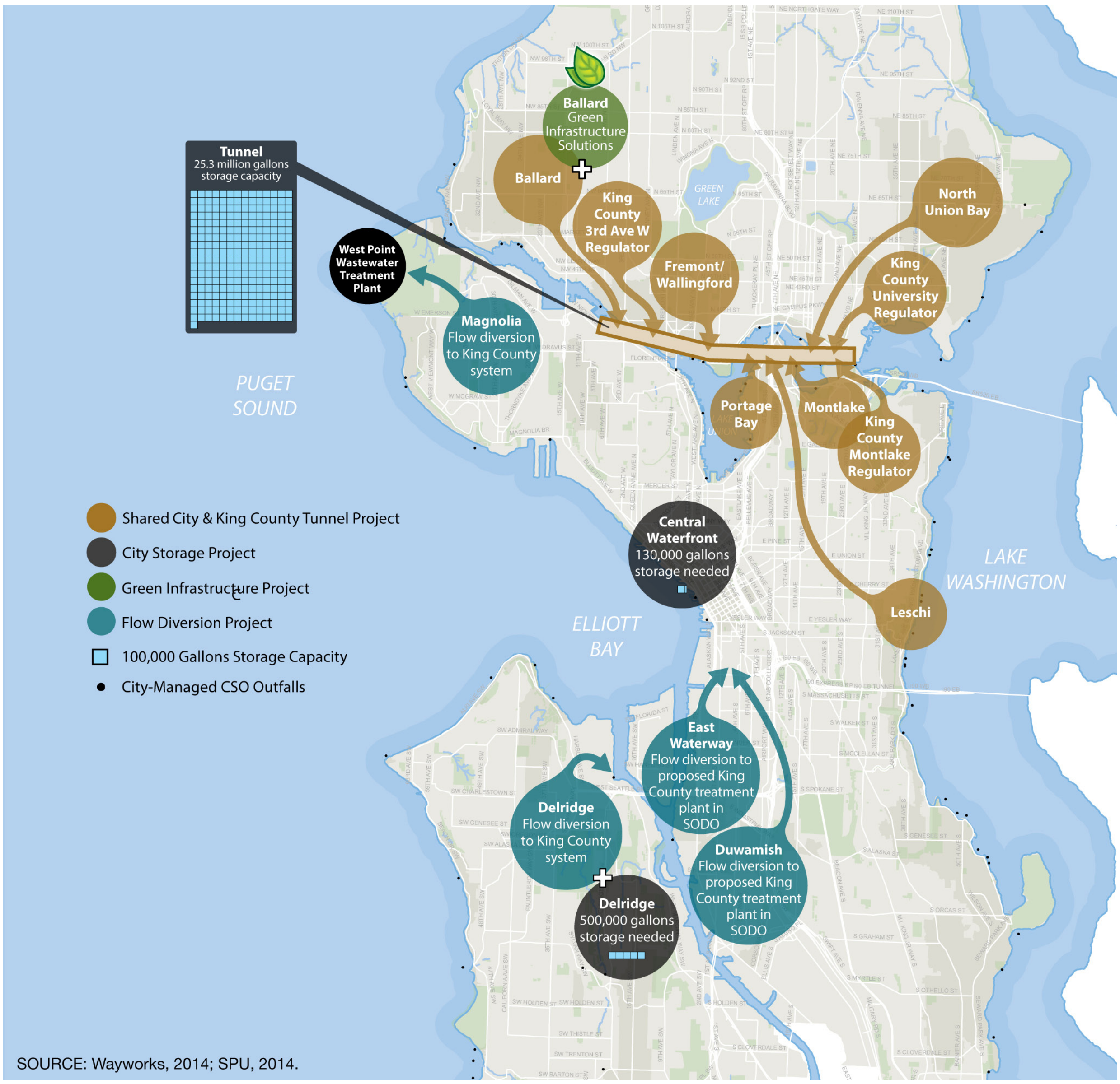


Figure 3-7. Shared Ship Canal Tunnel Option

The **Shared Ship Canal Tunnel Option** combines the control volumes from six City CSO areas along the Ship Canal and Lake Washington, and three of the largest King County CSO areas along the Ship Canal in a deep tunnel extending from the University District to Fremont/Wallingford. The tunnel would provide the storage needed to address sewage overflows in the City's CSO areas of Ballard, Fremont/Wallingford, Portage Bay, Montlake, North Union Bay, and Leschi. The tunnel would also eliminate the need for three separate King County CSO projects at outfalls near Pacific Street (University Regulator), Montlake Avenue (Montlake Regulator), and 3rd Avenue West.

The remaining City CSO areas (Magnolia, Duwamish, East Waterway, and the northernmost Delridge CSO basin) would be diverted to King County under the assumption that flow diversions could be incorporated into mutual interagency agreements. The Central Waterfront and the southern Delridge CSO neighborhoods would continue to be served by their respective neighborhood control measures.

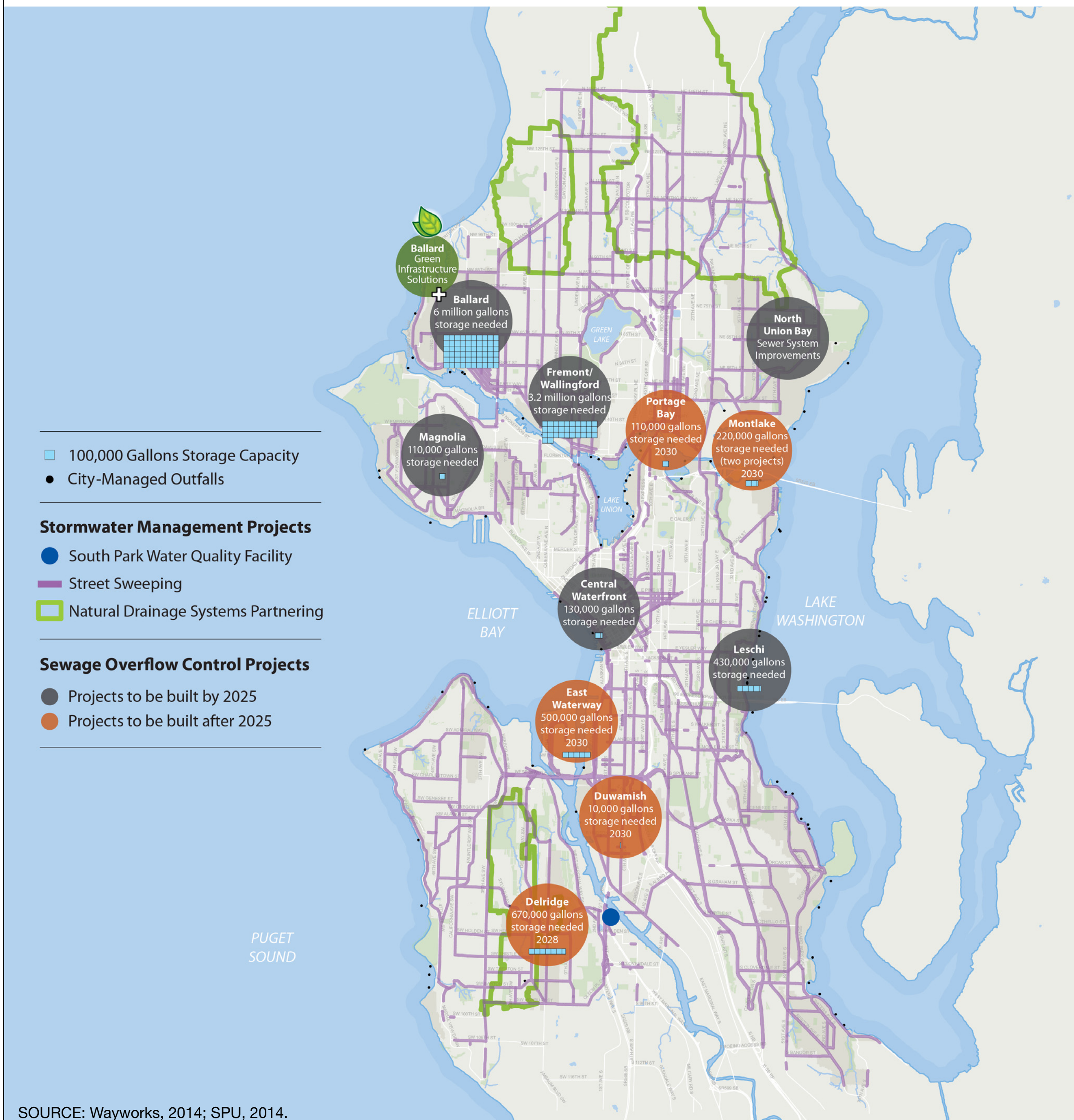
Prior to implementing any shared projects between the City and King County, a shared project agreement would need to be signed between the two agencies. Specifically, the City and King County would need to analyze the impacts of the proposed project on the downstream system and agree on an approach to address those impacts.

3.3 Integrated Plan Alternative

As described in Chapter 2, stormwater that enters the city's separate stormwater system is a major contributor to water quality issues. An approach that allows the City to integrate stormwater pollution management with CSO reduction strategies would lead to greater improvement of water quality, and represents a more comprehensive approach to water quality management.

Under the Integrated Plan Alternative, the City would implement stormwater pollution reduction projects in Seattle neighborhoods to address stormwater runoff in areas that are not part of the combined sewer system, using a combination of stormwater treatment technologies. These projects would reduce polluted stormwater runoff into the Duwamish Waterway, Lake Washington, Piper's Creek, Thornton Creek, Longfellow Creek, and Lake Union/Ship Canal. The City is focusing stormwater control projects in these areas to meet the Integrated Plan objectives established by the Consent Decree.

The City would also build CSO reduction projects using one of the four LTCP options outlined above for the LTCP Alternative. However, the City would delay the completion of some of the CSO control projects until 2030, while high-benefit stormwater treatment technology projects would be completed prior to 2025. Six CSO projects to control discharges into the lower Duwamish, Portage Bay and Ship Canal waterways would be constructed between 2028 and 2030. CSO control projects that would be delayed are located in the following neighborhoods: North Delridge, East Waterway, Duwamish, Portage Bay (Figure 3-8). These CSOs discharge to the lower Duwamish Waterway and Portage Bay, and Ship Canal. The City is required to propose a specific date for completing all CSO control projects to the EPA and Ecology.



SOURCE: Wayworks, 2014; SPU, 2014.

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Figure 3-8 Integrated Plan Alternative.

3.3.1 How were the Integrated Plan Stormwater Projects/Programs Identified?

The planning process for the Integrated Plan focused on identifying stormwater pollution reduction projects in high-priority basins that can meet the intent of the Consent Decree to *"result in significant benefits to water quality beyond those that would be achieved by implementation of CSO Control Measures only*."

The Consent Decree requires that the City describe the benefits of the proposed stormwater pollution reduction projects/programs in terms of reductions in pollutant loads and exposure to human and ecological receptors. In addition, the Consent Decree requires a cost-benefit analysis for the proposed projects. The City developed its Integrated Plan Alternative based on these requirements.

Identification of potential Integrated Plan stormwater projects/programs started with basin ranking to identify high-priority basins where water quality improvements are needed the most. The high-priority drainage basins that were analyzed for potential stormwater projects for the Integrated Plan included the following water bodies:

- Duwamish Waterway;
- Lake Washington;
- Lake Union; and
- Longfellow, Thornton, and Piper's Creeks.

Next, stormwater projects/programs were identified for each priority basin by completing the following steps:

- Identifying characteristics of the priority ranked basins;
- Identifying each receiving water body and its primary pollutants of concern;
- Calculating pollutant and flow estimates for each basin;
- Using basin-specific information and knowledge of stormwater treatment technologies to identify potential locations for stormwater treatment; and
- Estimating costs for each of the stormwater treatment alternatives.

Finally, these projects and programs were evaluated against the CSO control projects to identify where significant benefits to water bodies in and around Seattle could be achieved by implementing the stormwater pollution reduction programs and projects now, and deferring completion of certain CSO control projects until 2030.

Further information is included in *Volume 3, Integrated Plan.*

3.3.2 Integrated Plan Alternative Stormwater Projects/Programs

The Integrated Plan Alternative consists of three stormwater pollution reduction projects or programs that would be implemented before 2025: Natural Drainage Systems (NDS) Partnering; South Park Water Quality Facility, and Arterial Street Sweeping Expansion. As described above, these projects/programs are in addition to projects that would be implemented under one of the four LTCP options. The difference being, six of the CSO control projects would be deferred under the Integrated Plan Alternative. These deferred CSO control projects would be constructed between 2028 and 2030. In keeping with the Consent Decree, the three stormwater projects would provide significant benefits to water quality beyond those that would be achieved by implementing the CSO control projects alone. Figure 3-8 shows the proposed stormwater project locations and the CSO control projects that would be deferred under this alternative.

The three stormwater projects/programs can generally be described in terms of three stormwater pollution reduction strategies: source control best management practices (BMPs), flow control BMPs, and stormwater treatment BMPs. Natural Drainage Systems Partnering and South Park Water Quality Facility involve flow control and stormwater treatment BMPs. The third project, Arterial Street Sweeping Expansion, is a source control BMP.

3.3.2.1 South Park Water Quality Facility

The South Park Water Quality Facility would reduce pollutant loading from approximately 74 MG of stormwater each year by installing an end-of-pipe treatment system in South Seattle adjacent to the Duwamish Waterway. The facility would treat stormwater from the City's 250-acre 7th Avenue S drainage system. A treatment facility is considered in this basin because stormwater is a significant contributor of contaminants to the Duwamish Waterway in this location. Because of the sensitivity of the receiving water this location emerged as a high priority for stormwater pollutant reduction. The facility would be built in the same location as a new stormwater pump station the City plans to build to reduce flooding in this same area, creating an opportunity to leverage water quality and flood control projects.

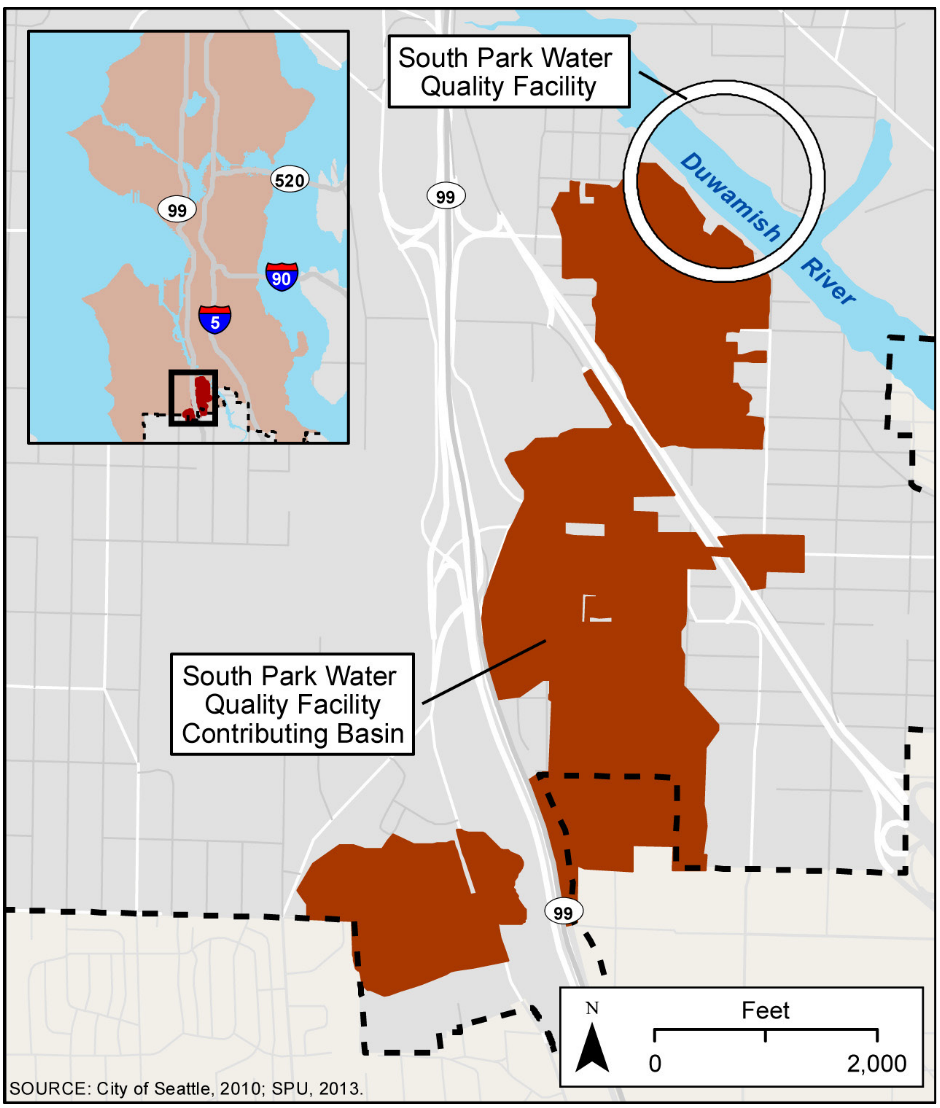


Figure 3-9. South Park Water Quality Facility

Stormwater would be routed through a basic, active treatment system such as chitosan-enhanced sand filtration (CESF) to remove a variety of pollutants prior to discharge to the Lower Duwamish Waterway through an existing outfall. This basic, active treatment would treat an average volume of approximately 74 MG per year from a drainage area of approximately 250 acres. If the Integrated Plan Alternative is selected, the South Park Water Quality Facility would be constructed by 2024 following project-specific environmental review and design.

3.3.2.2 Natural Drainage Systems Partnering

Natural Drainage System (NDS) Partnering, a flow control and stormwater treatment BMP, involves using natural drainage systems, such as engineered rain gardens, within various basins that drain to Piper's, Thornton, and Longfellow Creeks (Figure 3-10). Piper's Creek ultimately discharges to Puget Sound; Thornton Creek discharges to Lake Washington; and Longfellow Creek discharges to the Duwamish River and then into Puget Sound.

Flow Control and Stormwater Treatment BMPs

These technologies typically control the volume, rate, and duration of stormwater runoff, or remove the pollutants by settling, separation, filtration, biological uptake, and absorption. Typical flow control BMPs include infiltration technologies and flow routing. Typical stormwater treatment BMPs include both active and passive facilities, such as treatment facilities, filtering systems, and natural drainage systems (e.g., rain gardens or bioretention)

Projects implemented under this program would involve reconstructing City rights-of-way to manage flow and provide water quality treatment for polluted urban runoff primarily using bioretention facilities such as engineered rain gardens. Project locations would be identified by site factors and a community-nomination process. Projects would be designed to infiltrate into native soil where appropriate. Where complete reliance on infiltration is not technically feasible, systems would be augmented with underdrains.

Project locations would be prioritized based on stormwater management goals; however, community partnering goals (mobility, traffic calming, and beautification) would also be achieved as a secondary benefit. As a first step to NDS Partnering, the City would develop a program for encouraging residents or community groups to nominate their block(s) as candidates for NDS. Candidate blocks must be among the potential blocks identified by the City as potentially feasible for bioretention; the majority of these blocks are part of informal drainage systems (i.e., lacking curbs and gutters). Projects would be designed to infiltrate into native soil where appropriate. Where complete reliance on infiltration is not technically feasible, systems would be augmented with underdrains.

In summary, the following would be involved with selecting appropriate NDS Partnering project sites within these basins:

- Identify blocks that are potentially feasible for bioretention;
- Prioritize project locations based on stormwater goals;
- Conduct community outreach to encourage residents to nominate blocks as candidates for NDS and determine community goals (mobility, traffic calming, and beautification);
- Review right-of-way area, setback requirements, and locate utilities to determine bioretention sites; and
- Conduct geotechnical analysis (infiltration testing, depth of groundwater and hydraulic restrictive layer, erosion evaluation, evaluation of adjacent slopes and structures) to confirm site suitability and collect necessary information for detailed design.

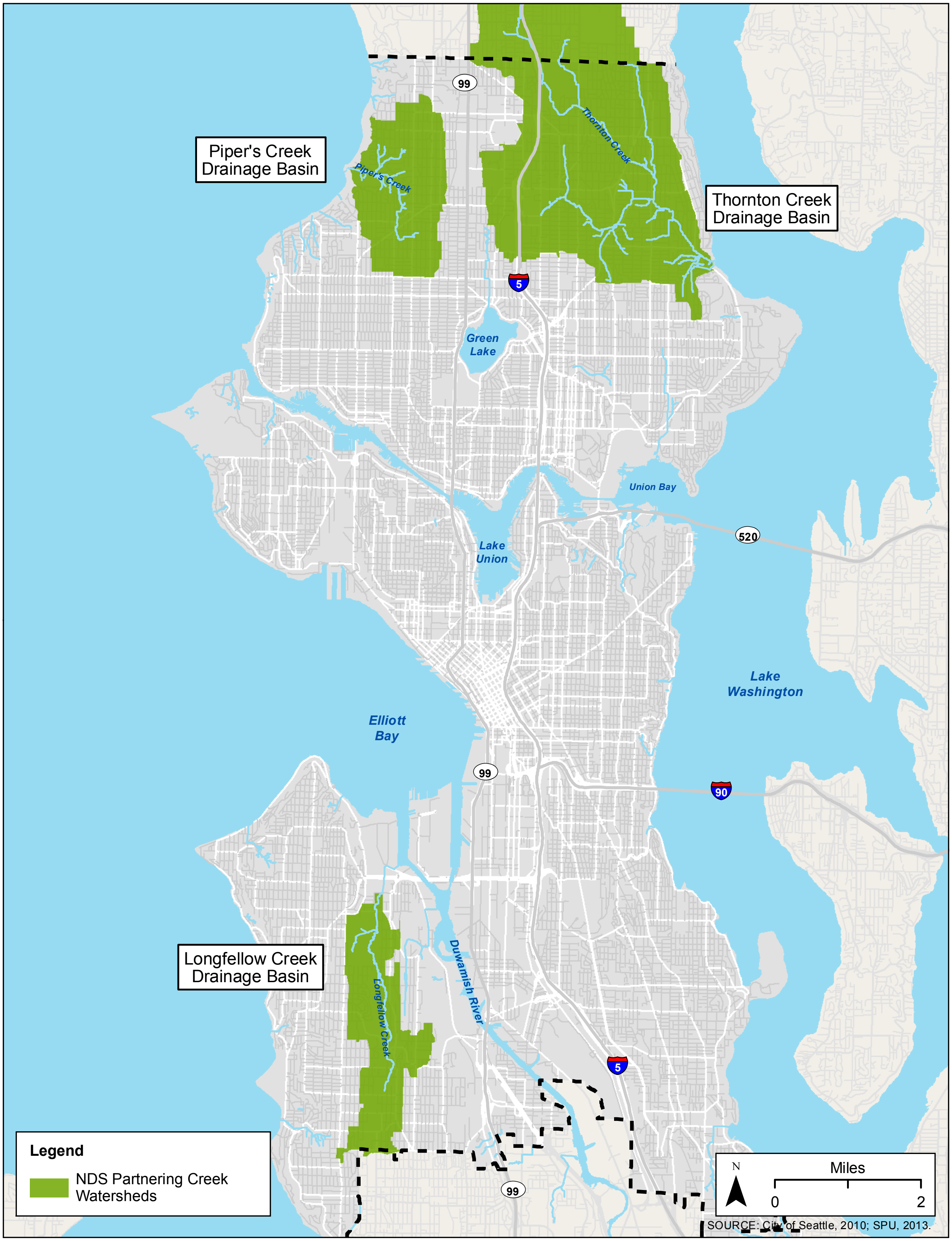


Figure 3-10 NDS Partnering.

3.3.2.3 Arterial Street Sweeping Expansion (Weekly Arterial Sweeping)

Street sweeping, a source control BMP, removes pollutants from roadways before they wash off into sewers and our local waterways. On most arterials, street sweeping is primarily conducted during the night.

The City's existing Street Sweeping for Water Quality Program started in 2011. It is a partnership between Seattle Public Utilities (SPU), which sets the program direction, provides water quality expertise, and funds routes that discharge directly to receiving waters, and the Seattle Department of Transportation (SDOT), which provides operational expertise, street sweeping services, and funding for routes that drain to a sewage treatment plant. Under the current sweeping schedule, 16 routes are swept every other week and six are swept weekly covering 415 curb miles each week, of which 73 percent drain directly to surface waters.

Source Control BMPs

These technologies typically prevent stormwater pollution or adverse impacts from occurring. For the Integrated Plan Alternative, the City's existing street sweeping program would expand the area, frequency and duration of the City's arterial street sweeping/program.

Seattle Public Utilities would expand its existing arterial street sweeping program by adding new arterial routes and increasing the frequency of sweeps. The citywide project would be designed to be expandable and adaptable to meet future needs. This approach has several benefits:

- Targets removal of pollutants from roadways
- Prevents a significant amount of solids/sediment and associated contaminants from reaching receiving waters, thereby improving water quality and substrate conditions.
- Provides reduced clogging of stormwater collection and conveyance systems, improved aesthetics, and improved air quality.

The program expansion would:

- Increase the route coverage from 83 to approximately 85 percent of curbed arterials (for a total 10,600 annual curb-miles), by adding 1 route, for a total of 25 routes
- Increase the sweeping season from 40 to 48 weeks per year
- Increase the sweeping frequency from biweekly to weekly for some routes: 21 routes will be swept on a weekly basis and 4 routes will be swept on a biweekly basis

Percent of total pollutant removal from expanded street sweeping (by receiving water)

Lake Washington	26%
Duwamish Waterway	22%
Lake Union	12%
Puget Sound South	12%
Thornton Creek	10%
Puget Sound Central/Elliott Bay	7%
Ship Canal/Salmon Bay	6%
Longfellow Creek	3%
Puget Sound North	0.8%

Because most existing development and roadways in the city were constructed before stormwater controls were required, runoff from many areas discharges directly to receiving waters without treatment. Retrofitting these existing systems to improve stormwater quality is often difficult and in many cases, retrofitting is not feasible due to physical site constraints (e.g., utility conflicts, grade restrictions, and tidal influence). Street sweeping can provide effective pollutant load reductions in area where retrofitting is impractical. If the Integrated Plan Alternative is selected, the expanded arterial sweeping program would begin in 2016.

More detailed information can be found in *Volume 3, Integrated Plan.*

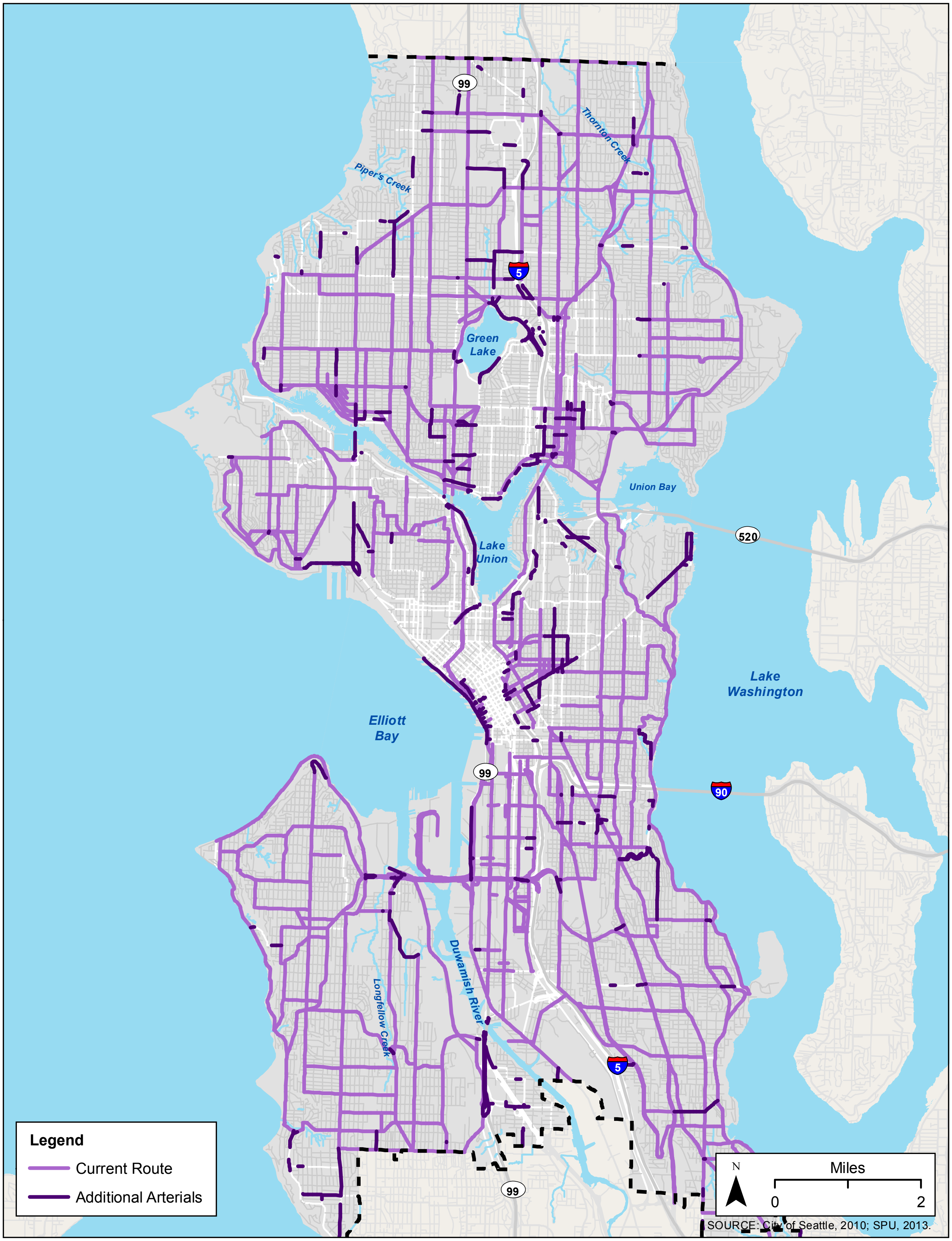


Figure 3-11 Arterial Street Sweeping Expansion.

3.4 Selection of a Preferred Alternative

Foremost in the development of the Plan is the need to comply with the Consent Decree and meet federal and state regulatory requirements. In order to comply with the Consent Decree, the City must select and implement an LTCP option. It is possible that the final option selected may include a combination of options or facilities presented in the EIS. The option that is selected could have some of the smaller elements modified (flow diversions could become storage tanks), but the major control measures (storage tanks or tunnels) would not change.

An Integrated Plan is an optional approach that is not required by EPA, but can be used to satisfy the Consent Decree.

The Plan for Protecting Seattle's Waterways, which consists of the following four volumes, will be submitted to EPA and Ecology for review and comment:

- Volume 1: Executive Summary
- Volume 2: CSO Long Term Control Plan
- Volume 3: Integrated Plan
- Volume 4: Programmatic EIS

The City will also continue to implement a public process and outreach to solicit input from the public and other stakeholders, including input received during a public hearing for the EIS and a public meeting on the Plan. The City will weigh the results of its MODA analysis for the LTCP and the Integrated Plan, address EPA and Ecology comments, and consider costs and input from the public and other stakeholders to identify a preferred alternative. Identification of a preferred alternative is expected to occur in early 2015 following release of the Final EIS.

CHAPTER 4

Affected Environment

The Plan area includes large portions of the city of Seattle in a densely developed urban setting. As a result, the Plan has the potential to affect many elements of the built and natural environment. This chapter identifies important features of the Plan area that could be affected by construction or operation of the implemented Plan.

What is included in this section?

This section includes information on the geology, soils, and groundwater in the Plan area, and their relevance to CSO control and stormwater projects. This section also describes the regulations that apply to these resources.

4.1 Earth and Groundwater

4.1.1 What is the regulatory setting for earth and groundwater?

4.1.1.1 Earth

The City's environmentally critical areas code (Seattle Municipal Code 25.09) regulates development within geologic hazard areas.

Development within these hazard areas is subject to restrictions during design and construction. Development on steep slopes is not permitted in most cases. Environmentally critical areas such as streams and wetlands are discussed in Section 4.4, Biological Resources. The City of Seattle has adopted erosion and sediment control standards for all projects involving land disturbance. The requirements are discussed in Section 4.3, Surface Water.

Geologic hazard areas regulated by the City include:

- Liquefaction-prone areas are susceptible to loss of strength during earthquakes.
- Landslide-prone areas include steep slopes (slopes with grades of 40 percent or greater). Under Seattle's environmentally critical areas ordinance, development on steep slopes is not permitted in most cases.
- Peat settlement-prone areas.
- Seismic hazard areas are subject to ground shaking and impacts from ground displacement.
- Volcanic hazard areas are subject to inundation by mud and debris flows or related flooding resulting from volcanic activity.

4.1.1.2 Groundwater

The Washington State Department of Ecology (Ecology) regulates groundwater quality under the Water Quality Standards for Groundwaters of the State of Washington (Washington Administrative Code 173-200). These standards list the maximum concentrations of contaminants that are allowed in groundwater and prohibit further groundwater contamination.

Construction that requires excavation below the groundwater table typically requires dewatering. Dewatering involves pumping to remove groundwater from the excavated area during construction. Depending on the volume and quality of the groundwater, it may be pumped to a tanker truck or discharged to the sanitary sewer system or other approved discharge location. The City of Seattle regulates dewatering discharges to sewers under Seattle Municipal Code 22.802 through 22.805, and Joint Director's Rule DPD DR 3-2004/SPU DR 02-04. These requirements would apply to construction projects that include temporary groundwater withdrawal or discharge.

4.1.2 What is the geologic setting of the Plan area?

Seattle is situated within the Puget Sound Lowland, a basin located between the Olympic Mountains to the west and the Cascade Range to the east (Troost et al., 2003; Troost and Booth, 2008). Seattle's unique geology results from the movement of materials caused by tectonic, volcanic, glacial, fluvial (river), coastal, and gravity-driven processes, as well as human-induced changes. The range of processes at work creates a degree of geological variation and complexity uncommon in most major cities. This complexity presents serious challenges for construction and development projects. Subsurface conditions may vary greatly and unpredictably over short distances, and project planners frequently must contend with multiple geological concerns for a single project. Seattle Public Utilities Geotechnical Engineering has prepared geotechnical reports for all neighborhoods in the Plan area with the exception of the Central Waterfront neighborhood (SPU 2012a, 2012b, 2012c, 2012d).

4.1.2.1 Which geologic processes have affected the Plan area?

The dominant geological process that contributed to Seattle's current landforms is the repeated cycle of glacial advance and retreat. At least seven glaciations have impacted the Seattle area within the last 2.4 million years (Troost and Booth, 2008) leaving behind complex geologic materials, in addition to eroding, reworking, and burying evidence of previous glaciations.

Seismic processes have also affected the Plan area, which is in a seismically active region located near the Cascadia Subduction Zone, a collision boundary where the Juan de Fuca tectonic plate dives beneath the North American plate. Of six known surface faults within Puget Sound, the Seattle Fault Zone is of particular relevance because Seattle sits astride this fault. This east-west trending fault runs roughly parallel to Interstate 90 from southern Bainbridge Island, through south Seattle, across Lake Washington, and into the Bellevue area and beyond (Figure 4-1).

4.1.3 What groundwater resources are present in the Plan area?

Depth to groundwater in the Plan area varies depending on the specific location. Numerous areas with shallow groundwater are present, as evidenced by springs that emerge from hillsides throughout the city. Information on groundwater depth in a particular area may be available from borings conducted for other development projects. Detailed information about the quantity and quality of groundwater in the Plan area is unavailable.

Groundwater quality in the Plan area is affected by historical and current releases of contaminants. Existing groundwater contamination sites are discussed in Section 4.6, Environmental Health and Public Safety.

4.1.4 How can geologic hazards affect facility construction and operation?

The presence of geologic hazards can affect the siting, design, construction, and operation of CSO and stormwater facilities. Geologic hazards in the Plan area are illustrated in Figure 4-1 and summarized as follows:

- Areas with loose, saturated soils that are prone to liquefaction present challenges for construction. These types of soils can shift or settle over time, causing problems for facilities built on them. Areas containing peat are prone to compression and can also settle following construction.
- Steep slopes that are prone to landslides can also have a high potential for erosion, particularly if vegetation is disturbed, causing problems during and after construction. Eroded sediment can also enter water bodies and degrade aquatic habitats.
- Areas containing artificial fill or lands substantially modified by humans may be challenging due to adverse or unpredictable soil characteristics. The construction potential of artificial fill depends on

technique and material type of the fill. Fill that is unsuited to construction may need to be removed or remediated to prevent problems such as settlement or expansion.

- Areas that have impermeable soils or extensive impervious paved surfaces are more susceptible to accumulating large volumes of water, which can create excessive runoff that results in flooding or other related problems.

4.1.5 How does surface geology affect natural drainage systems?

Natural drainage systems, described in Chapter 3, generally require soils that allow rain to infiltrate the ground rather than accumulating on the surface. The permeability of the soil directly affects infiltration rates. Permeability is a measure of a soil's ability to transmit water (and air) and depends on several factors including soil texture, soil structure, and compactness. Generally speaking, soils with higher proportions of fine-grained sediments such as clay and silt have less space between the soil particles and are less permeable than soils with more coarse-grained sediments such as sand and gravel. Soils that have been compacted (beneath the massive weight of glacial ice, for example) also have less space between soil particles and tend to be less permeable than uncompacted soils.

Figure 4-2 shows estimated soil infiltration characteristics based on mapped geological units (Troost and Booth, 2008). Areas with low potential infiltration, steep slopes, peat deposits, and near-surface groundwater present potential challenges for natural drainage systems. Areas with moderate infiltration potential, mostly glacial till, may have infiltration characteristics unsuitable for some types of natural drainage systems. Areas of high infiltration potential include zones of Vashon advance outwash, Vashon recessional outwash, and most other Holocene geological units.

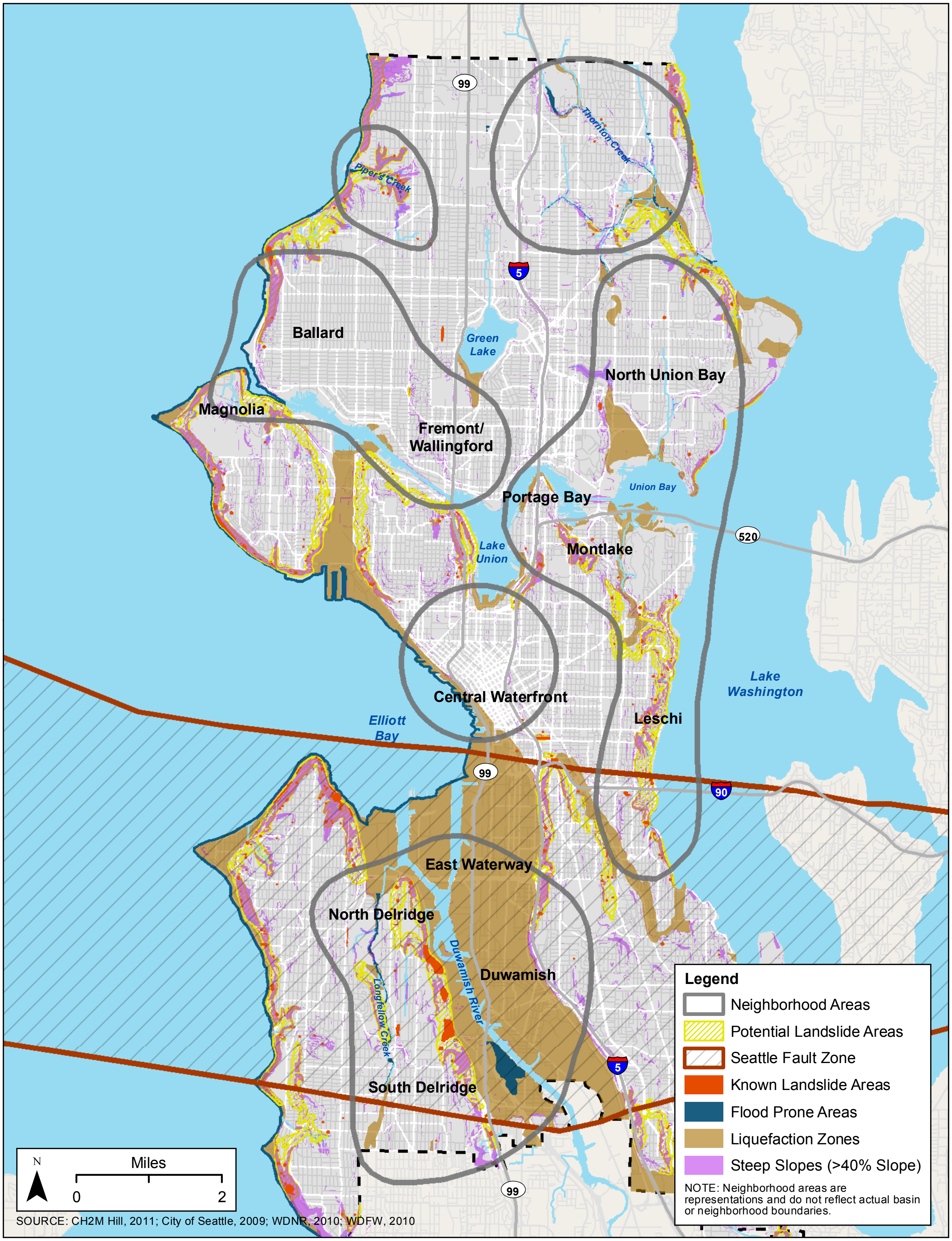


Figure 4-1 Geologic and Flood Hazard Areas.

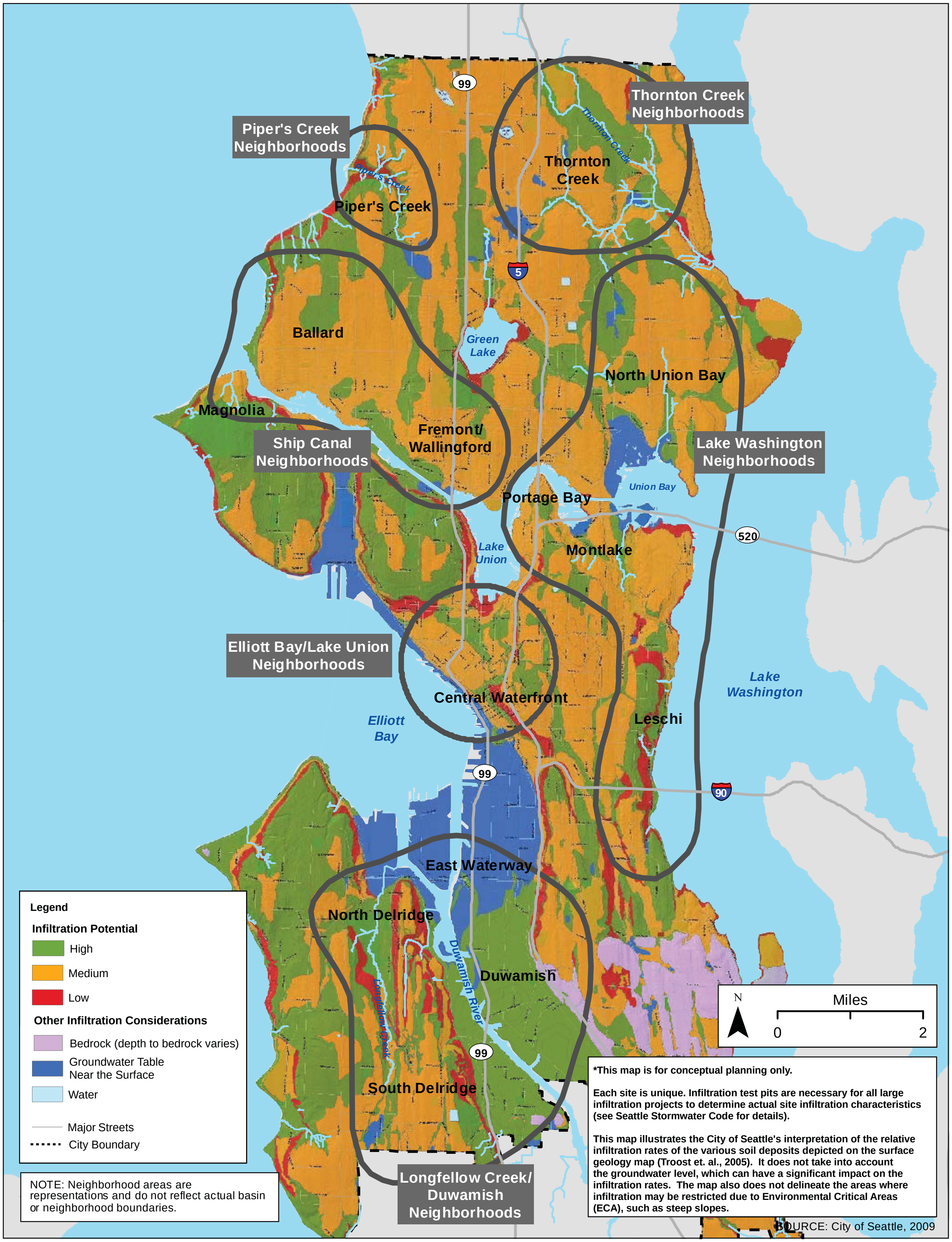


Figure 4-2 Groundwater Infiltration Potential.

4.1.6 How does groundwater affect construction?

The presence of a high groundwater table means that dewatering would likely be necessary during construction. The amount of dewatering required depends upon the depth and duration of construction activities. Because there are many underground storage tanks and known leaking underground storage tanks throughout the Plan area, there is a potential for encountering contaminated groundwater. Contaminated groundwater poses a risk to worker safety and requires approved treatment and disposal methods. Shallow groundwater could also constrain the ability to implement natural drainage systems that rely on infiltration.

4.1.7 What geologic hazards or limitations are present in Plan neighborhoods?

Table 4-1 summarizes the geologic hazards present in Plan neighborhoods.

Table 4-1. Summary of Geologic Hazards and Limitations in Plan Neighborhoods

Neighborhood	Geologic Hazards or Limitations
Ship Canal Neighborhoods	
Ballard Magnolia	• Steep slopes and landslide potential on the periphery are challenges to construction and operation. • Areas of fill may require removal or remediation. • Most of area has low potential infiltration because of glacial till. • Commercial/industrial areas near the Ship Canal have a high potential for encountering contaminated groundwater sites due to historic activity and known leaking underground storage tanks.
Fremont/Wallingford	• Relatively few construction/operation hazards, apart from liquefaction risk south of Green Lake. • Large areas of glacial till limit the potential for infiltration. • Commercial/industrial areas near the Ship Canal have a high potential for encountering contaminated groundwater sites due to historic activity and known leaking underground storage tanks.
Lake Washington Neighborhoods	
Leschi	• Steep, landslide-prone slopes overlooking Lake Washington. • Location atop Seattle Fault Zone puts area at risk for shallow crustal earthquake and surface rupture. • Infiltration potential limited in some areas due to steep slopes.
Montlake	• Substantial steep slope/landslide-prone area in south and west. • Small area of liquefiable peat soil at Lake Union. • Infiltration limited by widespread glacial till.
North Union Bay	• Liquefiable peat soils in Union Bay Natural Area. • Steep slopes in Ravenna Park and above Matthews Beach. • Area of liquefiable soil at Lake Washington. • Reduced infiltration potential due to glacial till.
Portage Bay	• Relatively limited hazard areas apart from steep slopes. • Reduced infiltration potential due to presence of lower permeability glacial sediments.

Table 4-1. Summary of Geologic Hazards and Limitations in Plan Neighborhoods	
Neighborhood	**Geologic Hazards or Limitations**
Longfellow Creek/Duwamish Neighborhoods	
Delridge	• Multiple areas presenting construction and operation challenges including extensive steep slope/landslide-prone areas, artificial fills, peat, and liquefiable soils along Duwamish River and Longfellow Creek. • Location atop Seattle Fault Zone puts area at risk for shallow crustal earthquake and surface rupture. • High groundwater; high infiltration potential farther to the south of this area.
Duwamish/East Waterway	• Extensive hazard areas including steep slope/landslide-prone areas along western flank of Beacon Hill, and liquefiable artificial fill and peat soils west of Beacon Hill in the Industrial District. • Location atop Seattle Fault Zone puts area at risk for shallow crustal earthquake and surface rupture. • Low-lying Industrial District has high groundwater. • Industrial areas have a particularly high concentration of known contaminated sites, so there is a high potential to encounter contaminated groundwater in this area.
Elliott Bay/Lake Union Neighborhoods	
Central Waterfront	• Extensive areas with artificial fill and regraded soils that are highly susceptible to liquefaction. • Widespread presence of impervious paved surfaces preventing infiltration. • Due to historic activity and high concentration of known leaking underground storage tanks in this area, there is a high potential to encounter contaminated groundwater.
Piper's Creek Neighborhoods	
	• Liquefaction area in Carkeek Park. • Extensive steep slope areas, potential slide areas, and known slide areas throughout the neighborhood.
Thornton Creek Neighborhoods	
	• Potential and known slide areas along Lake Washington and in the Meadowbrook and Maple Leaf areas of the neighborhood. Additional known slide areas near NE 125th Street and 15th Ave NE. • Liquefaction areas in Meadowbrook area and in/near Jackson Park Golf Course. • Steep slope areas throughout neighborhood, especially near Lake Washington.

4.2 Air Quality and Odors

4.2.1 What is the regulatory setting for air quality?

What is included in this section?

This section describes the regulations governing air quality, general air quality in the Puget Sound region, and potential sources of odor from CSO reduction and stormwater projects.

The federal Clean Air Act defines the Environmental Protection Agency's (EPA's) responsibilities for protecting and improving the nation's air quality. Under the Clean Air Act, EPA sets limits on certain air pollutants, including how much pollution can be present in the air anywhere in the United States.

In Washington State, responsibility for implementing the Clean Water Act has been delegated to the Washington State Department of Ecology. Locally, air quality is monitored by the Puget Sound Clean Air Agency (PSCAA), a separate organization with jurisdiction over King, Kitsap, Pierce, and Snohomish Counties. The PSCAA works in cooperation with EPA and Ecology and also implements specific air quality requirements such as dust control.

EPA has set federal standards for six "criteria air pollutants." These criteria air pollutants include fine and coarse particulate matter, ozone, carbon monoxide, sulfur dioxide, nitrogen dioxide, and lead. PSCAA and Ecology monitor and regulate levels of these pollutants to ensure the region meets federal air quality standards.

4.2.2 Why is air quality a concern?

Construction of major facilities can generate particulates, carbon monoxide, and ozone-creating compounds, which can be of concern to air quality.

- Dust, dirt, soot, and smoke are all considered "particulate matter." These materials are easily inhaled into the lungs and pose a host of serious health effects. They represent the most important criteria air pollutant challenge facing the region.
- Carbon monoxide is a colorless, odorless, toxic gas commonly formed when carbon-containing fuel is not burned completely. Motor vehicles are the main source of carbon monoxide in the Puget Sound region.
- Ozone is a pungent-smelling, colorless gas produced in the atmosphere when nitrogen oxides and volatile organic compounds chemically react under sunlight. The highest ozone levels occur on hot summer afternoons.

The other three of the six criteria pollutants are sulfur dioxide, nitrogen dioxide, and lead.

- Sulfur dioxide is a colorless, corrosive gas produced by burning fuels containing sulfur such as coal and oil. It is also created by industrial processes such as smelters, paper mills, power plants, and steel manufacturing plants.
- Nitrogen dioxide is a reddish brown gas that comes from motor vehicles. Other sources include industrial boilers and processes, home heaters, and gas stoves.
- Lead is a highly toxic metal that was used for many years in household products, automobile fuel, and industrial chemicals. Since the phase-out of lead in fuel and the closure of the Harbor Island lead smelter, airborne lead is no longer a public health concern in the Puget Sound region.

4.2.3 What about odors?

The major sources of odors in the Plan area include vehicle emissions, industrial discharges, and rail-related emissions. Vehicle exhaust fumes consist largely of carbon monoxide and sulfur compounds, and they are most noticeable during peak traffic hours on major roadways.

Odors are also generated by wastewater facilities. Odorous compounds in municipal wastewater systems consist mainly of reduced sulfur and nitrogen-based compounds including hydrogen sulfide, methyl mercaptan, and ammonia. The parts of a CSO system that can create odors include wastewater pipelines, maintenance holes, pump stations, storage facilities, and outfalls. Wet weather results in significant inflows of stormwater to the combined sewer system. This stormwater dilutes the concentration of sulfur and nitrogen compounds in wastewater, lowers the temperature, and increases the velocity through the conveyance system. These factors reduce the potential for significant odors. However, long conveyance distances or increased storage times may cause stagnation, oxygen deprivation, and accompanying odors in wastewater facilities.

4.2.4 What is the existing air quality in the Plan area?

According to PSCAA (2012), air quality in King County was generally good in 2012 (the year with the most recent published data). The air quality index rating in King County was “good” for 86 percent of the year, “moderate” for 13 percent of the year, and “unhealthy for sensitive groups” 1 percent of the year. However, the Puget Sound area as a whole is designated as a maintenance area for carbon monoxide. A pollutant associated with motor vehicle emissions, carbon monoxide is further controlled in many urban areas through air quality conformity regulations.

4.3 Surface Water

4.3.1 What are the regulations that govern surface water?

The overarching regulatory driver governing surface water is the federal Clean Water Act, which has resulted in water quality standards for surface water bodies. In Washington State, these regulations are implemented by the Washington Department of Ecology, including standards and limits for discharges into surface waters of the state.

The Clean Water Act serves as the overall legal and regulatory framework for CSO management, as described in Chapter 1. The Clean Water Act resulted in the adoption of EPA’s Combined Sewer Overflow Policy in 1994. The LTCP has been prepared consistent with the requirements of EPA’s Combined Sewer Overflow Policy.

Table 4-2 briefly describes state and local regulations for water quality, and permits for discharges to surface waters in the Plan area.

What is included in this section?

This section describes surface water resources in the Plan area with a focus on water quality. The section includes a summary of the regulatory setting for surface water, and a description of Plan area water bodies and existing water quality.

Table 4-2. Surface Water Related Regulations and Permits		
Statute	**Lead Agency**	**Regulated Activities**
State of Washington		
Water Quality Standards for Surface Waters of Washington State	Ecology	Standards for surface water quality in Washington State are established by Ecology (WAC 173-201A). The purpose of the standards is to identify designated beneficial uses, establish specific criteria, and establish policies for anti-degradation to protect the state's surface water bodies.
Clean Water Act Section 401 Water Quality Certification	Ecology	Actions subject to federal permits that result in pollutant discharge must obtain a water quality certification demonstrating that the action complies with all applicable water quality standards.
Construction Stormwater NPDES* General Permit	Ecology	Required for construction activities that disturb 1 acre or more of land and discharge stormwater to surface waters. Requires implementation of a stormwater pollution prevention plan, water quality monitoring, and record keeping and reporting protocols.
Phase I Municipal Stormwater NPDES* Permit	Ecology	The City of Seattle is covered under the Phase I municipal stormwater NPDES permit issued in June 2012 (Ecology, 2012b). Authorizes stormwater and in some cases other discharges to surface water and groundwater. The City is required to establish and implement a comprehensive stormwater management program, including regulations for development projects. Compliance with the City's stormwater code (and accompanying technical manuals for stormwater flow control and treatment) and construction stormwater controls ensure that projects meet the requirements of the Phase I municipal stormwater NPDES permit.
City of Seattle		
SMC 22.800 Stormwater Code (SMC 22.800) and Stormwater Manual (2009)	City of Seattle	Specifies stormwater treatment and flow control requirements for new and redevelopment projects and requirements for protecting water resources during construction. New and redevelopment projects not discharging to the combined sewer system that create or replace more than 5,000 square feet of pollution-generating impervious surface must provide stormwater treatment for pollution-generating pervious and impervious surfaces on the site. All projects are required to use green stormwater infrastructure to the maximum extent feasible. Oil control is required for stormwater runoff from targeted areas subject to heavy traffic usage.

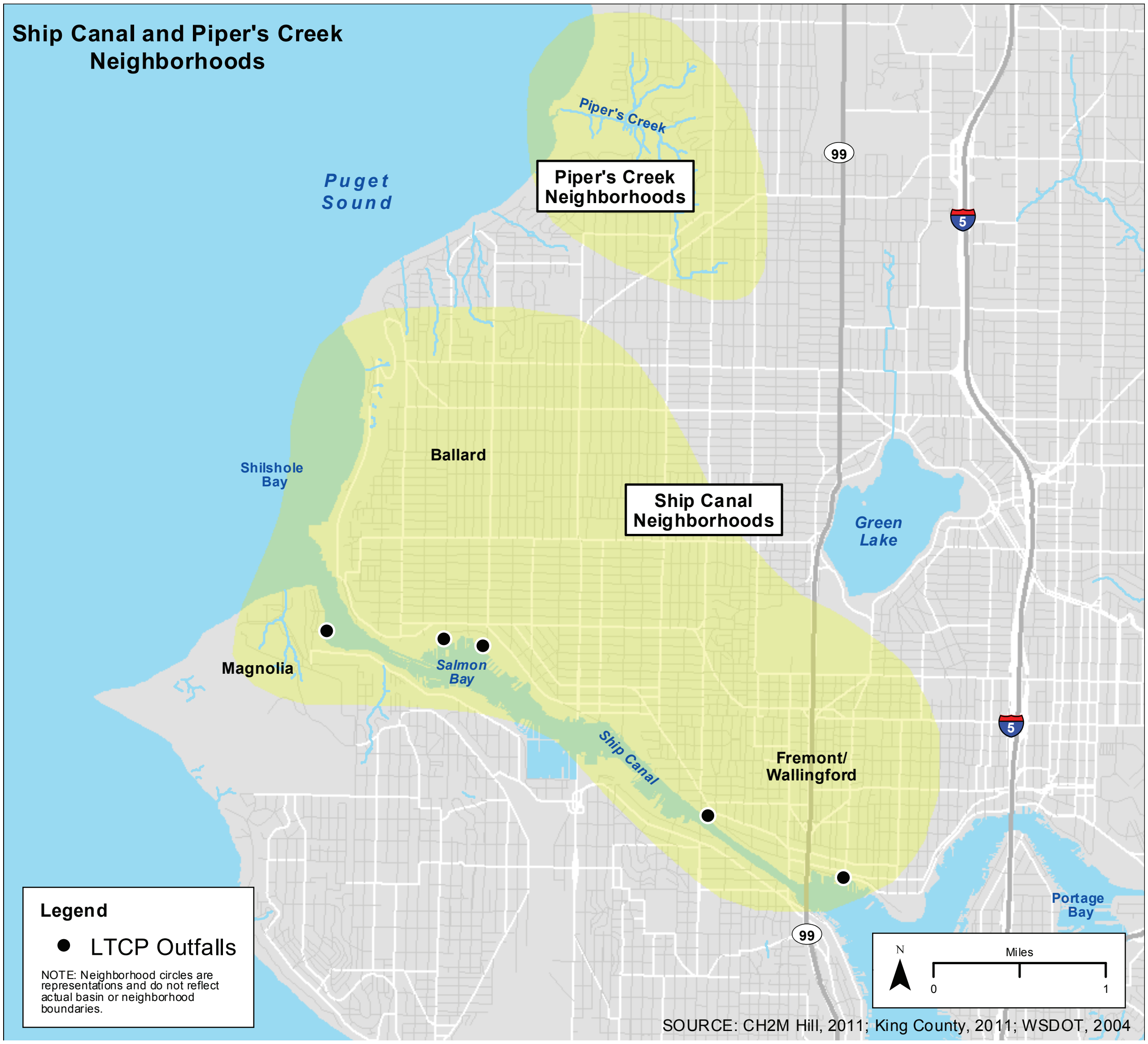
* National Pollutant Discharge Elimination System

4.3.2 What are the surface water resources within the Plan area?

Water bodies in the Plan area neighborhoods include Puget Sound, Elliott Bay, Lake Washington and the Ship Canal, Lake Union, the Duwamish River, Longfellow Creek, Piper's Creek, and Thornton Creek. The receiving water bodies in the Plan area are described below and illustrated in Figures 4-3 through 4-6, Biological Resources. Stormwater discharges to these water bodies are regulated under the municipal stormwater NPDES permit.

The City's Stormwater Code classifies all receiving waters in the Plan area except Longfellow Creek as Designated Receiving Waters. New development does not require flow control protection for stormwater runoff because these water bodies have sufficient capacity to receive discharges without causing flooding or physical damage. Stormwater discharges to Longfellow Creek are expected to meet the pre-developed "pasture" standard. All stormwater discharges to the combined sewer system are required to meet the peak control standard established by the City's stormwater manual. Treatment is required for stormwater runoff that doesn't involve discharge to the combined sewer system. All projects are required to use green stormwater infrastructure to the maximum extent feasible.

Additional detail about surface waters in the Plan area is included in Chapter 2 of *Volume 3, Integrated Plan*.



Puget Sound

Aquatic Use Classification:
Extraordinary

Recreation Classification:
Primary Contact

Overall Water Quality:
Good

Maximum Temperatures:
9.6 – 14.5 °C

Minimum DO:
2.5 – 8.1 mg/L

Impaired 303d Category 5 List at LTCP Outfalls:
Fecal coliform (Outfalls 57, 59)

Ship Canal/Lake Union

Aquatic Use Classification:
Core Summer Habitat

Recreation Classification:
Extraordinary Primary Contact

Overall Water Quality:
Fair

Maximum Temperatures:
20.6 – 23.3 °C

Minimum DO:
7.3 – 9.3 mg/L

Impaired 303d Category 5 List at LTCP Outfalls:
Fecal coliform, total phosphorus, lead, aldrin (Outfalls 20,138, 139, 140)

Piper's Creek

Aquatic Use Classification:
Core Summer Habitat

Recreation Classification:
Extraordinary Primary Contact

Overall Water Quality:
Fair

Maximum Temperatures:
13.0 – 16.0 °C

Minimum DO:
7.5 – 10.3 mg/L

Impaired 303d Category 5 List at LTCP Outfalls:
None (no Outfalls)

SOURCE: Ecology, 2013b.

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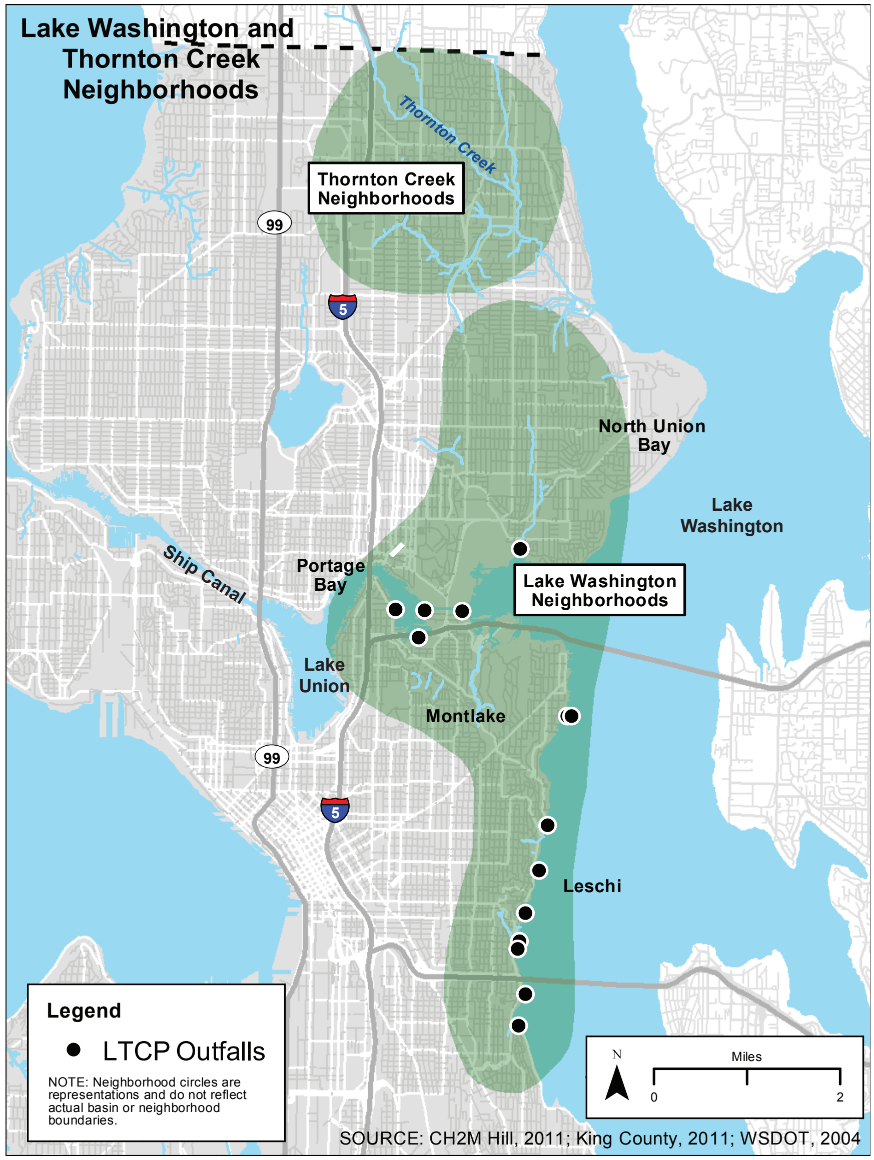
Figure 4-3. Ship Canal Neighborhoods - Surface Water Quality.



Thornton Creek

Aquatic Use Classification:
Spawning/Rearing

Recreation Classification:
Primary Contact

Overall Water Quality:
Fair

Maximum Temperatures:
15.0 – 17.6 °C

Minimum DO:
7.3 – 9.1 mg/L

Impaired 303d Category 5 List at LTCP Outfalls:
Temperature, dissolved oxygen (No Outfalls), fecal coliform

Ship Canal/Lake Union

Aquatic Use Classification:
Core Summer Habitat

Recreation Classification:
Extraordinary Primary Contact

Overall Water Quality:
Good

Maximum Temperatures:
20.6 – 23.3 °C

Minimum DO:
7.3 – 9.3 mg/L

Impaired 303d Category 5 List at LTCP Outfalls:
Fecal coliform, total phosphorus, lead, aldrin (Outfalls 20,138, 139, 140)

Lake Washington

Aquatic Use Classification:
Core Summer Habitat

Recreation Classification:
Extraordinary Primary Contact

Overall Water Quality:
Good

Maximum Temperatures:
20.9 – 23.6 °C

Minimum DO:
7.3 – 9.1 mg/L

Impaired 303d Category 5 List at LTCP Outfalls:
Fecal coliform (Outfall 36)

SOURCE: Ecology, 2013b.

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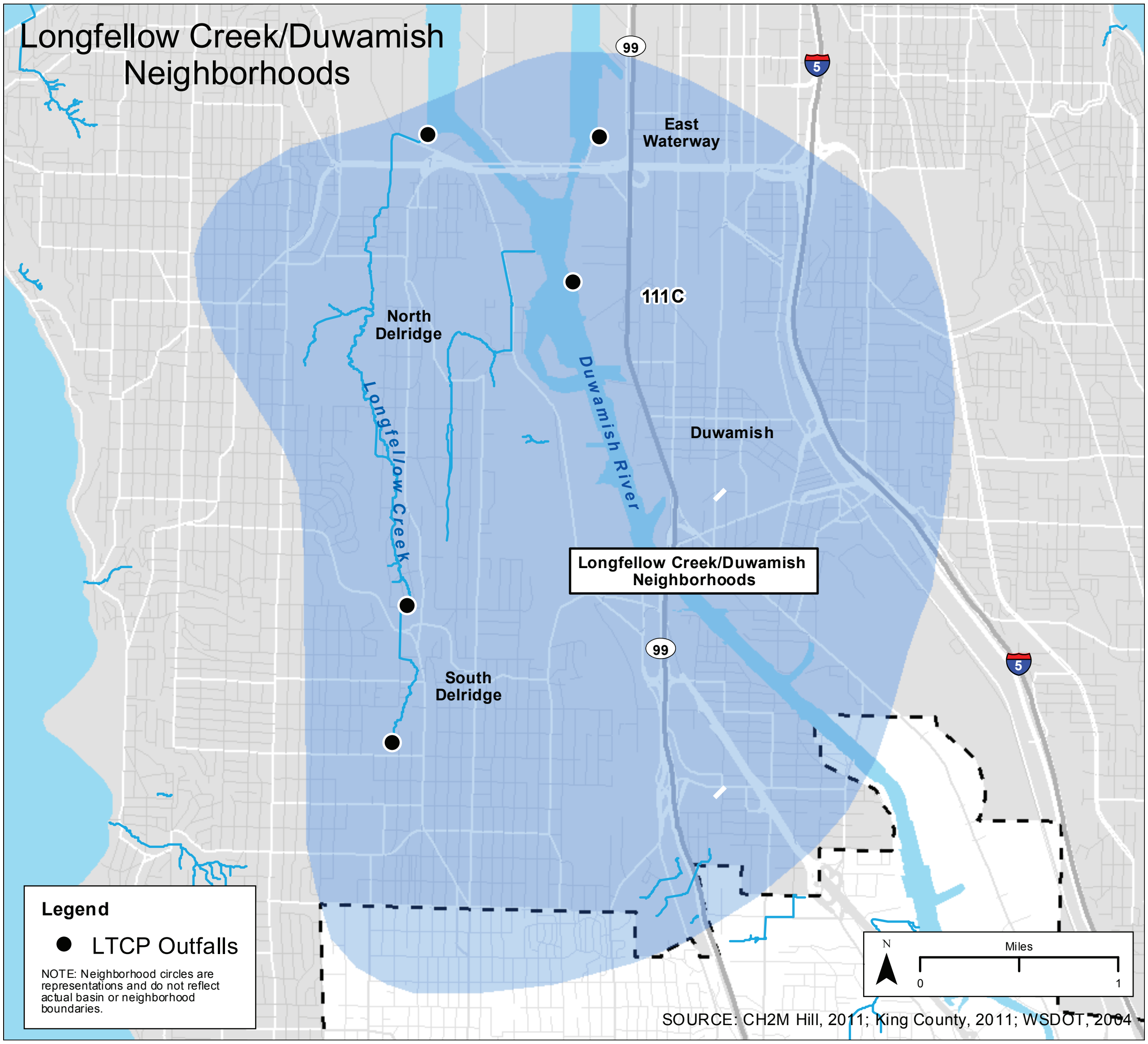
Figure 4-4. Lake Washington Neighborhoods - Surface Water Quality.



Longfellow Creek

Aquatic Use Classification:
Spawning/Rearing

Recreation Classification:
Primary Contact

Overall Water Quality:
Moderate

Maximum Temperatures:
12.0 – 19.2 °C

Minimum DO:
6.5 – 9.1 mg/L

Impaired 303d Category 5 List at LTCP Outfalls:
Fecal coliform, dissolved oxygen (Outfall 168, 169)

Duwamish River

Aquatic Use Classification:
Rearing/Migration Only

Recreation Classification:
Secondary Contact

Overall Water Quality:
Good

Maximum Temperatures:
17.0 – 23.2 °C

Minimum DO:
5.9 – 8.1 mg/L

Impaired 303d Category 5 List at LTCP Outfalls:
Fecal coliform, dissolved oxygen, tissue PCBs (Outfall 99); sediment bioassay (Outfall 111)

SOURCE: Ecology, 2013b.

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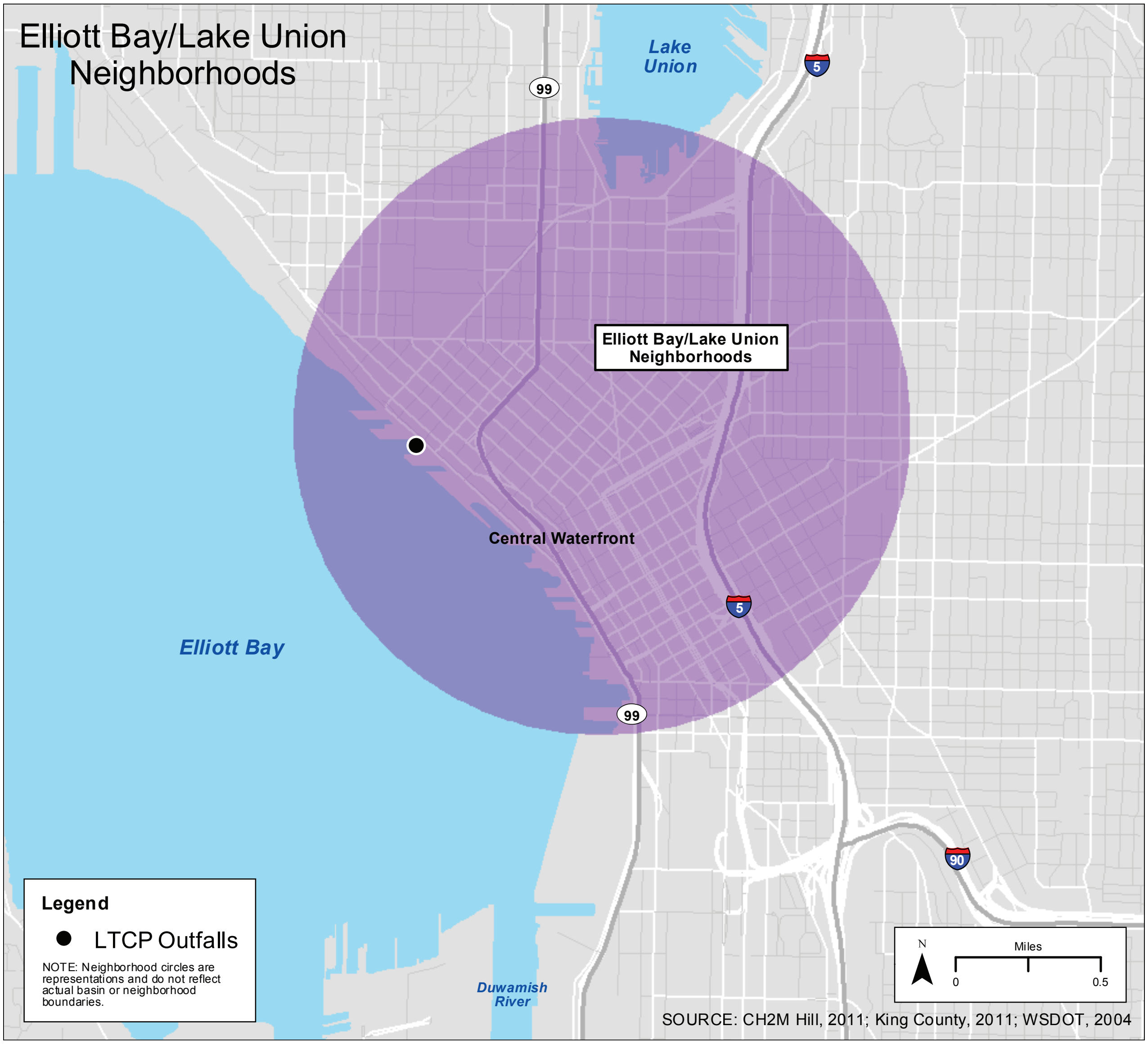
Figure 4-5. Longfellow Creek/Duwamish Neighborhoods - Surface Water Quality.



Elliott Bay

Aquatic Use Classification:
Excellent

Recreation Classification:
Primary Contact

Overall Water Quality:
Good

Maximum Temperatures:
13.1 – 16.2 °C

Minimum DO:
5.8 – 8.0 mg/L

Ilmpaired 303d Category 5 List at LTCP Outfalls:
Fecal coliform (Outfalls 70, 71, 72); sediment bioassay (Outfalls 71, 72)

Lake Union

See Figure 4-3

SOURCE: Ecology, 2013b.

Figure 4-6. Elliott Bay/Lake Union Neighborhoods - Surface Water Quality.

4.3.2.1 Puget Sound

Puget Sound is a fjord-like estuary that stretches from Hood Canal to north of Admiralty Inlet. Freshwater flows influence water circulation in this portion of Puget Sound. Two main freshwater bodies flow into Puget Sound in the Plan area, the Green/Duwamish River, which enters Elliott Bay, and the Cedar River (Lake Washington drainage basin), which flows into the Sound through Lake Washington and the Ship Canal.

4.3.2.2 Elliott Bay

Elliott Bay is a partially enclosed embayment that is bordered on the north, east, and south sides by urbanized areas of Seattle and by Puget Sound on the west. The eastern shoreline borders the Elliott Bay/Lake Union Neighborhoods. The southern portion of Elliott Bay near the Longfellow Creek/Duwamish Neighborhoods is heavily altered by industrial facilities including Harbor Island.

4.3.2.3 Lake Washington

Lake Washington is bordered on the west by the Lake Washington Neighborhoods. The Lake Washington drainage system has been highly altered and now drains through the Lake Washington Ship Canal rather than its historical outlet through the Duwamish River (Chrzastowski, 1983). Most of the lake shoreline in the Plan area is developed for residential uses. Lake levels are regulated by the Corps of Engineers through operation of the Lake Washington Ship Canal (Corps of Engineers, 2012a, 2012b).

4.3.2.4 Ship Canal/Lake Union

The Lake Washington Ship Canal system is an 8.6-mile-long navigable waterway, completed in 1934, connecting Shilshole Bay in Puget Sound to Union Bay in Lake Washington. The Ship Canal includes several interconnected waterways—Hiram M. Chittenden Locks (Ballard Locks), Salmon Bay, Salmon Bay Waterway, Fremont Cut, Lake Union, Portage Bay, and Montlake Cut. The Ship Canal borders the Ship Canal Neighborhoods on the west end and the Lake Washington Neighborhoods on the east end. Lake Union is a freshwater lake that receives most of its inflow from Lake Washington via the Montlake Cut and Portage Bay.

4.3.2.5 Duwamish River

The Duwamish River originates at the confluence of the Green and Black Rivers near Tukwila and flows northwest for approximately 12 miles, splitting at the southern end of Harbor Island to form the East and West Waterways before discharging into Elliott Bay. The Duwamish River flows through the Longfellow Creek/Duwamish Neighborhoods. The downstream portion of the Duwamish River serves as a major shipping route for bulk and containerized cargo. A portion of the lower Duwamish River is maintained as a federal navigation channel by the Corps of Engineers.

4.3.2.6 Longfellow Creek

Seattle's second largest watershed, the Longfellow Creek basin, is located in West Seattle in the Delridge area. The creek is 4.6 miles long and drains to the Duwamish River near Harbor Island through a 3,250-foot culvert (SPU, 2007). Approximately one-third of the main channel length is piped.

4.3.2.7 Thornton Creek

Thornton Creek and its many tributaries flow through the northeast part of Seattle, forming the city's largest watershed. The creek flows adjacent to the northern boundary of the North Lake Union area and drains to Lake Washington at Matthews Beach Park. Some of the stream flows through culverts, but a section in the Northgate area has been daylighted in recent years.

4.3.2.8 Piper's Creek

Piper's Creek is located in Carkeek Park in northwest Seattle and flows directly to Puget Sound. The mainstem of the creek is approximately 2 miles long, including the major tributary Venema Creek. Additional smaller tributaries drain into the park from an upland plateau.

4.3.3 What is the water and sediment quality of Plan area water bodies?

Ecology has established beneficial uses for each water body in the Plan area. Use designations differ for marine and fresh waters (Figures 4-3 to 4-6). Aquatic life use is rated higher in Puget Sound (extraordinary) than Elliott Bay (excellent). These marine water bodies are both designated for shellfish harvesting and primary contact recreation (such as swimming), although shellfish harvesting is prohibited for all marine beaches in Seattle due to potential contamination by fecal bacteria and other pollutants. Aquatic life and recreational uses for the freshwater bodies are highest (core summer habitat and extraordinary primary contact) for Lake Washington, Ship Canal/Lake Union, the small lakes, and all streams draining to lakes, followed by Longfellow Creek (spawning/rearing and primary contact), and the Duwamish River (rearing/migration and secondary contact). All freshwater bodies are designated for water supply uses with the exception that the Duwamish River is not designated for domestic water supply.

Water quality standards developed by Ecology under the Washington Administrative Code 173-201A set limits that are intended to protect aquatic life and recreational uses. The standards depend on the specific use designation for each water body, and they vary for fresh waters (streams, rivers, and lakes) and marine waters (Ecology, 2012a). Numeric standards are established for conventional parameters (common pollutants such as high temperature, low dissolved oxygen, pH, and turbidity), some toxic substances (mostly metals and some organic chemicals), and fecal bacteria.

Under Section 303(d) of the Clean Water Act, Ecology is required to prepare a water quality assessment and develop a list of surface waters (marine and fresh water) that are impaired. This list is periodically prepared by Ecology and submitted to EPA for review and approval. The Section 303(d) list identifies five categories of water quality impairments:

- Category 1 – meets tested standards for clean waters
- Category 2 – waters of concern
- Category 3 – insufficient data
- Category 4 – polluted waters that do not require the establishment of a total maximum daily load (TMDL) for targeted pollutant(s) to allow the achievement of the surface water quality standards
- Category 5 – polluted waters that require a TMDL program to establish maximum allowable pollutant discharges (Ecology, 2014)

Figure 4-7 summarizes water quality characteristics from Ecology's 2008 303(d) list including any impaired water bodies classified as Category 4 or Category 5 waters. The primary pollutants of concern in surface water bodies of the Plan area include bacteria, nutrients such as nitrogen and phosphorus, and toxic constituents such as metals and organic compounds. When concentrations of these pollutants exceed water and sediment quality standards, they may impair aquatic life and recreational uses. Additional information on water and sediment quality is included in Chapter 2 of *Volume 3, Integrated Plan*.

4.3.3.1 Marine Water Quality

Puget Sound waters are classified as extraordinary and Elliott Bay waters are classified as excellent under Washington Administrative Code 173-201A. In general, the overall water quality in Puget Sound and Elliott Bay is good based on water quality parameters such as bacteria, nutrients, temperature, chlorophyll, dissolved oxygen, solids, and transparency. However, fecal coliform bacteria have exceeded allowable levels in some areas of these marine waters that are included on the 303(d) list of impaired waters.

Water quality in the Duwamish River is good based on the water quality index of conventional parameters, and presents no risk to aquatic life based a low level of risk from harmful chemicals (Figure 4-5) (King County, 2009). The Duwamish River is included on Ecology’s 303(d) list as containing several areas of impaired waters for fecal coliform bacteria, dissolved oxygen, and ammonia.

4.3.3.2 Fresh Water Quality

King County has characterized water in the Ship Canal and Lake Union as fair for most parameters important to fish and wildlife (temperature, dissolved oxygen, pH, and nutrients) and to humans (fecal coliform bacteria) (Figures 4-3 and 4-4). The water in these areas is flushed rapidly with good quality outflow from Lake Washington. Some areas are on the 303(d) list for total phosphorus, fecal coliform bacteria, lead, or aldrin.

The water in Lake Washington is characterized as having good quality for most parameters important to fish and wildlife (temperature, dissolved oxygen, pH, nutrients, and metals) and to humans (fecal coliform bacteria) (Figure 4-4) (King County 2009). However, water quality is considered to be impaired for fecal coliform bacteria in some areas of the lake.

Longfellow Creek has fair water quality based on the water quality index of conventional parameters. The creek has a number of water quality problems, including nitrogen and phosphorus concentrations, bacteria and metal concentrations in storm flow, dissolved oxygen, temperature, and fecal coliform bacteria (Figure 4-5). Thornton Creek has poor water quality, primarily due to elevated levels of fecal coliform bacteria. Piper's Creek is also rated as fair based on the water quality index. Water quality impairments include fecal coliform bacteria (Longfellow, Thornton, and Piper’s Creeks), temperature (Thornton Creek), and dissolved oxygen (Longfellow and Thornton Creeks).

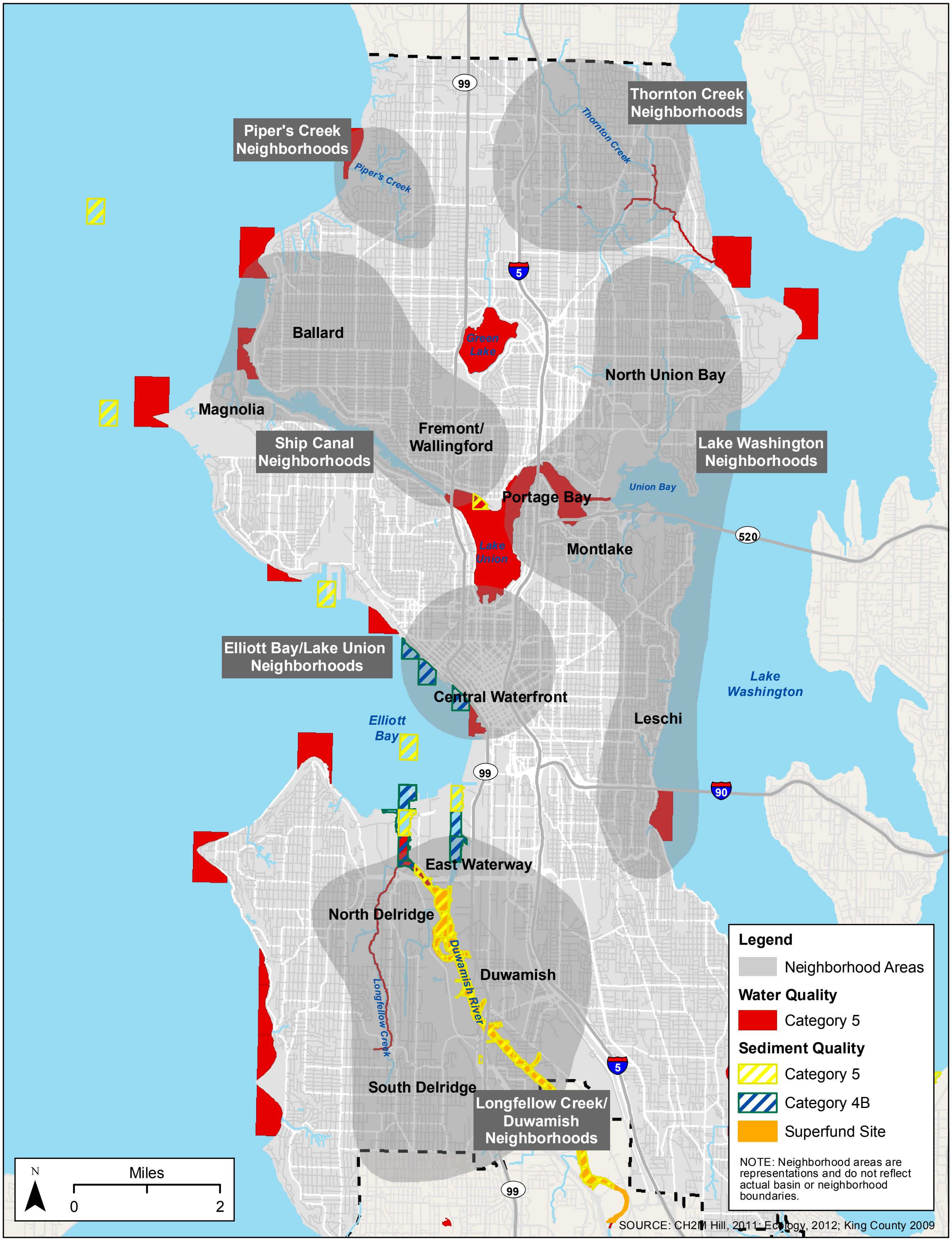


Figure 4-7 Water Quality and Sediment Quality (303(d)) & 305(b)).

4.3.3.4 Sediment Quality

King County characterizes sediment quality as good in Lake Washington, poor in Lake Union and Duwamish River, and fair or not rated in the remaining water bodies (King County, 2012b). Figure 4-7 illustrates the water bodies that are listed on the Ecology 303(d) list for having polluted sediments.

The lower Duwamish Waterway is listed as a Superfund site under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and as a Model Toxics Control Act (MTCA) site (Ecology, 2013c). The CERCLA and MTCA listings are for bottom sediments that contain elevated concentrations of polychlorinated biphenyls (PCBs), carcinogenic polycyclic aromatic hydrocarbons (CPAHs), arsenic, dioxins, and furans.

Sediment quality data for streams and small lakes include a limited amount of data for Thornton Creek (SPU, 2007). Sediment quality is rated as a potential problem caused by occasional exceedances of freshwater sediment guidelines for organic chemicals and the pesticide derivative DDE.

4.3.4 What are the sources of surface water pollutants in the Plan area?

Stormwater runoff is the leading pollution threat to surface waters. The primary contaminants in stormwater are bacteria, nutrients, sediment, and toxic chemicals (Ecology, 2011). Other pollution sources include CSOs, groundwater, wastewater treatment plants, and direct air deposition (Ecology and King County, 2011). Additional detail about contaminants in stormwater and CSOs, along with annual discharge volumes, is included in Chapter 6, *Volume 3, Integrated Plan.*

4.4 Biological Resources

4.4.1 What is the regulatory setting for biological resources?

What is included in this section?

This section describes the distribution and habitat conditions for fish, aquatic resources, and terrestrial plants and animals in the Plan area. This section also describes regulations aimed at protecting biological resources. Section 4.3 describes surface water resources and water quality issues that affect aquatic habitats.

A number of federal, state, and local regulations and permits relate to the protection of fish, aquatic resources, plants, and animals (Table 4-3). Projects that involve federal funding or permits from a federal agency trigger the need to comply with federal regulations. The Plan itself does not trigger federal regulations, but individual projects implemented under the Plan could be required to comply depending on their funding sources and permitting requirements.

Table 4-3. Regulations and Permits for Biological Resources

Statute	Lead Agency	Regulated Activities
Federal		
Endangered Species Act	National Marine Fisheries Service (NMFS) and U.S. Fish and Wildlife Service (USFWS)	Protects species identified as endangered or threatened along with critical habitat required for the conservation of those species. NMFS has authority over anadromous fishes, marine mammals, marine reptiles, and other fish species, while the USFWS has authority over terrestrial wildlife and resident fish species that inhabit inland waters. Requires that federal actions do not jeopardize the continued existence of any threatened, endangered, or proposed species or result in the destruction or adverse modification of critical habitat. To comply with the Act, project proponents are required to consult with the federal agencies regarding the effect of their projects on listed species.
Magnuson-Stevens Fishery Conservation Act	NMFS	Requires federal agencies to consult with NMFS on activities that may adversely affect Essential Fish Habitat for federally managed fish species within a 200-mile zone offshore of the United States.
Marine Mammal Protection Act	NMFS	Prohibits injury or harm to marine mammals in U.S. waters. NMFS has authority over whales, dolphins, porpoises, seals, and sea lions, while the USFWS has authority over walrus, manatees, otters, and polar bears. The USDA is responsible for managing marine mammals in captivity.
Migratory Bird Treaty Act	USFWS	Protects many of the most common birds in the Plan area as well as birds that are listed as threatened or endangered. USFWS has authority to regulate most aspects of the taking, possession, transportation, sale, purchase, barter, exportation, and importation of migratory birds. As of March 2010, there are 1,007 species protected under the Act (Federal Register Vol. 75, No. 39). Species whose occurrences in the United States are strictly the result of intentional human introduction are not protected under the Act. Of particular concern are activities that affect birds nesting on bridges, buildings, signs, illumination poles, and other structures in areas planned for construction.

Table 4-3. Regulations and Permits for Biological Resources

Statute	Lead Agency	Regulated Activities
Bald and Golden Eagle Protection Act	USFWS	Specifically protects bald and golden eagles and makes it unlawful to take, import, export, sell, purchase, or barter any bald or golden eagles, their parts, products, nests, or eggs. “Take” includes pursuing, shooting, poisoning, wounding, killing, capturing, trapping, collecting, molesting, or disturbing eagles. To avoid potential disturbance to bald eagles, the National Bald Eagle Management Guidelines (USFWS, 2007) provide recommendations that will likely avoid take for a list of activities.
State of Washington		
State Hydraulic Code (Chapter 220-110 WAC)	Washington Department of Fish and Wildlife (WDFW)	Protects fish life and their habitat through regulation of activities in streams and lakes. WDFW administers state rules through its Hydraulic Project Approval (HPA) program. An HPA must be obtained from WDFW before work is conducted that uses, obstructs, diverts, or changes the natural flow or bed of state waters. The conditions of an HPA can be designed to protect fish, shellfish, and their habitat.
Priority Habitats and Species Program	WDFW	Provides information on documented locations of fish and aquatic resources, terrestrial plants and animals, and habitats that are listed or defined as priority. Priority species are those species that are: state endangered, threatened, sensitive, or candidate species; animal aggregations considered vulnerable; and species of recreational, commercial, or tribal importance that are vulnerable (WDFW, 2008). Priority habitats are habitat types or elements of habitat with unique or significant value to a diverse assemblage of species. A priority habitat may consist of a unique vegetation type (e.g., shrub-steppe) or dominant plant species, a described successional stage (e.g., old-growth forest), or a specific habitat feature (e.g., cliffs).
Natural Heritage Program	Washington Department of Natural Resources (WDNR)	Provides information for listed plant species or those that are defined as rare. Also maintains information on rare ecological communities and priority species.
City of Seattle		
Environmentally Critical Areas Ordinance (Seattle Municipal Code [SMC] 25.09)	City of Seattle Department of Planning and Development (DPD)	Protects and regulates activities on or adjacent to critical areas in the City. Critical areas include: geologic hazard areas, flood-prone areas, wetlands, fish and wildlife habitat conservation areas (FWHCAs) and abandoned landfills. FWHCAs are wildlife habitats that are mapped or designated by WDFW, corridors connecting priority habitats, or areas that support species of local importance. FWHCAs and wetlands are typically protected by a buffer in which development, including clearing and other land disturbing activities, is prohibited or restricted. Riparian corridors, a type of FWHCA, include all areas within 100 feet of the ordinary high water mark of a watercourse. Parcels containing riparian corridors and shoreline habitat are also subject to the general development standards in SMC 25.09.060 and specific development regulations in SMC 25.09.200, as well as regulations regarding tree and vegetation alteration and pesticide use.

Table 4-3. Regulations and Permits for Biological Resources

Statute	Lead Agency	Regulated Activities
SEPA Plants and Animals Policy (SMC 25.05.675.N)	DPD	City policy to minimize or prevent loss of wildlife habitat. Allows DPD to grant, condition or deny construction and use permit applications for public or private proposal that are subject to environmental review.
Shoreline Master Program (SMC 23.60)	DPD	Regulates water bodies above a threshold size as well as lands within 200 feet of the ordinary high water mark of those water bodies. Regulations include restrictions on development in the shoreline zone, requirements for maintaining native vegetation, and development standards.
Tree Protection Ordinance (SMC 25.11) and specific environmental policies related to trees (SMC 25.05.675)	DPD	Trees in Seattle are specifically valued and legally protected under various regulations in addition to the environmentally critical areas code. "Exceptional trees" are specifically protected and defined as a tree or group of trees that constitutes an important community resource because of its unique historical, ecological, or aesthetic value. Prior to construction at any site, a survey for exceptional trees would need to be conducted by a licensed arborist as required under SMC 25.11.

4.4.2 What types of aquatic and terrestrial habitat are present in the Plan area?

This section describes the types of aquatic and terrestrial habitat present in the Plan area and the species that may potentially occur as year-round residents or as migrants. This section focuses on species present in Plan neighborhoods and in the vicinity of CSO outfalls within the marine waters of Puget Sound (Elliott Bay and Salmon Bay) as well as freshwater/estuarine systems including the lower Duwamish River, Lake Washington, Lake Union, and the Ship Canal upstream of the Hiram M. Chittenden Locks (Ballard Locks).

To characterize these biological resources, the project team reviewed GIS data for the Plan area. Data sources included aerial imagery, the City's GIS data for environmentally critical areas (wetlands, streams, and riparian corridors) and the WDFW's Priority Habitats and Species (PHS) information. The *Seattle Biological Evaluation* was also reviewed for information about biological resources in the City (City of Seattle, 2012).

This review is a general summary for the purposes of identifying biological resources that could be affected by implementation of the Plan. Additional resources could exist but are not identifiable at the coarse scale of the GIS data. As with most construction projects conducted in the city, projects proposed under the Plan would require site-specific analysis to determine the presence of sensitive or protected plants, habitats, fish, or wildlife.

The Plan area contains diverse fish and wildlife habitats and species (City of Seattle, 2012). The largest patches of terrestrial wildlife habitat are found in public parks, shorelines, and steep slope areas that are undeveloped. Both marine and freshwater environments are present in the Plan area resulting in substantial diversity for aquatic species. For example, Puget Sound has documented occurrences of 188 fish species representing 72 families (Pietsch and DeVaney, 2012). Some of these marine species use freshwater habitats during part of their life cycles (salmonids, lampreys, sturgeon). The freshwater environments of the Plan area (as described in Section 4.3) are known to support an additional 31 fish species.

Table 4-4 lists the aquatic and terrestrial habitats including WDFW priority habitats documented within each of the Plan neighborhoods (WDFW, 2012a). The following sections briefly describe each habitat type.

Table 4-4. Aquatic and Terrestrial Habitats in the Plan Area

Plan Neighborhood	**Ship Canal**	Ballard	Fremont	Wallingford	Magnolia	**Lake Washington**	Portage Bay	Montlake	North Union Bay	Leschi	**Longfellow Creek/ Duwamish**	Delridge	East Waterway	Duwamish	**Elliott Bay/Lake Union**	Central Waterfront	**Piper's Creek**	**Thornton Creek**
HABITATS																		
Nearshore		X			X								X	X		X	X	
Riparian Corridors		X			X			X		X		X					X	X
Freshwater Wetlands		X	X		X			X	X	X		X		X			X	X
Forest		X	X	X	X			X		X		X		X			X	X
Natural Areas		X			X		X	X	X	X		X		X		X	X	X
Landscaped Areas		X	X	X	X		X	X	X	X		X		X		X	X	X

4.4.2.1 Nearshore

The nearshore zone includes shoreline, intertidal and subtidal habitats along Puget Sound. Shoreline habitats include riparian vegetation and bluffs that erode and supply sediment to adjacent beaches. Intertidal and subtidal areas consist of rocky substrate, native vegetation (such as eelgrass and macroalgae) or habitat-forming species (such as oyster reefs and sea pens). Nearshore areas provide important aquatic habitat for fish and other aquatic species. WDFW designated priority aquatic species most likely to be found in the vicinity of CSO outfalls include Chinook salmon, coho salmon, chum salmon, pink salmon, sockeye salmon, coastal cutthroat trout, steelhead, bull trout, rockfish species, sole species, California sea lion, harbor seal, mollusks, and Dungeness crab. Priority terrestrial species that use nearshore areas include bald eagle, peregrine falcon and great blue heron.

Other aquatic species that use estuarine and nearshore habitats in the Plan area may include marine mammals (primarily restricted to the marine waters of Puget Sound and to some extent the lower Duwamish River), reptiles (Pacific pond turtle), crustaceans (crab and shrimp), mollusks, and numerous bird species that forage in aquatic areas and shorelines (such as, marbled murrelet, gulls, terns, cormorants, common murre, great blue heron).

Nearshore habitats occur along the Puget Sound shorelines in the Plan Area. Estuarine zones, a subset of nearshore habitat mapped by WDFW, are shown on Figures 4-8 through 4-11. The Ship Canal Neighborhoods have the most nearshore habitat compared to other neighborhoods.

How do aquatic animals use habitats in the Plan area?

As shown on Figures 4-8 through 4-11, fish and other aquatic animals use the habitats of the Plan area for several different activities, including the following:

- Migration—travel to and from the ocean;
- Breeding areas;
- Foraging—feeding;
- Haulout areas—areas where marine mammals come out of the water and rest;
- Spawning—fish breeding;
- Rearing—areas where juvenile fish feed and grow to adulthood;
- Overwintering—areas where fish species spend the winter before migrating to summer areas; and
- Holding—areas where fish pause in their migration upstream or downstream.

4.4.2.2 Riparian Corridors

Riparian corridors are vegetated corridors present along streams. Within the Plan area, riparian corridors are typically vegetated with deciduous trees and shrubs with a few conifer trees. Native plants common to riparian corridors in the Plan area include red alder, big-leaf maple, Indian plum, and horsetail. Common aquatic plants include rushes, sedges, common cattail, duckweed, water lily, and pondweed. Nonnative invasive aquatic plants such as Eurasian milfoil are present in some areas. Some riparian corridors in the City are wide and densely vegetated, while most are narrow and constrained by urban development. Riparian areas provide important wildlife habitat including forage, cover, and complex habitat structure. This habitat supports a wide variety of terrestrial species such as songbirds, woodpeckers, and raptors. Riparian corridors also benefit aquatic habitats by providing shade, large wood, and organic material to streams.

Riparian corridors mapped by the City are shown on Figures 4-8 through 4-11. Riparian habitats occur throughout the Plan area. The Longfellow Creek/Duwamish Neighborhoods have the greatest amount of this habitat type.

4.4.2.3 Freshwater Wetlands

Freshwater wetlands in Seattle are associated with lake edges, streams and their riparian corridors, and scattered low-lying areas. Emergent, scrub-shrub, and forested wetlands are present, with scrub-shrub wetlands being the most common. Plant species common to emergent wetlands include reed canarygrass (nonnative), common cattail, and soft rush. Scrub-shrub and forested wetlands support many of the same plant species as riparian corridors, but also include dogwood, willow, and other water-tolerant species. In addition to supporting aquatic wildlife and amphibian species, wetlands in the City provide habitat for terrestrial songbird species and raptors.

Freshwater wetlands mapped by the City are shown on Figures 4-8 through 4-11. The largest wetland complexes are located in the Lake Washington Neighborhoods.

4.4.2.4 Forest

Forested communities are present in scattered patches throughout the city. Forests can be dominated by conifers (such as Douglas fir) or deciduous trees (such as big-leaf maple) or support a mixture of conifer and deciduous species. Forested areas are typically associated with steep slopes, top of bluffs, greenbelts, and other pockets of undeveloped land. Plant species common to forested habitats in Seattle include Douglas fir, western red cedar, vine maple, and swordfern. Forested habitats are important for woodpeckers, raptors, songbirds, crows, and jays. The largest patches of forest occur in the Lake Washington Neighborhoods.

4.4.2.5 Natural Areas

Natural areas support intact or natural vegetation (both native and nonnative) that is not formally landscaped. Parks and other public lands in the City support natural areas. Natural areas can contain mapped and unmapped riparian corridors and wetlands as well as forested habitats, but they can also contain grass or shrub areas that are not maintained or mowed.

Natural areas are present in all Plan neighborhoods and provide habitat for a wide variety of urban wildlife species. WDFW classifies some natural areas as "Urban Natural Open Space," a priority habitat type characterized as a biodiversity area or corridor that is relatively important to various species of native fish and wildlife (Figures 4-8 through 4-11).

4.4.2.6 Landscaped Areas

Landscaped areas provide habitat for wildlife despite their level of development and human presence. Landscaped gardens, golf courses, and recreational parks provide food and water sources, shelter, and other habitat elements important for terrestrial wildlife. Species that use landscaped areas are usually those that can tolerate some level of ongoing human disturbance.

4.4.3 What habitats and priority species occur in each Plan neighborhood?

The following sections summarize the types of habitat and priority species that have been documented by WDFW in each of the Plan neighborhoods.

4.4.3.1 Ship Canal Neighborhoods

The Ship Canal Neighborhoods are unique in that they contain both freshwater and marine environments supporting a wide array of species. Of particular note are species that use both environments to complete their life cycles such as Pacific salmon, steelhead, bull trout, and lamprey. From Puget Sound, these species enter the Ship Canal via the fish ladder at the Hiram M. Chittenden Locks and move through Lake Washington to tributary streams to complete their reproductive cycles. Mapped natural areas that support forested habitats and wetlands are present in Discovery and Golden Gardens Parks. Nesting bald eagles have been documented in both parks and along the Puget Sound shoreline. Great blue herons form nesting colonies in the southern portion of the area in Kiwanis Park, and at the north end in the North Beach or Blue Ridge area. Purple martins use hollow gourds that have been installed along the shoreline.

The marine waters adjacent to the Ballard area support numerous marine fish species; invertebrates such as clams and Dungeness crab; marine mammals such as California sea lion and harbor seal; and a wide variety of seabird species including marbled murrelet, common murre, waterfowl, and gulls.

The Fremont and Wallingford neighborhoods are densely developed and lack terrestrial habitats except for the landscaped or natural areas in Lower Woodlands Park and the Woodland Park Zoo. The freshwater portion of the Ship Canal adjacent to these neighborhoods is primarily used as a migratory corridor for anadromous fish species such as bull trout, Pacific salmon, and steelhead. No spawning or reproduction of these species is anticipated in the Ship Canal Neighborhoods due to lack of suitable habitat.

4.4.3.2 Lake Washington Neighborhoods

The Lake Washington Neighborhoods are located adjacent to the freshwater environments of the Ship Canal, Lake Union, and Lake Washington. Riparian corridors are present in the Leschi area along Mount Baker, Frink, and Madrona Creeks, which flow down an east-facing slope to Lake Washington. These stream corridors are also connected to forested or wetland habitats in public parks or natural areas. Both resident and anadromous fish species are present, including Chinook salmon, coho salmon, sockeye salmon, coastal cutthroat trout, rainbow trout/steelhead, and bull trout. Sensitive fish species both rear and migrate in Lake Washington. In 2009, nesting peregrine falcons were documented at the west end of the I-90 floating bridge (WDFW, 2012a).

The Montlake area includes a number of mapped wetlands, riparian corridors (Interlaken Creek), and natural areas. These relatively intact corridors connect these habitats and the Portage Bay and Lake Washington shorelines. These aquatic habitats support regular concentrations of waterfowl and foraging opportunities for other seabirds (primarily gulls and cormorants) (WDFW, 2012a). The area near the SR-520 crossing of Lake Washington contains abundant rooted aquatic vegetation and adjacent wetland habitats that likely support Pacific chorus frog, red-legged frog, and bull frog (invasive species). The aquatic habitat near SR-520 may also support populations of Pacific pond turtle. However, the Pacific pond turtle is a state endangered species that has been extirpated from most of its range in Washington. Since 1990, the Woodland Park Zoo and WDFW have administered a collaborative program to enhance the survival of pond turtles that combines protection of nests in the wild and hatchling capture and release in the Puget Sound lowlands (Hays et al., 1999).

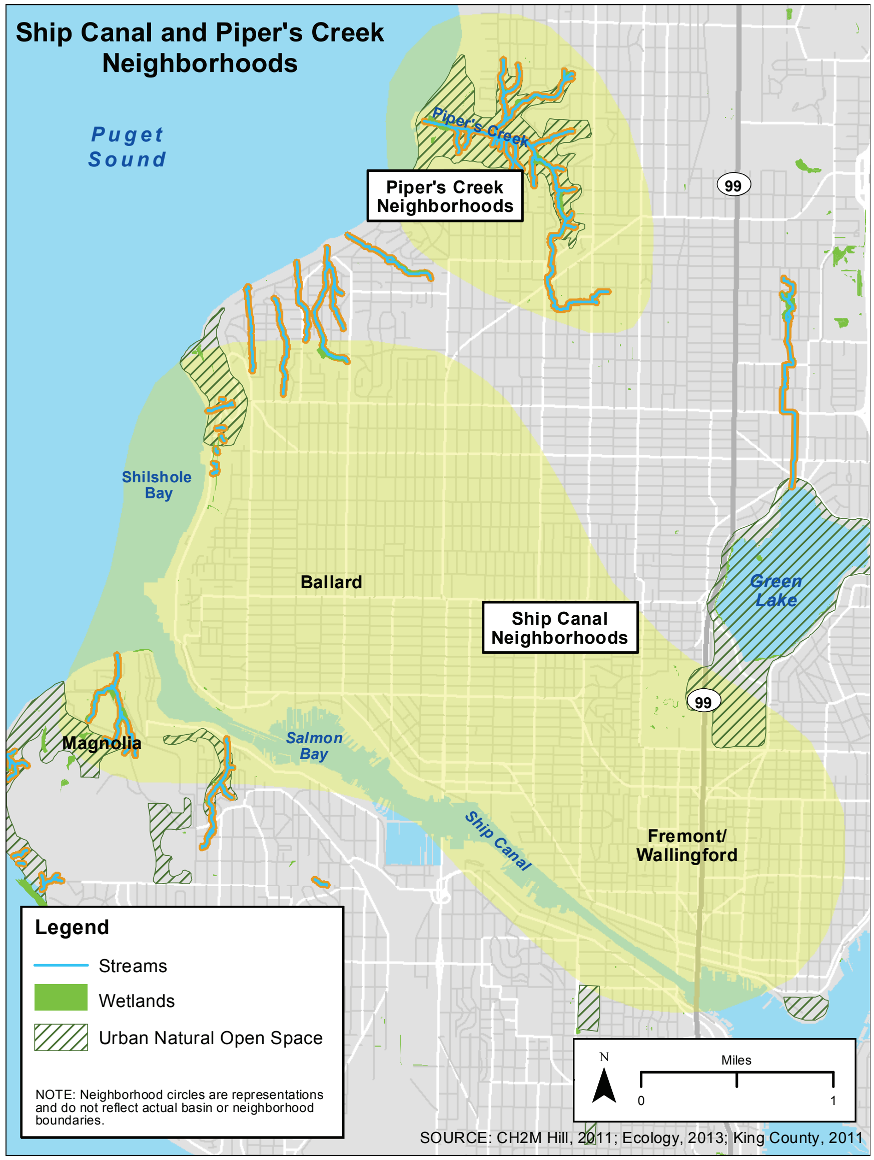
The Washington Park Arboretum contains stands of coniferous and deciduous forest intermixed with landscaped grasslands. Nesting bald eagles and great blue herons are regularly observed in this area.

North Union Bay contains several urban streams with mapped riparian corridors (Yesler, Ravenna, and Matthews Creeks). A large wetland complex is present at the south end of the area along the Lake Washington shoreline. This area, known as the Union Bay Natural Area, supports diverse wetland and upland habitats that support terrestrial wildlife species as well as waterfowl, amphibians, and aquatic species. Bald eagles have been documented nesting in this area and great blue herons are common. Restoration of the Union Bay Natural Area has been occurring since 1990. Projects have focused on creating forest, wetland, and grassland habitats over nearly 15 of the 75 acres.

4.4.3.3 Longfellow Creek/Duwamish Neighborhoods

The Longfellow Creek/Duwamish Neighborhoods drain to the tidally influenced portion of the lower Duwamish River, an area that supports multiple sensitive fish species. Urbanization has reduced the quality and quantity of aquatic and riparian habitats within the Longfellow Creek drainage area, but restoration efforts are ongoing. The Delridge area contains two riparian corridors surrounding Longfellow and Puget Creeks. Although the corridors are surrounded by development and are narrow in places, they are adjacent to natural areas that support forested habitats and wetlands such as Longfellow Creek Green Space, Roxhill Bog, and Puget Park. Camp Long Park contains intact mixed coniferous-deciduous forest that provides habitat for a variety of songbirds, woodpeckers, crows and jays, owls, and other raptors. The West Seattle Golf Course provides habitat for some species due to its proximity to Camp Long. Along the eastern edge of the Delridge area, the West Duwamish Green Space provides forested habitat and a continuous connection between multiple riparian corridors. The greenbelt supports nesting bald eagles and great blue herons. Osprey nest on elevated structures west of the Duwamish River, and peregrine falcons have been recorded on the 1st Avenue S bridge over the river. The Duwamish River provides a migratory corridor for adult salmonids during their annual upstream migrations to spawning areas in the Green River and tributaries. The Duwamish River also provides important habitat for juvenile salmonids as they outmigrate to Puget Sound. Marine mammals also use the lower Duwamish River as well as breeding populations of gulls and potentially other seabirds; foraging seabirds such as cormorants and gulls; and waterfowl concentrations. Invertebrates and fish that can tolerate brackish water are likely also present (sculpin, flatfish, crab). Sensitive mollusk species are not anticipated due to the highly developed nature of the shoreline. It is likely that sensitive crustacean species may venture into the lower Duwamish River on occasion. Restoration of fish and wildlife habitats along the Duwamish River has been occurring since the 1980s, including over 25 acres of intertidal and wetland habitat.

The industrial nature of the Duwamish area limits terrestrial wildlife habitat. In the eastern portion of the East Duwamish Greenbelt, west-facing slopes support deciduous and mixed coniferous-deciduous forest, seep wetlands, snags (dead standing trees), and shrub habitat. These slopes provide habitat for roosting and foraging raptors such as red-tailed hawk. Nesting ospreys have been documented near Martin Luther King Way. Jefferson Park and Jefferson Park Golf Course, located on the eastern edge of the Duwamish area, likely provide habitat for some terrestrial wildlife species.



Piper's Creek

Chinook salmon (T)	OCCURRENCE / MIGRATION
Coho salmon	SPAWNING / REARING / MIGRATION
Coastal cutthroat trout (resident)	OCCURRENCE / MIGRATION
Steelhead (T)	OCCURRENCE / MIGRATION
Chum salmon	OCCURRENCE / MIGRATION

Shilshole Bay

Chinook salmon (T)	MIGRATION
Steelhead (T)	MIGRATION
Bull trout (T)	FORAGING / MIGRATION
Coho salmon	MIGRATION
Sockeye salmon	MIGRATION
Chum salmon	MIGRATION
Pink salmon	OCCURRENCE / MIGRATION
Coastal cutthroat trout (sea-run/resident)	OCCURRENCE / MIGRATION / FORAGING
Pacific sand lance	BREEDING AREA
Dungeness crab	PRESENCE
Pacific geoduck	PRESENCE
Southern Resident killer whale (E)	OCCURRENCE
California sea lion	FORAGING / HAULOUT AREAS
Steller's sea lion (T)	POTENTIAL HAULOUT AREAS
Harbor seal	FORAGING
Marbled murrelet (T)	FORAGING

Ship Canal

Chinook salmon (T)	OCCURRENCE / MIGRATION
Steelhead (T)	OCCURRENCE / MIGRATION
Bull trout (T)	OCCURRENCE / MIGRATION
Coho salmon	OCCURRENCE / MIGRATION
Sockeye salmon	OCCURRENCE / MIGRATION
Coastal cutthroat trout (sea-run/resident)	OCCURRENCE / MIGRATION

T = Threatened
E = Endangered

SOURCE: WDFW, 2012; Ecology, 2013; King County, 2009.

FILE NAME: Fig04-08_Fish_and_Wildlife_ShipCanal.ai / CREATED BY: JAC / DATE LAST UPDATED: 04/28/14

Figure 4-8. Ship Canal Neighborhoods - Fish and Wildlife Species and Habitats.

Lake Union/Union Bay

Chinook salmon (T)	OCCURRENCE / MIGRATION
Steelhead (T)	OCCURRENCE / MIGRATION
Bull trout (T)	OCCURRENCE / MIGRATION
Coho salmon	OCCURRENCE / MIGRATION
Sockeye salmon	OCCURRENCE / MIGRATION
Coastal cutthroat trout (sea-run/resident)	OCCURRENCE / MIGRATION
Pacific pond turtle	OCCURRENCE

Thornton Creek

Chinook salmon (T)	SPAWNING / REARING / MIGRATION
Coho salmon	SPAWNING / REARING / MIGRATION
Sockeye salmon	SPAWNING / REARING / MIGRATION
Coastal cutthroat trout (resident)	OCCURRENCE / MIGRATION
Steelhead (T)	OCCURRENCE / MIGRATION

Lake Washington

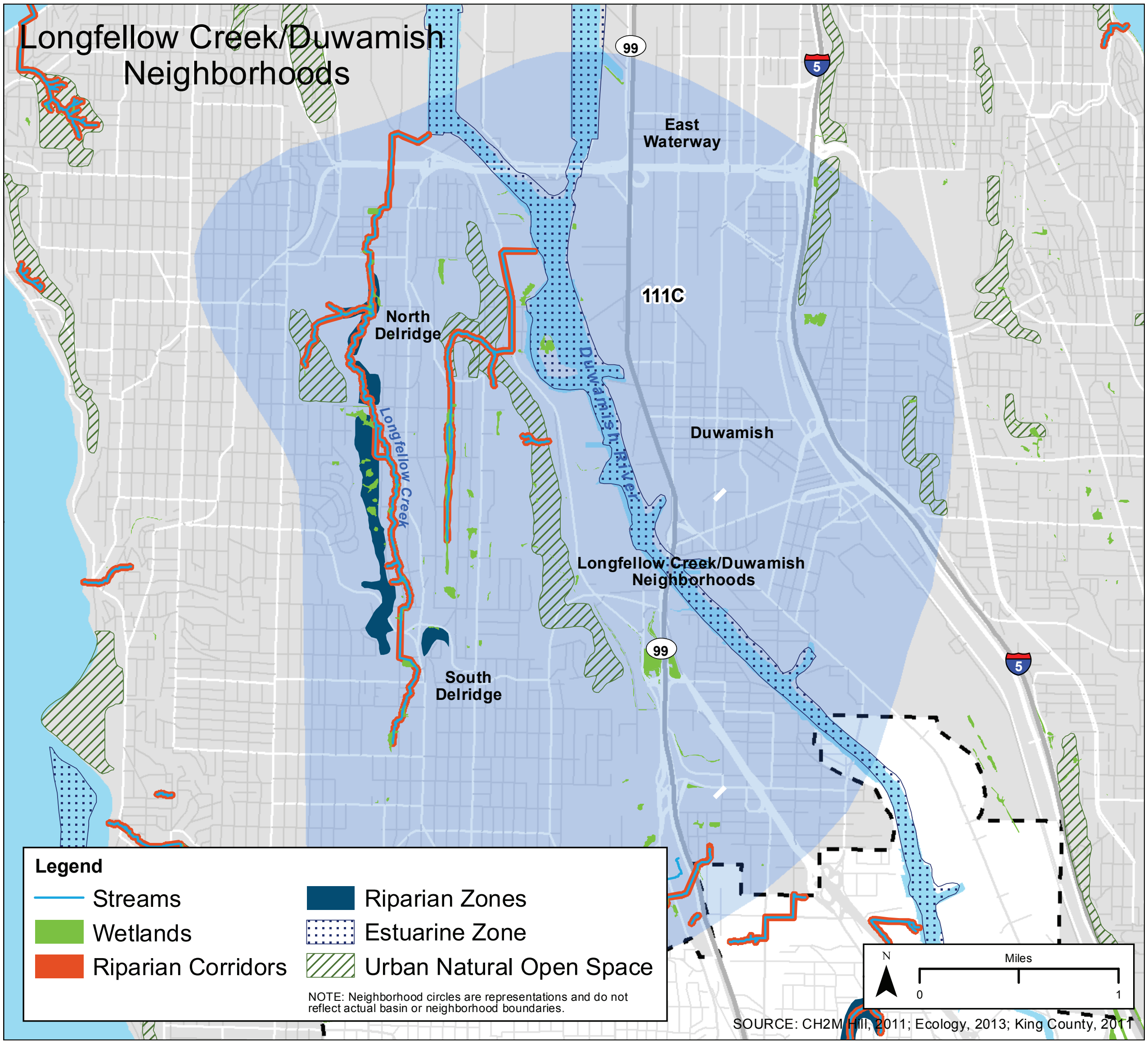
Chinook (T)	MIGRATION / HOLDING / REARING
Steelhead (T)	MIGRATION / TRIBUTARY SPAWNING
Bull trout (T)	MIGRATION / FORAGING / OVERWINTERING
Coho salmon	MIGRATION / TRIBUTARY SPAWNING
Sockeye salmon	MIGRATION / REARING / SPAWNING
Coastal cutthroat trout	OCCURRENCE / MIGRATION
Pacific pond turtle	OCCURRENCE
Waterfowl concentrations	BREEDING / REGULAR CONCENTRATIONS

T = Threatened
E = Endangered

SOURCE: WDFW, 2012; Ecology, 2013; King County, 2009.

FILE NAME: Fig04-09_Fish_and_Wildlife_LakeWashington.ai / CREATED BY: JAC / DATE LAST UPDATED: 04/28/14

Figure 4-9. Lake Washington Neighborhoods - Fish and Wildlife Species and Habitats.



Longfellow Creek

Chinook Salmon (T)	OCCURRENCE / MIGRATION
Steelhead (T)	OCCURRENCE / MIGRATION
Coho salmon	SPAWNING / REARING / MIGRATION
Coastal cutthroat trout (resident)	OCCURRENCE / MIGRATION

Duwamish River

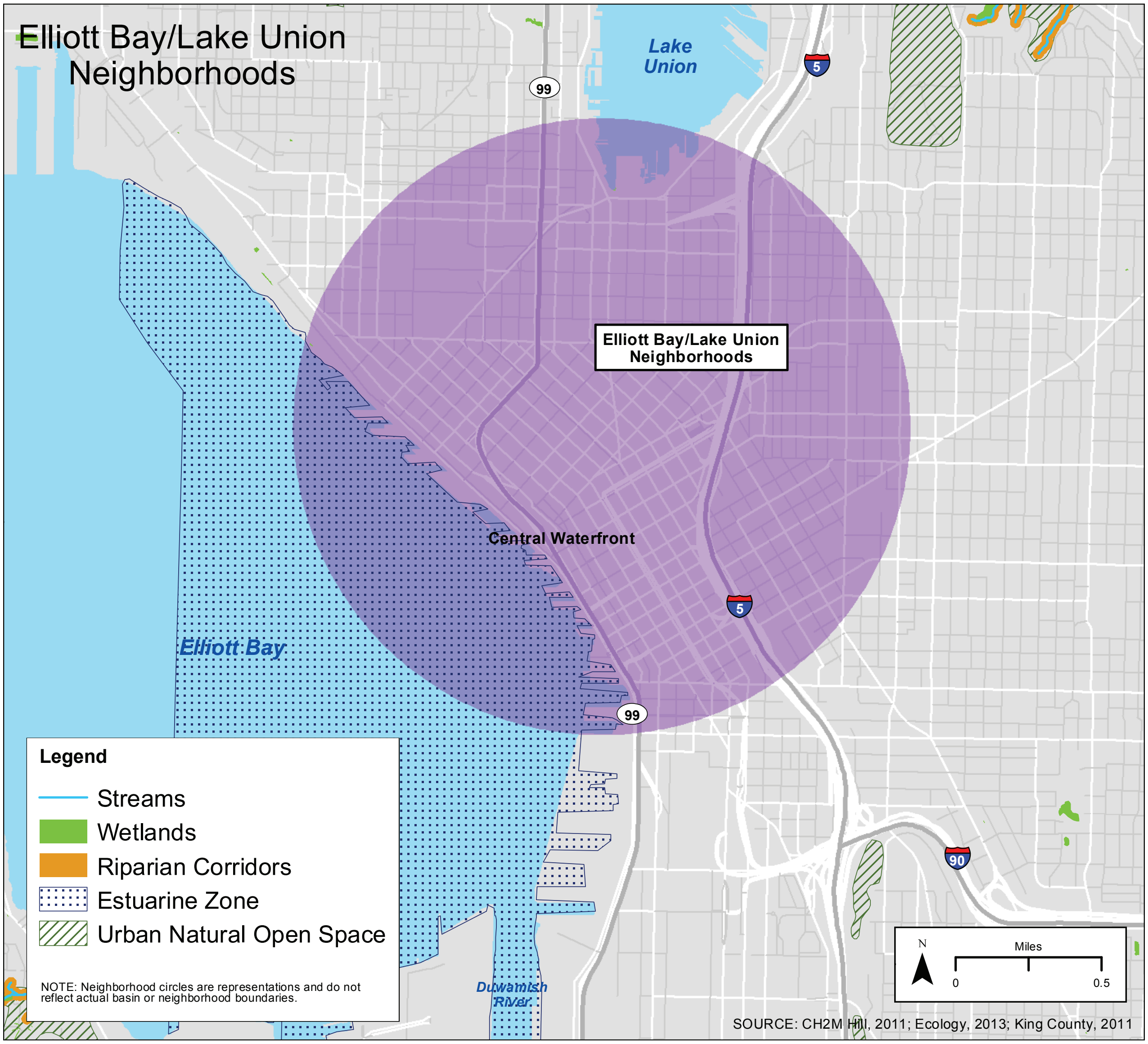
Chinook salmon (T)	OCCURRENCE / MIGRATION
Steelhead (T)	OCCURRENCE / MIGRATION
Bull trout (T)	FORAGING / OVERWINTERING
Coho salmon	OCCURRENCE / MIGRATION
Sockeye salmon	OCCURRENCE / MIGRATION
Chum salmon	OCCURRENCE / MIGRATION
Pink salmon	OCCURRENCE / MIGRATION
Coastal cutthroat trout (sea-run/resident)	OCCURRENCE / MIGRATION
California sea lion	FORAGING / HAULOUT AREAS
Steller's sea lion (T)	POTENTIAL HAULOUT AREAS
Harbor seal	FORAGING
Alcids	BREEDING

T = Threatened
E = Endangered

SOURCE: WDFW, 2012; Ecology, 2013; King County, 2009.

FILE NAME: Fig04-10_Fish_and_Wildlife_Longfellow-Duwamish.ai / CREATED BY: JAC / DATE LAST UPDATED: 04/28/14

Figure 4-10. Longfellow Creek/Duwamish Neighborhoods - Fish and Wildlife Species and Habitats.



Elliott Bay

Chinook salmon (T)	REARING / FORAGING / MIGRATION
Steelhead (T)	MIGRATION
Bull trout (T)	FORAGING / OVERWINTERING / MIGRATION
Coho salmon	OCCURRENCE / MIGRATION
Sockeye salmon	OCCURRENCE / MIGRATION
Chum salmon	OCCURRENCE / MIGRATION
Pink salmon	OCCURRENCE / MIGRATION

Coastal cutthroat trout (sea-run)	OCCURRENCE
Rockfish (all species) (T, E)	OCCURRENCE
Southern Resident killer whale (E)	OCCURRENCE
Humpback whale (E)	OCCURRENCE
California sea lion	FORAGING
Harbor seal	FORAGING
Marbled murrelet (T)	FORAGING

Lake Union

See Figure 4-9

T = Threatened
E = Endangered

SOURCE: WDFW, 2012; Ecology, 2013; King County, 2009.

Figure 4-11. Elliott Bay/Lake Union Neighborhoods - Fish and Wildlife Species and Habitats.

4.4.3.4 Elliott Bay/Lake Union Neighborhoods

The Elliott Bay/Lake Union Neighborhoods are highly developed and contain minimal vegetation and terrestrial wildlife habitat. Denny Park contains large trees and supports the largest patch of natural habitat. Landscaped parks in Central Waterfront Seattle provide habitat for species tolerant of human activities and noise. Peregrine falcons have nested on buildings (mainly the Chase Bank Tower) most years since 1994 when the first nest box was installed. Nesting activity was last observed in 2009 (WDFW, 2012a).

Aquatic species in these neighborhoods are primarily those associated with the marine environment of Elliott Bay (Puget Sound). This includes all sensitive fish, mammal, and bird species potentially occurring in Puget Sound as shown on Figure 4-11, and other marine birds such as common murre, cormorants, gulls, and terns as well as invertebrates including mollusks, crustaceans, sea stars, and sea cucumbers. Species such as humpback whale, Dall’s porpoise, geoduck, and Steller sea lion may occur on rare occasion in Elliott Bay.

4.4.3.5 Piper’s Creek

The Piper’s Creek area is developed for residential uses with the exception of the mainstem of the creek, which lies wholly within Carkeek Park, a mapped natural area that supports forested habitats and wetlands (Figure 4-12). The mouth of Piper’s Creek at Puget Sound supports intertidal habitat for invertebrates, mollusk species, and foraging opportunities for seabirds. Bald eagles and great blue herons likely use the mouth and adjacent shoreline for foraging although no nests are mapped in the area.

4.4.3.6 Thornton Creek

The Thornton Creek area is also densely developed. Portions of Thornton Creek and its tributaries contain areas of forested and riparian habitat. Near the outlet to Lake Washington, a great blue heron rookery is present and bald eagles likely use the large trees along the shoreline.

Thornton Creek itself is a mix of open and culverted reaches that support both resident and anadromous fish species, including fall-run Chinook salmon, coho salmon, sockeye salmon, and resident coastal cutthroat trout (WDFW, 2012a; 2012b). Numerous restoration projects in the Thornton Creek drainage basin have been undertaken to improve habitat for fish and other aquatic species.

4.4.4 What federally listed endangered and threatened species and critical habitat are present in the Plan area?

Table 4-5 summarizes information about the species in the Plan area that are listed under the federal Endangered Species Act, including the date of listing, status (threatened or endangered), and whether critical habitat has been designated in the Plan area.

Table 4-5. Federally Listed Species in the Plan Area			
Federally Listed Species	**Date Listed**	**Status[1]**	**Critical Habitat in Plan Area**
Chinook salmon Puget Sound Evolutionarily Significant Unit (ESU)	1999	T	Yes
Steelhead Puget Sound Distinct Population Segment (DPS)	2007	T	No[2]
Bull trout Coastal-Puget Sound DPS	1999	T	Yes
Eulachon (Columbia River smelt) Southern DPS	2010	T	No
Bocaccio rockfish Puget Sound DPS	2010	E	No[2]
Canary rockfish Puget Sound DPS	2010	T	No[2]
Yelloweye rockfish Puget Sound DPS	2010	T	No[2]
Southern Resident killer whale	2005	E	Yes
Humpback whale	1970	E	No
Steller sea lion	1990	T	No
Marbled murrelet	1992	T	No

[1] T = threatened; E = Endangered
[2] No critical habitat has yet been designated for the species

Generally, water bodies in the Plan area provide listed fish species with habitat for upstream migration, outmigration to the sea, rearing, holding, and foraging (Figures 4-8 through 4-11). In addition, the nearshore areas of Puget Sound, the Ship Canal, Lake Union, Union Bay, Lake Washington, and the Duwamish River are designated as critical habitat for Chinook salmon. Eulachon are infrequent users of marine waters adjacent to the Plan area. All three rockfish species could occur in the Plan area, especially in Elliott Bay adjacent to the Elliott Bay/Lake Union Neighborhoods where larval rockfish have been documented.

Of the marine mammals, the Southern Resident killer whale is most likely to use Puget Sound. Puget Sound, including the nearshore adjacent to the Plan area, has been designated as killer whale critical habitat. Steller sea lions are not commonly seen in Puget Sound, but they could use haulout areas that are also used by the more common California sea lion. California sea lion haulout areas are located in nearshore habitat of the Ship Canal and Elliott Bay/Lake Union Neighborhoods, as well as the lower Duwamish River area of the Longfellow Creek/Duwamish Neighborhoods. Humpback whales are rare in Puget Sound, but they could use marine habitats near the Plan area.

The marbled murrelet is a seabird that forages in marine waters and nests in trees within inland forests. No nesting habitat exists in the Plan area, but marbled murrelets likely forage in Puget Sound adjacent to the Ship Canal, Longfellow Creek/Duwamish, Elliot Bay/Lake Union and Piper’s Creek Neighborhoods.

No populations of threatened or endangered plant species are currently documented in the Plan area (WNHP, 2012).

4.5 Energy and Climate Change

What is included in this section?

This section discusses the regulatory setting, and sources and providers of energy within the Plan area. This section also provides information on climate change, including the regulatory framework for assessing impacts of climate change and greenhouse gas emissions, the existing sources of emissions in the Plan area, and potential risks associated with climate change.

4.5.1 What is the regulatory setting for energy and climate change?

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. However, some of the standards included in the energy codes may serve as guidelines for construction of buildings associated with projects under the Plan.

There are relatively few mandatory regulations pertaining to greenhouse gases at either a federal or state level. Mandatory regulations apply primarily to large emitters such as petroleum refineries and aluminum manufacturers, and these typically require quantifying rather than reducing greenhouse gas emissions. State and many local governments have developed and continue to refine policies aimed at reducing emissions, with these policies typically focused largely on government actions rather than the private sector.

4.5.2 What is the energy setting of the Plan area?

Energy that powers existing development in the Plan area is supplied by Seattle City Light (electricity) and Puget Sound Energy (natural gas). Electricity is generally supplied by overhead power lines and natural gas through pipelines within street rights-of-way. Most of Seattle's electricity comes from the Seattle City Light hydropower facilities on the Skagit River and from Boundary Dam on the Pend Oreille River. The remaining hydropower comes from a mix of sources, including long-term contracts with the Bonneville Power Administration (BPA).

Natural gas is transported into the Puget Sound Energy (PSE) distribution area through large pipelines with sources in British Columbia, Alberta, and Rocky Mountain states. Smaller PSE-owned pipelines deliver natural gas to the Plan area.

4.5.2.1 CSO Control and Stormwater Facilities and Energy Consumption

CSO control facilities are designed to use gravity as much as possible for conveyance, but these systems typically require some level of energy to operate. Electric pumps and ventilation equipment are the main energy-consuming components of CSO facilities. Operation of CSO equipment can be energy intensive, but the equipment operates infrequently, only during and after storm events.

Construction of new CSO control and stormwater facilities under the Plan would require large quantities of construction materials. Energy is used to manufacture and transport these materials to the construction sites. Large construction projects, such as those envisioned under the Plan, require substantial amounts of energy to fuel construction equipment, worker vehicles, and other support services.

4.5.3 What is the climate change and greenhouse gas emissions setting of the Plan area?

Seattle's greenhouse gas emissions originate from three main sources: transportation, buildings, and industry. Transportation accounts for 62 percent of emissions, with two-thirds of transportation emissions coming from cars and trucks. Energy use in buildings accounts for 21 percent, and industrial operations and processes make up the remaining 17 percent of emissions (City of Seattle, 2008).

Why are greenhouse gases considered?

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.

4.5.3.1 Risks Associated with Climate Change

Recognized risks associated with climate change in Washington include increased sea levels, reduced snowpack, changes in water availability, changes in timing of streamflows, increased forest fires, increased winter precipitation, and decreased summer precipitation. Sea level rise and increases in the timing and amount of runoff and precipitation are the risks most likely to directly affect existing CSO control facilities and the anticipated design and sizing of future CSO control and stormwater facilities. Except for sea level rise, the risks from climate change are likely to be similar for all of the neighborhoods.

Climate change projections for the Pacific Northwest and specifically the state of Washington have been developed by the Climate Impacts Group at the University of Washington (Climate Impacts Group, 2009). Three of the studies included in the Climate Change Impacts Assessment evaluated the impacts on water management issues in the Puget Sound region (Vano et al. 2009, Rosenberg et al. 2009, and Elsner et al., 2009).

Overall precipitation is expected to increase in the Puget Sound region between now and the 2080s by a range of 0.2 percent to 4.9 percent (Vano et al., 2009). Most of the increased precipitation would occur during the cool season (October to March) while warm season precipitation would decrease. This would result in overall wetter winters and drier summers, changing the current patterns of runoff from a springtime peak caused by snowmelt to a winter peak caused by rainfall. Timing of flooding in the Puget Sound region is also expected to shift, with increased flooding in the January to March period and decreased flooding from April to May.

Changes in precipitation and timing would also affect soil moisture and infiltration rates, which in turn would affect stormwater runoff. Modeling indicates that snowpack will decrease, resulting in a decrease in the amount of water stored as snow (Elsner et al., 2009). The reduced winter snowpack and earlier snowmelt will reduce summer soil moisture levels in the mountains and coastal drainages west of the Cascades. As a result, runoff is predicted to increase.

One of the Climate Impact Group's studies specifically evaluated impacts of climate change on stormwater infrastructure (Rosenberg et al., 2009). Future climate changes may alter the intensity or duration of precipitation, affecting how existing stormwater and combined sewer systems function and requiring changes in how facilities are designed. Models generally indicate that peak discharges will increase, but there is a lack of consistency about the predicted amount of increase. There is even more uncertainty associated with predictions for the frequency of peak discharges. Rosenberg et al. conclude that the design standards used for stormwater design will need to adapt to changes specific to individual regions.

Another risk to utilities associated with climate change is sea level rise. Increases in sea level will affect where outfalls and other facilities can be located. The City of Seattle has prepared a draft map of sea level rise potential in Seattle for 2050 (SPU, 2013b). The map shows that areas most at risk for sea level rise include low-lying areas of the Duwamish River basin, Golden Gardens Park, West Point, Alki Point, and various areas along the West Seattle shoreline. As a result, portions of the Duwamish and Central Waterfront areas face greater potential risks from the effects of sea level rise than the other Plan neighborhoods.

4.6 Environmental Health and Public Safety

4.6.1 What are the regulations that govern environmental health?

In general, regulations governing environmental health are focused on minimizing the potential for exposure to chemicals or contaminants that could be harmful to humans or wildlife. The Environmental Public Health Division of the Washington State Department of Health (DOH) leads this effort, working with local governments and agencies in the areas of drinking water, food safety, shellfish protection, wastewater management, health risk assessments, and other areas. Regulations in these areas are implemented by the DOH.

> **What is included in this section?**
>
> This section summarizes environmental health regulations in the Plan area and identifies environmental health concerns that would need to be considered in assessing the impacts of proposed facilities,

Washington State Water Quality Standards (WAC 173-201A) have been developed to protect human and environmental health. These regulations, along with the requirements enforced by DOH, provide the regulatory framework for environmental health.

4.6.2 What are the relevant environmental health concerns in the Plan area?

Existing environmental health concerns in the Plan area that are relevant to the analysis of the Plan alternatives include untreated CSO and stormwater discharges and contaminated soil and groundwater sites.

Untreated CSOs and stormwater include dissolved and particulate heavy metals and chemicals adsorbed (attached) to particles that settle to the bottom. Evidence suggests that untreated CSOs and stormwater? can cause contamination of sediments near outfalls (King County, 2010) that could affect humans and/or fish coming in contact with those sediments. Additional information about potential environmental health risks associated with untreated CSO and stormwater discharges is included in Chapter 6, *Volume 3, Integrated Plan.*

Public health risks can occur through swimming, scuba diving, wading, or fishing in waters that receive untreated CSO discharges. People can be exposed to pathogens or other pollutants through direct contact with contaminated water or sediments (e.g., swimming or wading), ingestion of pathogen-containing water, or eating contaminated fish or shellfish. Pathogens present in untreated discharges include bacteria and viruses. Potentially toxic pollutants such as petroleum products or metals also are conveyed in untreated CSO and stormwater discharges. CSO releases can contain pharmaceuticals, personal care products, and endocrine-disrupting chemicals. Additional information on exposure risks associated with contaminants in CSOs and stormwater is included in Chapter 7, *Volume 3, Integrated Plan.*

Contaminated soil and groundwater can present environmental health risks to humans or animals that come in contact with the contaminated materials. Exposure can occur during or following construction. In addition, cleaning up contaminated soil can significantly increase the cost and schedule requirements for development of a site, and this is a major consideration during facility siting, design, and construction.

4.6.3 Are there potentially contaminated sites located in the Plan area?

Figure 4-12 illustrates documented contaminated sites within the Plan area. The Washington State Department of Ecology's Toxics Cleanup Program maintains a database of contaminated sites and leaking underground storage tanks (LUSTs) within the state. The database includes information on current and past cleanup sites as well as voluntary cleanup sites, covering a wide range of contaminants, such as petroleum products and byproducts, solvents, and other hazardous wastes.

In general, LUSTs are associated with gas stations or other automotive uses, causing contamination of soil and groundwater with petroleum or benzene. However, some LUSTs in industrial areas are associated with other uses or contaminants. Ecology tracks all cleanup sites for contamination of groundwater, surface water, soil, sediment, air, and bedrock.

The EPA maintains a database of Superfund sites, which are locations with uncontrolled hazardous materials. The lower Duwamish Waterway is listed as a Superfund site under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and as a Model Toxics Control Act (MTCA) site (Ecology, 2013c). Seattle has several other listed Superfund sites. The Lockheed West Seattle site is at the north end of the Delridge area and is listed for historic releases of metals, PCBs, and petroleum products into Elliott Bay. Additionally, Harbor Island, located at the mouth of the Duwamish River directly adjacent to the Delridge and Duwamish areas, is listed as a Superfund site for contamination in soil, groundwater, and sediments.

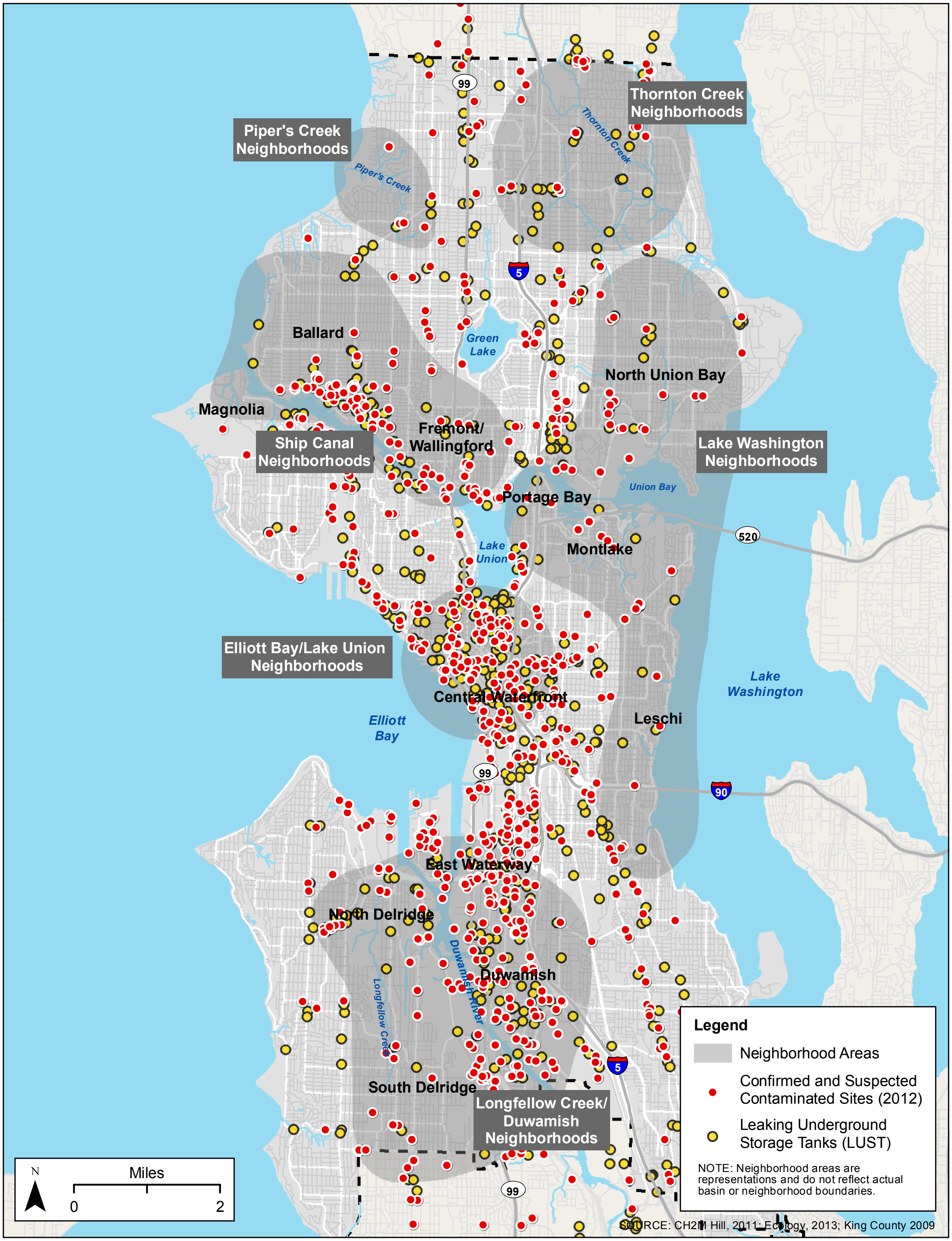


Figure 4-12 Contaminated Sites & Leaking Underground Storage Tanks.

4.7 Noise and Vibration

4.7.1 What is noise?

Noise can be defined as unwanted sound. However, sound is measurable, whereas noise is subjective. The relationship between measurable sound and human irritation is the key to evaluating noise impacts.

Noise is typically measured in units called decibels (dB). For the purposes of environmental analysis, noise is often quantified as “A-weighted”decibels (dBA), which correspond to the frequencies that are audible to the human ear. A whisper measures about 30 dBA, while a typical conversation is in the range of 50 to 60 dBA, and a jet taking off at a distance of 200 feet measures about 120 dBA. The human ear perceives an increase of 10 dBA as a doubling of the noise level; an increase of 3 dBA or less is barely perceptible, and an increase of 5 dBA or more is noticeable. Noise levels drop off sharply with distance from the noise source.. Hearing loss can begin to occur with prolonged exposure to noise at 85 dB. For context, normal conversation is approximately 60 dB and the noise from heavy city traffic can reach 85 dB (NIDCD, 2008).

4.7.2 What is vibration?

Ground-borne vibration is a small but rapidly fluctuating motion transmitted through the ground. Vibrations can result during construction associated with large equipment, blasting, excavation, pile driving, and tunneling operations. Vibration can be quantified in terms of the mechanical motion of the medium (e.g., floor) 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 is attenuated (lessens) with distance. The attenuation rate varies depending on the medium through which the vibration travels.

4.7.3 What is the regulatory setting for noise and vibration?

4.7.3.1 City Noise Regulations (SMC 25.08.410, SMC 25.08.420)

The Seattle Municipal Code (SMC) defines the maximum permissible sound levels within residential, commercial, and industrial districts (SMC 25.08.410) (Table 4-6), along with permissible modifications (SMC 25.08.420).

Table 4-6. Maximum Permissible Environmental Noise Levels (dBA)

Type of Noise Source	Type of Receiving Property		
	Residential (day/night)	Commercial	Industrial
Rural	52/42	55	57
Residential	55/45	57	60
Commercial	57/47	60	65
Industrial	60/50	65	70

Source: SMC 25.08.410

Noise from construction activities is allowed to exceed the maximum permissible sound levels between 7:00 a.m. and 10:00 p.m. on weekdays, and between the hours of 9:00 a.m. and 10:00 p.m. on weekends. The limits may be exceeded by 25 dBA for equipment on construction sites. The SMC also states that impact equipment, such as pavement breakers, jackhammers, and others that create impulse noise, may exceed the maximum permissible sound levels in any one-hour period, but may not exceed the following:

- 90 dBA continuously;
- 93 dBA for 30 minutes;
- 96 dBA for 15 minutes; or
- 99 dBA for 7.5 minutes (SMC 25.08.425).

SMC 25.05.675 establishes specific environmental policies for noise, including the policy that the City will minimize or prevent adverse noise impacts from new developments and uses. The City can require assessments of noise impacts and require mitigation as part of environmental review for a project. Mitigation measures could include reducing the size of the project, setting time limits on operation, and buffering or landscaping to reduce offsite noise impacts.

4.7.3.2 State Vibration Regulations (WAC 296-52-67065)

The City does not regulate vibration, but vibration caused by CSO-related construction will be subject to state vibration regulations. The Washington Administrative Code sets maximum limits on ground vibrations for dwellings, public buildings, schools, churches, commercial sites, cofferdams, piers, underwater structures, and institutional buildings near blasting sites (WAC 296-52-67065 Vibration and Damage Control). Vibration limits are measured in maximum allowable peak particle velocity.

4.7.4 What are the existing noise conditions in the Plan area?

A description of sound levels for individual Plan neighborhoods is provided below. Major noise sources generally include commercial and industrial areas, railways, and major roads. Sensitive receptors include residences, schools, hospitals, and nursing homes.

4.7.4.1 Ship Canal Neighborhoods

The Ship Canal Neighborhoods are primarily residential with areas of mixed-use commercial and relatively low noise levels. Traffic on local arterials and overhead airplane traffic are the predominant noise sources. Light-industrial areas are located in the neighborhoods, primarily near the Ship Canal. Sensitive receptors include Swedish Medical Center in Ballard and many public and private schools.

4.7.4.2 Lake Washington Neighborhoods

Most neighborhoods are residential, but many commercial corridors are present. Noise from SR-520 and Interstate 5 is audible in these neighborhoods, as is overhead airplane traffic. In addition to residences and numerous public and private schools, major sensitive receptors include the University Medical Center and Children’s Hospital and Medical Center in North Union Bay. The Montlake area includes a number of recreational facilities, including the Washington Park Arboretum, where natural, lower noise levels are important considerations for park visitors.

4.7.4.3 Longfellow Creek/Duwamish Neighborhoods

The neighborhood includes industrial areas near the Duwamish Waterway including the Industrial District, the principal industrial area of Seattle and one of the largest and most intensely developed manufacturing/industrial areas in the Pacific Northwest. Other major noise producers are I-5, SR-99, and the Spokane Street Viaduct in the Duwamish neighborhood. The remaining parts of the neighborhoods are primarily residential with several public and private schools as sensitive receptors.

4.7.4.4 Elliott Bay/Lake Union Neighborhoods

The Central Waterfront is mostly commercial, with industrial uses adjacent to Elliott Bay. Traffic levels are very high in the neighborhood, including I-5, SR-99, and ferry terminal traffic. Major sports stadiums (Century Link Field and Safeco Field) directly south of the neighborhood also contribute to traffic and noise. The Central Waterfront has fewer sensitive receptors than other Plan area neighborhoods, but it does contain several schools.

4.7.4.5 Piper's Creek

The Piper's Creek area is mostly residential, with commercial uses along Holman Road. Major noise sources include Holman Road and the Burlington Northern-Santa Fe Railroad, which runs through Carkeek Park along Puget Sound. Sensitive receptors include Carkeek Park and schools.

4.7.4.6 Thornton Creek

The Thornton Creek area is largely residential with several commercial areas, including Northgate Mall and its surrounding commercial uses. Major sources of traffic noise include I-5, SR-522 (Lake City Way), 15th Avenue NE, and NE Northgate Way. Sensitive receptors include many schools in the area.

4.8 Land Use and Visual Quality

4.8.1 What is the regulatory setting for land use?

4.8.1.1 Seattle Comprehensive Plan Policies

The City of Seattle Comprehensive Plan (DPD 2005) provides policies that guide the adoption of development regulations and inform policy decisions regarding development within the City. The most salient goals and policies relevant to the Plan are listed below, along with a summary of the subject matter:

Utilities

- UG1: Provide reliable and affordable service while acknowledging the City's goals of environmental stewardship, social equity, economic development, and public health protection
- UG2: Maintain the service reliability of the City's utility infrastructure
- U15: Prioritize CSO projects according to frequency, volume, and location sensitivity
- U18: Work with neighborhood and community representatives in siting facilities
- U20: Incorporate accessible open space in the siting and design of City utility facilities

Environment

- EG1: Protect and improve air, land, and water quality for people and wildlife
- EG4: Recognize and enhance the value of aquatic areas

What is included in this section?

This section provides information on land and shoreline use characteristics, plans, and policies in the Plan area. This section also discusses existing conditions related to visual quality in the Plan area—the overall bulk and scale of structures, light and glare, and views.

- EG5: Pursue the long-term health of Seattle's receiving waters by taking actions that address flooding, water quality, habitat and barriers to fish passage
- EG6: Minimize the number and extent of CSO events
- E4: Protect and retain trees that enhance historical, cultural, environmental and aesthetic character
- E23: Protect and retain trees and tree canopy that enhance Seattle's historical, cultural, environmental and aesthetic character.

4.8.1.2 Seattle Land Use Code

The Seattle Land Use Code (Seattle Municipal Code (SMC) Chapter 23) includes use regulations and development standards for siting public facilities. Public facilities required for CSO control and stormwater facilities are generally permitted outright in all zones in the city with the exception of Residential Single-Family zones as illustrated in Table 4-7. In Residential Single-Family zones, the City Council must approve siting public facilities such as CSO control and stormwater facilities on private property.

In zones other than Residential Single-Family, City Council approval is also required if a public facility project does not meet a specific development standard, such as setbacks, height, or landscaping, required in the zone in which the project is located. This process is referred to as a "Council Waiver or Modification of a Development Standard" and is similar to the Council Conditional Use Permit process.

Table 4-7. Land Use Code Requirements for CSO control and Stormwater Facilities

Zoning District	Use Requirements	Seattle Municipal Code Section
Residential Single-Family	Requires Council Conditional Use	23.51A.002
Multi-Family	Permitted outright	23.45
Residential Commercial	Permitted outright	23.46
Commercial	Permitted outright	23.47A
Seattle Mixed	Permitted outright	23.48
Downtown • Downtown Harborfront 1 • Downtown Harborfront 2	Subject to Shoreline Management Program requirements Permitted outright	23.48 23.49
Industrial	Permitted outright	23.50

The City evaluates potential impacts to land use through its Master Use Permit process. The Seattle Department of Planning and Development (DPD) evaluates Master Use Permit applications using specific criteria provided in the Seattle Municipal Code.

Common Master Use Permits required for CSO control and stormwater facilities include the following:

- Land Use/Type V Master Use Permit – Waiver/Modification of Development Standards for Public Facility
- Land Use/Type IV Master Use Permit – Council Conditional Use Permit
- Land Use/Type II Master Use Permit – Environmentally Critical Area Exceptions
- Land Use/Type II Master Use Permit- Shoreline Substantial Development Permit
- Land Use/Master Use Permit – State Environmental Policy Act (SEPA) Project Conditioning based on Seattle's SEPA Policies (Seattle Municipal Code 25.05)
- Land Use/Master Use Permit - Variance

Construction within city streets or rights-of-way would require a Utility Major Permit or Street Improvement Permit from the Seattle Department of Transportation according to Seattle Municipal Code 15.32. This would include construction of storage pipes, conveyance lines, and flow transfers constructed in city streets or rights-of-way under the LTCP options, and construction of NDS projects under the Integrated Plan Alternative. The Seattle Department of Transportation, in consultation with the City, would determine which permit applies for each project. Construction in streets and drives in parks would require a permit from Seattle Parks and Recreation. All of these permits include conditions on construction and requirements for street improvements and/or restoration.

4.8.1.3 Seattle's Shoreline Master Program

Seattle's Shoreline Master Program (Seattle Municipal Code Chapter 23.60) includes policies and regulations governing development and uses on and adjacent to marine and freshwater shorelines. In the Plan area, these shorelines (or Shoreline District) consist of the areas extending 200 feet landward from the following bodies of water: Elliott Bay and other waters of Puget Sound, Lake Washington, Lake Union, Lake Washington Ship Canal, Duwamish River, and associated wetlands and floodplains. These areas are subject to shoreline development standards that must be met in addition to zoning requirements.

Additional requirements for shoreline areas establish the types of land uses permitted and development regulations governing building size and other standards. All development within the Shoreline District, including the development of CSO control and stormwater facilities, must be consistent with the policies of the State Shoreline Management Act and Seattle's Shoreline Master Program.

Shoreline Management Act

Seattle's Shoreline Master Program implements the State Shoreline Management Act created by citizen referendum in 1972. The major policy areas of the Shoreline Management Act are as follows:

- Preferred uses are those that are water-oriented including single-family residences, ports, shoreline recreational uses, and water-dependent industrial and commercial developments.
- Environmental protection is required for shoreline natural resources to ensure no net loss of ecological function.
- Public access to the shoreline is promoted by requiring a public access element in local Shoreline Master Programs and requiring that new development must maintain public access.

The City's Shoreline Master Program classifies shoreline zones into 11 categories, known as shoreline designations (Table 4-8). These designations are based on the both the level of existing shoreline development and the City's goals for preserving and enhancing shorelines. Shorelines in the Plan neighborhoods include a mix of all of these shoreline designations.

The City of Seattle is in the process of updating its Shoreline Master Program. The City Council adopted the updated Shoreline Master Program in January 2013. The code update is awaiting approval from the Washington State Department of Ecology. It is not anticipated that the Shoreline Master Program will change substantially from the version adopted by the Council. Therefore, this section describes the adopted version.

Table 4-8 summarizes the requirements for utility lines and utility service uses in the City's shorelines. Utilities lines are generally allowed by permit or permitted as a special use in most shoreline designations. In the Conservancy Preservation (in water) designation and the Conservancy Recreation designation, utility lines are allowed as a special use if no reasonable alternative location exists. These two shoreline designations are located along the Puget Sound and Lake Washington shorelines in several of the Plan neighborhoods.

The Shoreline Master Program includes two regulations specific to utility lines in the Shoreline District.

- All new utility lines must be located outside the Shoreline District to the extent possible (Seattle Municipal Code 23.60A.217B).
- Pipelines carrying materials intrinsically harmful or potentially injurious to aquatic life or water quality must have shutoff facilities and use other appropriate best management practices to prevent and contain such materials from entering the water or the ground.

Utility service uses include facilities used for treating and storing stormwater and CSOs. These uses are prohibited in the Conservancy Navigation, Conservancy Preservation, and Conservancy Waterway shoreline designations. In all other designations, they are allowed if they reasonably require a shoreline location to operate. The Conservancy Navigation designation encompasses all the area on the water side of the ordinary high water mark. Areas of Conservancy Preservation are located throughout the Plan neighborhoods. Conservancy Waterways are located along the Lake Union and Portage Bay shorelines.

The decision on a Shoreline Substantial Development Permit for utility lines and utility service uses is made by the Director of DPD as defined in Seattle Municipal Code 23.60A, Subchapter I: Purpose and Policies.

Table 4-8. Shoreline Master Program Requirements for Utility Service Uses and Utility Lines		
Shoreline Designation	**Utility Service Uses**	**Utility Lines**
Conservancy Management	Utility services are allowed if they reasonably require a shoreline location to operate.	Allowed by permit
Conservancy Navigation	Prohibited	Special Use
Conservancy Preservation	Prohibited	Utility lines are allowed on dry land as a special use and are allowed in water as a shoreline conditional use if no reasonable alternative location exists.
Conservancy Recreation	Utility service uses for treating and storing stormwater or combined sewage are allowed as a shoreline conditional use if they reasonably require a shoreline location to operate.	Utility lines are allowed as a special use, if no reasonable alternative location exists.
Conservancy Waterway	Prohibited	Special Use
Urban Commercial	Utility service uses are allowed if they reasonably require a shoreline location to operate.	Allowed by permit
Urban General	Utility service uses are allowed if they reasonably require a shoreline location to operate.	Allowed by permit
Urban Harborfront	Utility service uses are allowed as a special use on waterfront lots and are allowed on upland lots, if they reasonably require a shoreline location to operate.	Special use on waterfront lots and allowed by permit on upland lots.
Urban Industrial	Utility service uses are allowed if they reasonably require a shoreline location to operate.	Allowed by permit
Urban Maritime	Utility service uses are allowed if they reasonably require a shoreline location to operate.	Allowed by permit
Urban Residential	Utility service uses are allowed if they reasonably require a shoreline location to operate.	Allowed by permit

4.8.1.4 Environmentally Critical Areas

The City of Seattle regulates several kinds of environmentally critical areas under Seattle Municipal Code Chapter 25.09. Within the Plan neighborhoods these include geologic hazard areas, fish and wildlife habitat conservation areas, and wetlands. Environmentally critical areas are discussed in more detail in Section 4.1, Earth and Groundwater; and Section 4.4, Biological Resources.

4.8.2 What is the regulatory setting for visual quality?

The City of Seattle regulates aspects of visual quality through its Land Use Code and Environmental Policies, discussed below. The City's Shoreline Master Program also protects the visual quality of the shoreline zone through additional building development standards and requirements to protect view corridors. View corridor protection includes maintaining a view of the water from the public right-of-way, meeting minimum size requirements, prohibiting structures, and limiting parking in the corridor (Seattle Municipal Code 23.60.170). Any facilities constructed under the Plan would meet these requirements.

4.8.2.1 Seattle Municipal Code Title 23 Land Use Code

The Land Use Code (Title 23 of the Seattle Municipal Code) regulates visual quality through development standards for different zoning classifications. The development standards include building height restrictions, lot coverage and setbacks, landscaping and screening, and façade requirements. These restrictions and requirements are intended to ensure that new development will be consistent with existing land uses. Public facilities located in residential zones must be compatible in bulk to the surrounding community, and landscaping must be used to ensure the compatibility of public facilities with surrounding uses (Seattle Municipal Code 23.51A).

The Land Use Code includes provisions to minimize light and glare by requiring that exterior lighting must be shielded and directed away from adjacent uses. In residential zones, light and glare controls must be used for public facilities to ensure compatibility with surrounding uses (Seattle Municipal Code 23.41A).

4.8.2.2 Environmental Protection Policies

The City's Environmental Policy on Height, Bulk and Scale (Seattle Municipal Code 25.05.675G) states that development must be “reasonably compatible with the general character” of the area. The City can limit height, modify building bulk and facades, and reposition development to minimize bulk impacts. The Light and Glare policy states that lighting must minimize or prevent hazards and other adverse impacts (Seattle Municipal Code 25.05.675K). The City can place limits on the lighted area, intensity, location, angle, or hours of illumination and can require landscaping to shield the lighting from adjacent properties.

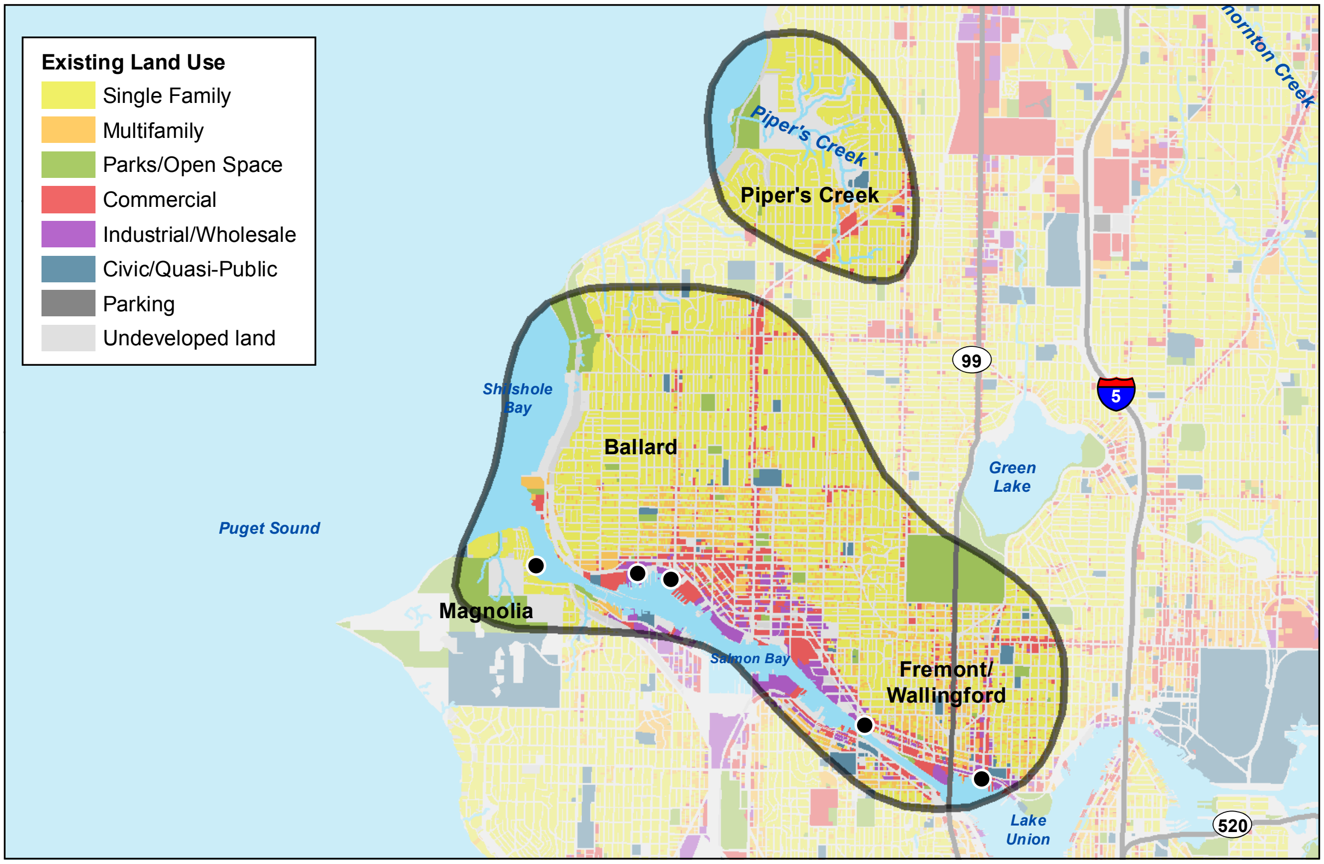
The City also has a Public View Protection policy (Seattle Municipal Code 25.05.675.P) that seeks to protect public views of significant natural and human-made features seen from viewpoints, parks, scenic routes, and view corridors. The policy protects views of Mount Rainier, the Olympic and Cascade Mountains, the Downtown skyline, and major bodies of water including Puget Sound, Lake Washington, Lake Union, and the Ship Canal. The City has inventoried the views from these public areas in an atlas (City of Seattle, 2002).

Important viewpoints in the Plan area include Gasworks Park in the Fremont/Wallingford area and Myrtle Edwards and Olympic Sculpture Parks in the Central Waterfront area. The policy also requires protection of public views of the Space Needle from numerous locations throughout the City. Because the specific locations of proposed facilities are not yet known, more detailed analysis relating to view protection would be conducted when site details have been determined.

4.8.3 What are the existing and anticipated future land and shoreline use characteristics in the Plan area?

The Plan area is located entirely within the city of Seattle. Land use patterns in the Plan area typify urban levels of development and reflect historic land use patterns in Seattle. Figures 4-13 through 4-16 depict existing land use and zoning in the Plan area. Developed land uses in the Plan area are predominantly single-family residential and multi-family residential, followed by commercial and industrial uses. Industrial uses are located primarily within the Longfellow Creek/Duwamish Neighborhoods. Public street rights-of-way in the Plan area are used by industrial, commercial, and vehicle traffic as well as by cyclists and pedestrians. With the exception of the Delridge area, all of the Plan neighborhoods include portions of the City's Shoreline District and shoreline habitat designated as environmentally critical areas. Figures 4-13 through 4-16 show existing land use and zoning for the Plan neighborhoods.

Future land use in the Plan area is guided by the City of Seattle Comprehensive Plan. The Plan area is almost fully developed. Therefore, the amount of impervious surface area is unlikely to increase significantly in the future. Redevelopment is expected to occur within Seattle, with some neighborhoods experiencing more redevelopment than others, particularly in Seattle's designated urban villages, neighborhood areas where future growth is intended to match the existing character of the neighborhood. Zoning in the city reflects Comprehensive Plan designations and is generally consistent with current development.



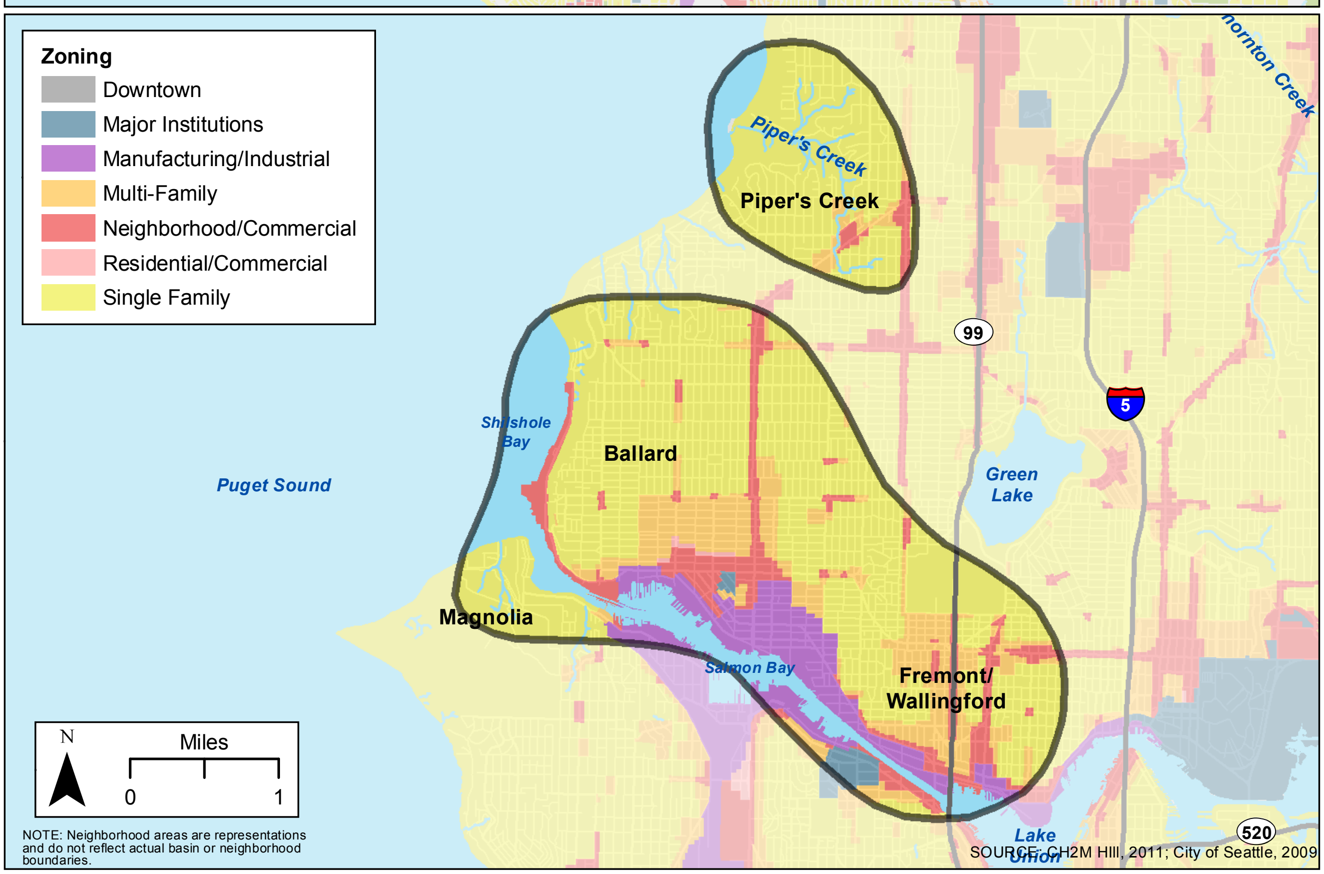


Figure 4-13 Existing Land Use and Zoning: Ship Canal and Piper's Creek Neighborhoods.

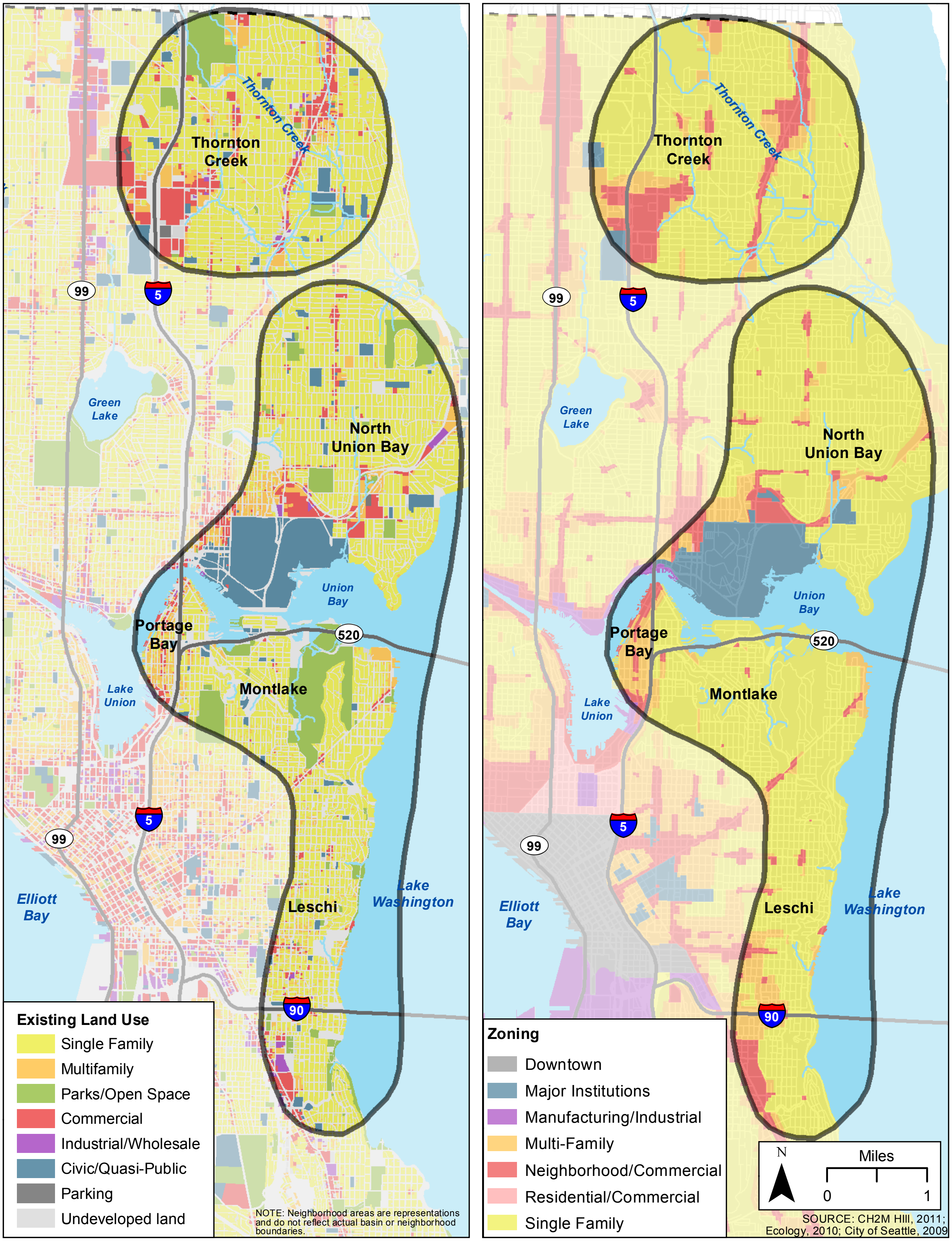


Figure 4-14 Existing Land Use and Zoning: Lake Washington and Thornton Creek Neighborhoods.

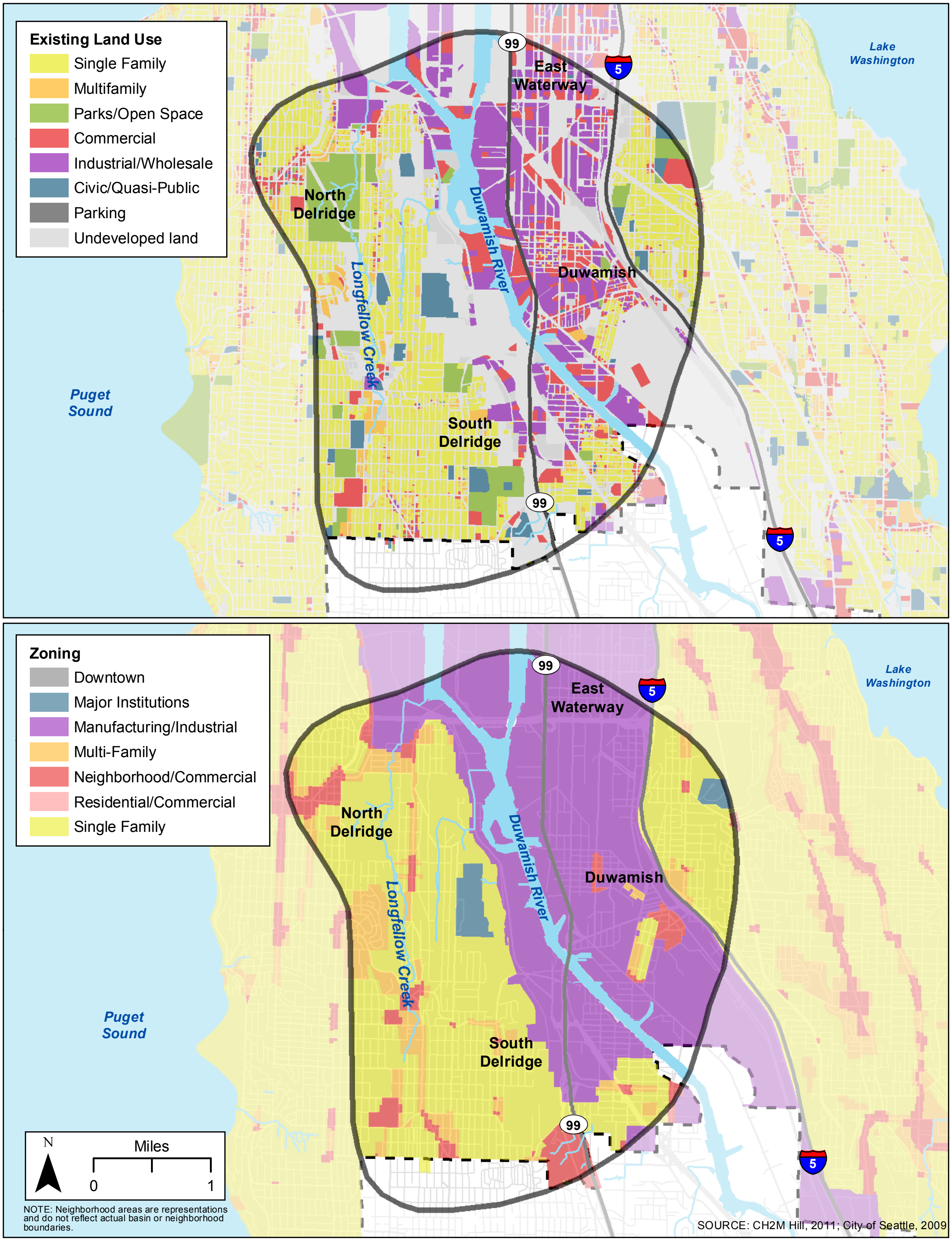


Figure 4-15 Existing Land Use and Zoning: Longfellow Creek/Duwamish Neighborhoods.

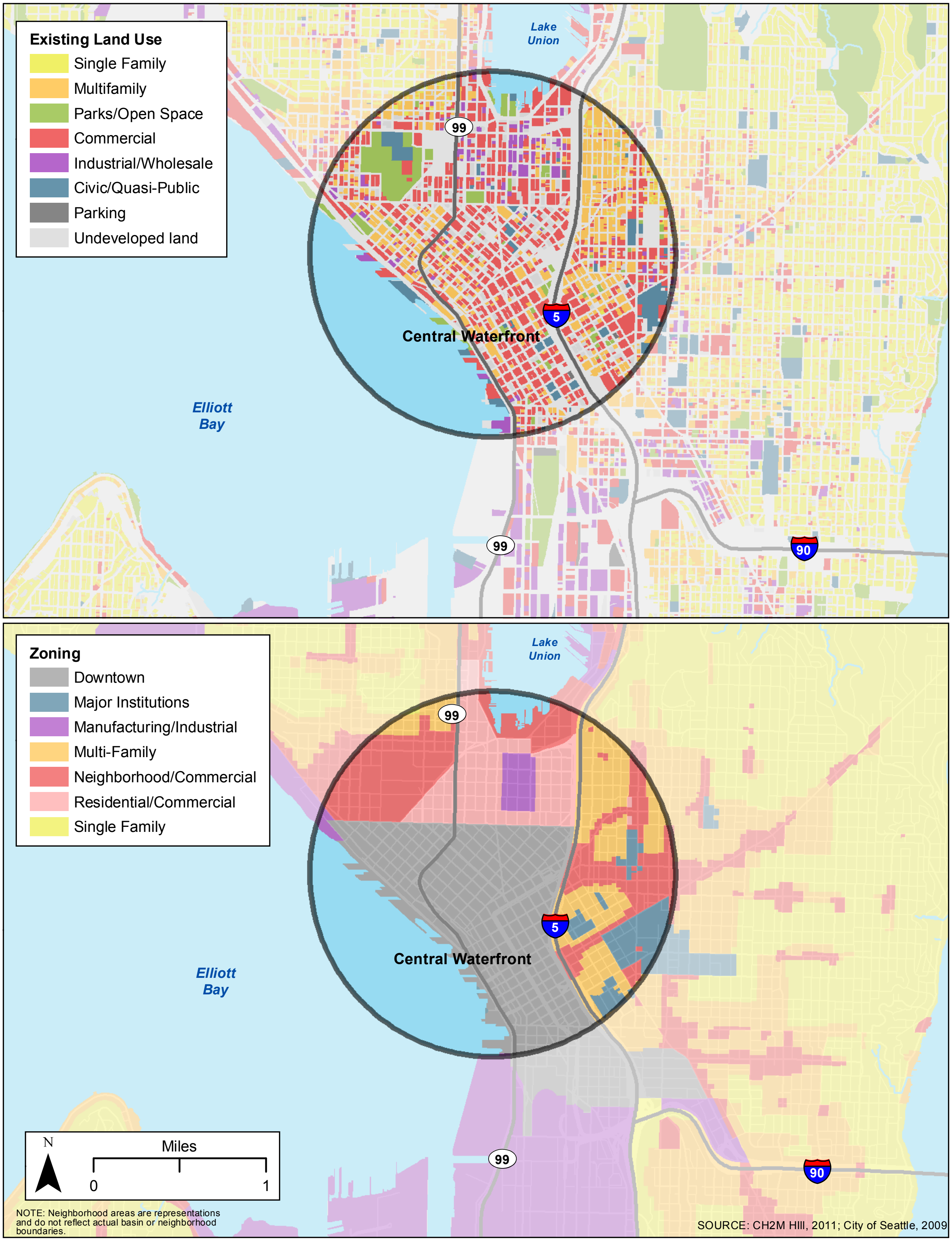


Figure 4-16 Existing Land Use and Zoning: Elliott Bay/Lake Union Neighborhoods.

4.8.4 What are the existing visual characteristics of the Plan area?

Seattle is noted for its views of the surrounding mountains and water bodies as well as structures such as the Space Needle and downtown skyline. These views are an integral part of the city's environmental quality. As described above, the Land Use Code protects public views of Mount Rainier, the Olympic and Cascade Mountains, the downtown skyline and major bodies of water, and from some locations, the Space Needle.

Each of the Plan neighborhoods offers different views of these features, as summarized in Table 4-9.

Table 4-9. Public Views from Plan Neighborhoods

Plan Neighborhoods	Significant Public Views
Ship Canal	
Ballard	Mount Rainier, Olympic Mountains, Cascade Mountains, Puget Sound, Ship Canal
Fremont	Cascade Mountains, Ship Canal, Lake Union
Wallingford	Cascade Mountains, Ship Canal, Lake Union
Lake Washington	
North Union Bay	Mount Rainier, Cascade Mountains, Ship Canal, Lake Washington
Portage Bay	Ship Canal, Lake Washington
Lake Union	Olympic Mountains, Cascade Mountains, Ship Canal, Lake Union
Montlake	Cascade Mountains, Ship Canal, Lake Union, Lake Washington
Union Bay	Mount Rainier, Cascade Mountains, Lake Washington
Leschi	Mount Rainier, Cascade Mountains, Lake Washington
Longfellow Creek/Duwamish	
Delridge	Puget Sound, Olympic Mountains, Cascade Mountains, Downtown Skyline
Duwamish	Puget Sound, Downtown Skyline
Elliott Bay/Lake Union	
Central Waterfront	Mount Rainier, Olympic Mountains, Puget Sound, Downtown Skyline
Piper's Creek	
Piper's Creek	Mount Rainier, Olympic Mountains, Puget Sound, Downtown Skyline
Thornton Creek	
Thornton Creek	Mount Rainier, Cascade Mountains, Lake Washington

4.9 Recreation

4.9.1 What are the adopted plans and policies for parks and recreation in the Plan area?

What is included in this section?

This section provides an overview of the distribution and types of park and recreational opportunities within the Plan area. This section also identifies adopted goals, policies, and plans aimed at protecting and enhancing recreational resources. Section 4.6, Environmental Health and Public Safety, describes issues related to water contact recreation. Section 4.11, Transportation, further addresses bicycle paths and trails.

4.9.1.1 Seattle Parks and Recreation 2011 Development Plan

In 2011, the City of Seattle adopted the *Parks and Recreation 2011 Development Plan* which identifies goals, objectives, and policies for the park and recreation system and discusses priorities for acquisition and development projects through 2017. The *2011-2016 Capital Improvement Program* includes over 100 capital projects at City parks, from minor maintenance projects to major renovation and development of new parks.

4.9.1.2 Plans for Individual Parks

Some City parks have Vegetation Management Plans designed to guide development while maintaining and improving vegetation. Parks within the Plan area that have Vegetation Management Plans include the Burke Gilman Trail in the Ship Canal, Lake Washington, and Thornton Creek Neighborhoods; Discovery Park, Golden Gardens Park, and Woodland Park in the Ship Canal Neighborhoods; Lake Washington Boulevard and Ravenna Woods in the Lake Washington Neighborhoods; Camp Long in the Longfellow Creek/Duwamish Neighborhoods; and Carkeek Park in the Piper's Creek Neighborhoods.

4.9.1.3 Joint Use Agreement with Seattle School District

Over one-third of the schools in the Seattle Public Schools district adjoin parks land or facilities. Seattle Parks and Recreation and the Seattle School District have a Joint Use Agreement for facility use. Each agency has agreed to make its buildings and grounds available for use by the other agency after the space requirements for its own programs have been met.

If projects implemented under the Plan were to impact parks subject to the Joint Use Agreement, they would need to be coordinated with the School District. Parks subject to the agreement within the Plan area include Ballard Playground, Soundview Playfield, B. F. Day Playground, and Wallingford Playground in the Ship Canal Neighborhoods; Laurelhurst Playfield, View Ridge Playfield, Leschi Park, and Madrona Park in the Lake Washington Neighborhoods; High Point Playfield, Cleveland Playfield, and Jefferson Park in the Longfellow Creek/Duwamish Neighborhoods; Sacajawea Park and Meadowbrook Park in the Thornton Creek area; and Carkeek Park in the Piper's Creek area.

4.9.1.4 Ordinance No. 118477

Any construction in a park would have to comply with the requirements of Initiative 42 (Ordinance No. 118477) related to siting public facilities in parks. The ordinance states the following:

> " no [park] land or facility shall be sold, transferred, or changed from park use to another usage, unless the City shall first hold a public hearing regarding the necessity of such a transaction and then enact an ordinance finding that the transaction is necessary because there is no reasonable and practical alternative and the City shall at the same time or before receive in exchange land or a facility of

> equivalent or better size, value, location and usefulness in the vicinity, serving the same community and the same park purposes."

The ordinance also allows any person to seek review in Superior Court if park land is changed to another use.

4.9.2 What recreational properties and activities exist in the Plan area?

The Plan area includes a wide range of recreational properties and facilities. Parks and sites with designated public access within the Plan area are shown on Figure 4-17.

Most of the recreational properties in the Plan area are owned and managed by Seattle Parks and Recreation and the Port of Seattle. The City of Seattle parks and recreation system comprises a variety of parks, open space, boulevards and trails, lakes and creeks, recreational, cultural, environmental and educational facilities, and a broad variety of programs. The Parks and Recreation Department is responsible for the operation and maintenance of 430 parks, 185 athletic fields, 151 outdoor tennis courts, 112 neighborhood play areas, 26 community centers, 11 off-leash areas, 10 swimming pools, and 4 golf courses. City parks include pocket parks and neighborhood parks primarily designed for local residents, and large parks that attract tourists and visitors from the other areas of the city and the region. Major parks and attractions in the Plan area are listed in Table 4-10.

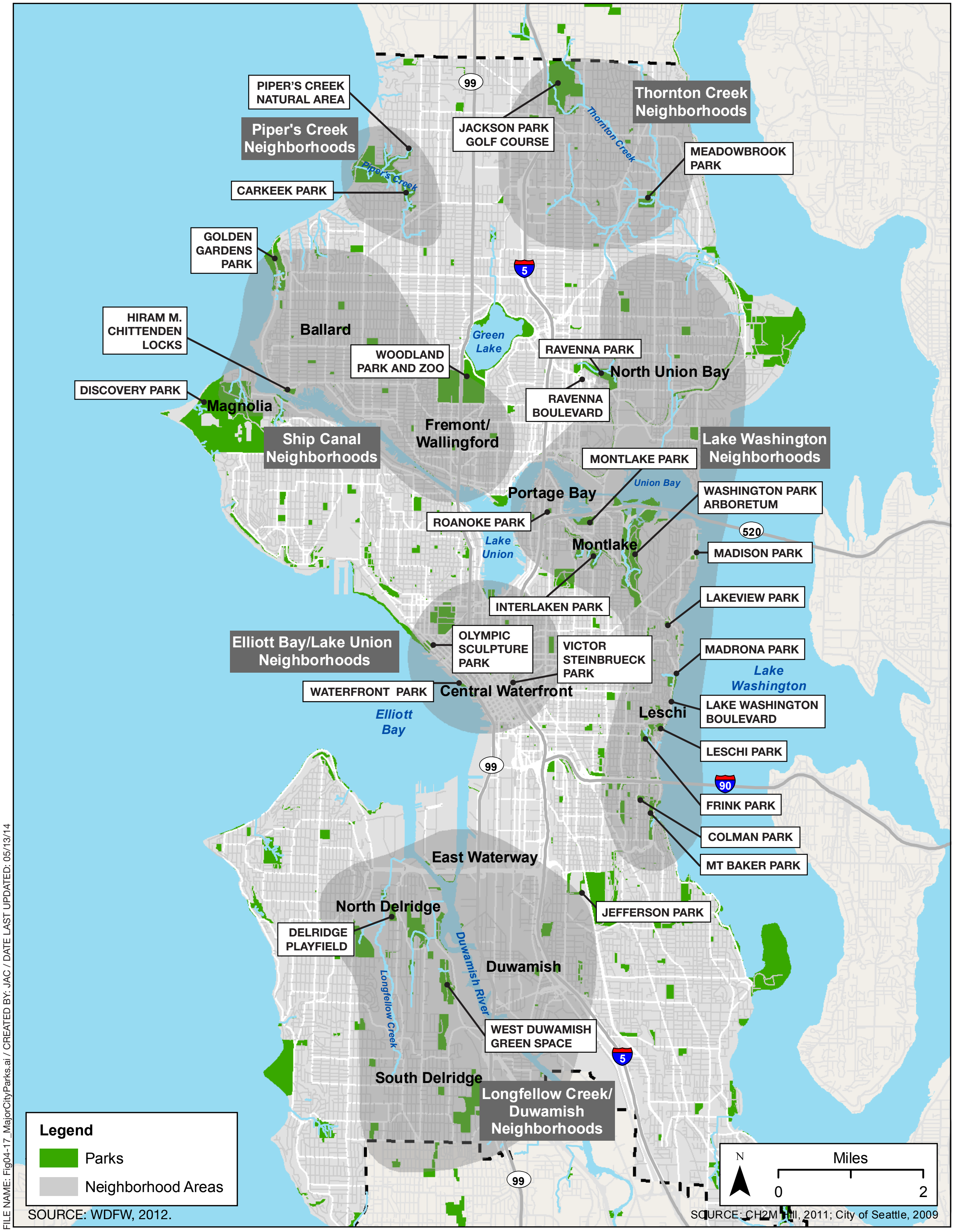


Figure 4-17 Major Parks within the Plan Area.

Table 4-10. Major Seattle Parks by Plan Neighborhood

Plan Neighborhoods	Major Parks and Attractions
Ship Canal	
Ballard	Golden Gardens Park, Hiram M. Chittenden Locks, Burke Gilman Trail
Fremont/Wallingford	Woodland Park, Woodland Park Zoo, Burke Gilman Trail
Magnolia	Discovery Park
Lake Washington	
North Union Bay	Ravenna Park, Ravenna Boulevard, Burke Gilman Trail, Union Bay Natural Area, University of Washington Athletic Complex
Portage Bay	Roanoke Park
Montlake	Montlake Park, Interlaken Park, Washington Park Arboretum
Leschi	Madrona Park, Leschi Park, Lake Washington Boulevard, Mount Baker Park, Frink Park, Colman Park
Longfellow Creek/Duwamish	
Delridge	West Duwamish Green Space, Longfellow Creek Green Space, Delridge Playfields, Duwamish Trail, Alki Trail
Duwamish	Jefferson Park, Chief Sealth Trail
Elliott Bay	
Central Waterfront	Aquarium, Olympic Sculpture Park, Piers 62 and 63, Victor Streinbrueck Park, Waterfront Park, Myrtle Edwards Park
Piper's Creek	
Piper's Creek	Carkeek Park, Piper's Creek Natural Area
Thornton Creek	
Thornton Creek	Jackson Park Golf Course, Meadowbrook Park and Pond, Burke Gilman Trail, Thornton Creek Park, North Acres Park

Several of the parks located within the Plan area were designed by the influential landscape design firm led by the Olmsted Brothers, including Woodland Park in the Fremont/Wallingford area; Washington Park and Arboretum and Interlaken Park in the Montlake area; Madrona Park, Frink Park, Mt. Baker Park, and Colman Park in the Leschi area; and Jefferson Park in the Duwamish area. The Olmsted Brothers also designed a number of boulevards with the Plan area, including Lake Washington, Interlaken, Montlake, and Washington Park Boulevards. Numerous other parks throughout the city, including some in Plan neighborhoods, were influenced or suggested by the Olmsted Brothers.

Seattle Parks and Recreation maintains several public swimming beaches. Three of these beaches are within the Lake Washington Neighborhoods: Madison Park, Madrona, and Mount Baker Beaches.

Some parks in Plan neighborhoods, including Ravenna Park, the Mt. Baker Boat Facility, Gas Works Park, and Discovery Park, have National Park Service Land and Water Conservation Fund grants. These grants provide funds for acquisition and development of recreation areas. The Port of Seattle has more than 60 acres of parks and public access sites. These include bicycle and pedestrian trails, picnic areas, habitat restoration areas, fishing piers, and shoreline access. Within the Plan area, most of these sites are located in the Elliott Bay/Lake Union and Longfellow Creek/Duwamish Neighborhoods.

In 2008, Seattle voters passed a Parks and Green Spaces Levy. A number of park projects funded by the levy have been completed and several are planned for the future. The levy also funds an Opportunity Fund. Several upcoming projects funded by the levy and the Opportunity Fund would take place in Plan neighborhoods, including the Threading the Needle park project in Ballard at the 24th Avenue street end.

Schools have recreational facilities such as athletic fields and playgrounds that are generally open to the public. Most Plan neighborhoods include water access or waterfront recreation, and all neighborhoods include opportunities for passive recreation.

Public and private marinas can be found in the Ship Canal, Lake Washington, Longfellow Creek/Duwamish, and Elliott Bay/Lake Union Neighborhoods. Private or public golf courses can be found in the Lake Washington Neighborhoods (Broadmoor Golf Club and University of Washington Golf Range) and Longfellow Creek/Duwamish Neighborhoods (West Seattle Recreation Center and Jefferson Park Golf Course).

The Seattle Department of Transportation maintains a 450-mile bikeway network in the city made up of separate pathways, marked streets, and connectors. Separate bicycle pathways in the Plan area include the Burke Gilman Trail in the Ship Canal and Lake Washington Neighborhoods and Thornton Creek area; Elliott Bay Trail in the Elliott Bay/Lake Union; Mountains to Sound Trail in the Lake Washington; and Duwamish Trail, Alki Trail, and Chief Sealth Trail in the Longfellow Creek/Duwamish Neighborhoods. These trails are illustrated in Figure 4-20 in Section 4-20, Transportation.

There are 17 adopted Green Streets in Downtown Seattle and 15 adopted Neighborhood Green Streets. A Green Street is a street right-of-way that, through a variety of design and operational treatments, gives priority to pedestrian circulation and open space over other transportation uses. The treatments may include sidewalk widening, landscaping, traffic calming, and other pedestrian-oriented features. Among their many functions, Green Streets create open space opportunities in residential areas that may be otherwise lacking public open spaces. Neighborhood Green Streets are designated through neighborhood plans or other City adoption processes.

4.10 Historic, Cultural, and Archaeological Resources

> **What is included in this section?**
>
> This section includes information on the regulations that apply to historic, cultural, and archaeological resources in the Plan area. It also provides a brief history of Seattle and summarizes the known cultural resources in the Plan area.

4.10.1 What is the regulatory setting for cultural resources?

Cultural resources are evaluated under different regulations depending on funding, permitting, and land ownership. These federal, state, and local regulations are summarized in Table 4-11.

Table 4-11. Regulations and Permits for Historic, Cultural and Archaeological Resources

Statute	Lead Agency	Regulated Activities
Federal		
National Historic Preservation Act, Section 106 of 16 USC 470s	Funding or permitting agency	Requires lead federal agency to "take into account the effect of the undertaking on any district, site, building, structure, or object that is included in or eligible for inclusion in the National Register." The lead federal agency will require the proponent to identify historic properties that may be potentially affected, assess the effects, and seek ways to avoid, minimize, or mitigate any adverse effects on historic properties.
State of Washington		
State Environmental Policy Act (SEPA)	Ecology	Requires that cultural resources within a proposed project area must be identified, and that measures must be proposed to reduce or control impacts on these resources. Under SEPA, the Department of Archaeology and Historic Preservation (DAHP) provides formal opinions on the significance of sites and the impact of proposed projects on such sites.
Indian Graves and Records (RCW 27.44), Abandoned and Historic Cemeteries and Historic Graves (RCW 68.60), Archaeological Sites and Resources (RCW 27.53), and Discovery of Human Remains (RCW 27.44)	DAHP	These laws contain clauses regarding the inadvertent discovery of cultural resources or human remains during activities such as construction.
Executive Order 05-05	DAHP	Establishes a review process by DAHP and affected Tribes for state-funded capital or land acquisition.
City of Seattle		
Historic Preservation Program (SMC 25.12)	Landmarks Preservation Board	Reviews and must approve proposed alterations to City of Seattle Landmarks. Issues a Certificate of Approval for any changes.

4.10.2 What is the history of the area?

Central Puget Sound and Lake Washington were inhabited for thousands of years prior to the arrival of EuroAmericans. The shorelines, freshwater streams, rivers, and lakes were seasonally and permanently inhabited by Native American people. These areas were utilized for food gathering, fishing, hunting, and procuring other resources. Upland areas were also utilized, though probably less intensively. Several significant archaeological sites within the Plan area demonstrate the long Native American occupation of the Puget Sound region.

EuroAmerican settlement of Seattle began with the arrival of the Denny Party in 1851. The city developed in several historic periods roughly divided into the Frontier Period (1850-1889), the Developmental Period (1890-1940), the Metropolitan Period (1941-1968), and the Modern Period (1969-present).

Historic resources are generally not considered eligible to the National Register of Historic Places until they are 50 years old. Because construction of projects implemented under the Plan is not anticipated until 2016 at the earliest, this means that the termination of the Metropolitan Period for the Plan would be 1966.

Evaluation Criteria for Listing in the National Register of Historic Places.

The quality of significance in American history, architecture, archeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association and

(a) that are associated with events that have made a significant contribution to the broad patterns of our history; or

(b) that are associated with the lives of persons significant in our past; or

(c) that embody distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or

(d) that have yielded, or may be likely to yield, information important in prehistory or history. (36 CFR 60.4)

Because different areas of the city grew at separate paces, there is variation among the neighborhoods in terms of the timing of their historic periods. For example, the Elliott Bay Neighborhoods entered into the Developmental Period following the Great Seattle Fire in 1889, while other areas that lacked streetcars or utilities remained functionally in the Frontier Period. Seattle grew through annexation and many of today’s neighborhoods began as small incorporated towns.

Both aboveground and buried cultural resources related to the historic uses described below could be present in each of the neighborhoods.

4.10.2.1 Ship Canal Neighborhoods

In general, the growth of railroads in the 1890s led to the development of the Ship Canal Neighborhoods. Magnolia, Wallingford, and Brooklyn (now part of the University District) were annexed in 1891, while Ballard was annexed to the city in 1907. The Ship Canal Neighborhoods were significantly impacted by the creation of the Ship Canal between 1911 and 1934. Development of neighborhoods north of 80th Street did not occur until after 1912 when roads were constructed. Early industries in these neighborhoods included shingle mills, fishing, and ship building.

4.10.2.2 Lake Washington Neighborhoods

Beginning around 1869 and continuing into the early 1900s, this group of neighborhoods developed over a broader period of time than other neighborhoods in the Plan area. As with the Ship Canal Neighborhoods, the Lake Washington Neighborhoods grew through annexation. The Lake Washington Neighborhoods were influenced by the construction of the Ship Canal between 1911 and 1934. The University of Washington moved to its present location in 1895 and developed substantially by 1909 when it hosted the Alaska-Yukon-Pacific Exposition.

4.10.2.3 Longfellow Creek/Duwamish Neighborhoods

As with other neighborhoods, growth occurred through annexation: West Seattle and Columbia City were annexed in 1907 while Georgetown was annexed in 1910. The Duwamish River was reworked through dredging and straightening between 1909 and 1920, which influenced the development of the neighborhoods. Flooding became less prevalent and industry took over the reclaimed land. Industries in these neighborhoods included steel mills, shipping, breweries, and ship building.

4.10.2.4 Elliott Bay/Lake Union Neighborhoods

The Elliott Bay/Lake Union Neighborhoods were the earliest areas developed within Seattle following the arrival of the Denny Party in late 1851. The depth of Elliott Bay was an essential factor in locating the heart of the new city because timber was viewed as a major export. Logging and milling were among the earliest industries, but other commerce soon grew to supply the increasing population. The first post office was established in 1852 quickly followed by a private school. The town was platted in 1853 within three original homesteads of Arthur Denny, Carson Boren, and Dr. David S. Maynard; this established the present day street grid (Bagley, 1916).

The Elliott Bay/Lake Union Neighborhoods are among the most substantially altered neighborhoods in Seattle. Elliott Bay was filled over the course of many years, piers were built out over the water, and the land was regraded numerous times.

4.10.2.5 Piper's Creek

The Piper's Creek area was not annexed until 1940 and 1954. This area was considered remote during the Frontier and Developmental Periods. The area's small shoreline-focused communities expanded with the introduction of improved road access. Early industries revolved around logging and milling, followed by agricultural and residential use of cleared lands.

4.10.2.6 Thornton Creek

The Thornton Creek area includes portions of Lake City and Cedar Park. These areas were annexed by Seattle in 1953-1954 and saw substantial growth during the Metropolitan and Modern Periods. At the turn of the century, these areas were remote forested areas with limited roads. Early industries were tied to logging and milling, with small communities located along the western shore of Lake Washington. As roads into the area were improved, development increased.

4.10.3 What is the study area for cultural resources for the Plan?

The study area for cultural resources for the Plan is defined as the "neighborhoods" depicted on Figure 4-2. The study area does not include water bodies because no in-water work is expected. The project team reviewed the Seattle Landmarks register and the state cultural resources database for each Plan neighborhood in March 2012 to assess the presence of historic register properties, recorded archaeological and historic sites, cemeteries (including municipal cemeteries, historic/inactive cemeteries, and individual historic and Native American gravesites), and "historic properties" (defined as buildings and structures 50 years of age or older). The project team also reviewed the Washington State Archaeological Predictive Model developed by DAHP to identify potential locations of unknown buried precontact (or prehistoric) cultural resources. The Predictive Model categorizes most of the Plan area as having a moderate to very high probability for buried precontact cultural resources. Prior to any development in moderate to very high probability areas, cultural resources surveys are recommended (moderate probability areas) or highly advised (high probability and very high probability areas).

Previous cultural resources investigations have been conducted within the Plan area. In general, the few systematic surveys that have been conducted have been for infrastructure projects such as highway, light rail, or utility construction. Because there have been few previous investigations, the Predictive Model has not been refined in these areas.

All of the Plan neighborhoods were developed more than 50 years ago and they all contain numerous historic properties. However, not all of these are historically significant. Historic properties with demonstrated significance exist in all Plan neighborhoods and include properties listed on the National Register of Historic Places or as designated Seattle Landmarks. City of Seattle historic districts exist within the Ship Canal, Lake Washington, and Elliott Bay/Lake Union Neighborhoods. National Register districts exist in all neighborhoods except for Longfellow Creek/Duwamish. Cultural resources have been identified within a variety of settings in each neighborhood including road corridors, parks, and commercial areas. In some instances, the resource is the road corridor itself, as is the case for Queen Anne Boulevard or Lake Washington Bicycle Path, which are designated Seattle Landmarks.

Several parks and boulevards in the Plan area were designed by the nationally recognized landscape architects Frederick Law Olmsted and John Charles Olmsted. These historic parks and boulevards are described in more detail in Section 4.9, Recreation.

Several of the archaeological sites recorded within the Plan area are of particular significance including the Duwamish No. 1 Site, a 2,000-year-old winter camp and food processing site (Campbell, 1981; URS Corporation and BOAS, Inc., 1987) and *St'it'uchi*, a Native American Traditional Cultural Property on the shores of Lake Washington that is eligible for listing on the National Register of Historic Places. Cemeteries are located in all of the neighborhoods except for Piper's Creek.

4.10.4 What cultural resources are likely to be located within the Plan area?

The land within the Plan area has been subject to earthquakes, river migration, and sea level changes which have affected the preservation of cultural resources. For example, an earthquake 1,100 years ago caused Alki Point to rise 10 feet in elevation and West Point to sink 10 feet in elevation (to below sea level). The drainage patterns in the Duwamish-Green River Valley have undergone numerous changes (Troost et al., 1995; Lewarch et al., 1996).

Human modification of the landscape has also greatly impacted the preservation of cultural resources, including changes in the elevation of Lake Washington (lower since the construction of the Ship Canal), the straightening of the Duwamish River, and massive regrades in the Elliott Bay/Lake Union Neighborhoods. Due to the complex, intertwined natural and cultural histories of Seattle, archaeological resources in any given area may be deeply buried, shallowly buried, exposed at the surface, or previously eroded/destroyed by natural and human processes. Buried cultural resources could include Native American sites such as encampments, resource procurement sites, food processing sites, or features such as fish weirs, or historic buried resources such as foundations, historic abandoned infrastructure (roads and utilities), privies, and dumps.

4.11 Transportation

4.11.1 What are the relevant adopted plans, policies, and regulations?

What is included in this section?

This section describes federal, state, and local transportation plans and policies that are relevant to the Plan. It summarizes the existing transportation system, including roadways, parking, transit, and nonmotorized facilities, within the areas that could be affected by the Plan projects. It also describes major transportation capital improvement projects that are either planned or underway in the Plan area.

Transportation impacts associated with the Plan are anticipated to result primarily from construction. Table 4-12 describes transportation standards and regulations related to construction within public road rights-of-way.

In addition to the standards and regulations described in the table, there are regulations that apply to work near rail facilities. The Washington State Department of Transportation (WSDOT) oversees freight and passenger rail service throughout the state, but it does not have jurisdiction over rail infrastructure. Any work near rail facilities must be coordinated directly with the owners of the railroads. A 3-mile segment of railroad in Ballard is owned by the Ballard Terminal Railroad. All other railroads in the Plan area are owned by the Burlington Northern-Santa Fe (BNSF) Railway.

Table 4-12. Regulations, Guidelines and Permits for Transportation Projects in Seattle

Statute or Guideline	Lead Agency	Regulated Activities
Federal		
Manual on Uniform Traffic Control Devices (MUTCD)	Federal Highway Administration (FHWA)	Defines standards used by road managers nationwide to install and maintain traffic control devices on all public streets, highways, bikeways, and private roads open to public traffic. The MUTCD is a compilation of national standards for all traffic control devices, including road markings, highway signs, and traffic signals. It is updated periodically to accommodate the nation's changing transportation needs and address new safety technologies, traffic control tools, and traffic management techniques. The MUTCD includes standards for signs, flagging, and barricades in temporary construction work zones.
State of Washington		
Work Zone Traffic Control Guidelines	Washington State Department of Transportation (WSDOT)	WSDOT has jurisdiction over state highways and ramp intersections. Work conducted within the right-of-way of state highways must be coordinated with WSDOT. The WSDOT *Work Zone Traffic Control Guidelines* (WSDOT, 2012c) are based on the standards set forth in the MUTCD.

Table 4-12. Regulations, Guidelines and Permits for Transportation Projects in Seattle		
Statute or Guideline	**Lead Agency**	**Regulated Activities**
City of Seattle		
Traffic Control Manual for In-Street Work	City of Seattle Department of Transportation (SDOT) Traffic Management Division	Defines the basic principles and standards for work performed within a street right-of-way so that work areas are safe and congestion is minimized; motorized and nonmotorized traffic is warned, controlled, and protected; and all traffic is expedited through the work zone to the extent possible. The manual defines requirements for traffic control plans, including pedestrian and bicycle access, detours, parking, and construction scheduling requirements, among other requirements. Work near King County Metro facilities (including trolley wires and bus stops) must be coordinated with Metro. A traffic control plan is required prior to the commencement of work in the public right-of-way when: • The project will impact pedestrian or vehicle movements on an arterial street; or • The project will impact pedestrian or vehicle movements in a high-impact area as defined by the City Traffic Engineer; or • Traffic control cannot be made to exactly match sketches in the Traffic Control Manual; or • Other special circumstances exist as determined by the City Traffic Engineer.

4.11.2 What are the existing transportation characteristics of the Plan area?

The existing transportation system includes roadways, parking facilities, transit, rail, Port of Seattle facilities, and nonmotorized facilities, described in the following sections.

4.11.2.1 Roadways

Figure 4-18 shows the Seattle roadway system and highlights the freeways, arterials, and collectors that serve the Plan area. All roadways in Seattle have designated functional classifications, which depend on the types of trips the roadways serve and the relative levels of traffic volumes they carry.

Each roadway within Seattle has been designated with one of the following classifications (City of Seattle, 2005):

- **Interstate Freeways** provide the highest capacity and least impeded traffic flow for longer vehicle trips (includes I-5 and I-90).
- **Regional Arterials** provide for travel between regions, carry traffic through the city, and serve important traffic generators, such as regional shopping centers, a major university, or sports facilities.
- **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 (includes SR-99 and SR-520).
- **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 or provide direct access to destinations.

- **Commercial (Local) Access Streets** directly serve commercial and industrial land uses and provide localized traffic circulation.
- **Residential (Local) Access Streets** provide access to neighborhoods and other streets.
- **Alleys** provide access to the rear of residences and businesses and are not intended for through trips. Where a continuous alley network exists, it is the preferred corridor for utility facilities.

These functional classifications represent varying levels of emphasis on mobility and access. For example, freeways and arterials provide a high degree of mobility and have more limited access to adjacent land uses, accommodating larger traffic volumes at higher speeds. In contrast, residential and commercial access streets provide a high degree of access to adjacent land and are not intended to serve through traffic, carrying smaller traffic volumes at lower speeds. Collectors generally provide a more balanced emphasis on traffic mobility and access to land uses. The Plan neighborhoods have a variety of types of streets that consist of arterials, collectors, and local access streets.

In addition, the City has designated some of Seattle's arterial streets as Major Truck Streets. They accommodate substantial freight movement through the city and connect to major freight traffic generators (City of Seattle, 2005). Roadway characteristics and potential issues for Major Truck Streets would be similar to those of any other arterial roadway, but the streets would likely carry more truck traffic.

The City of Seattle conducts regular counts of Average Daily Traffic (ADT) on arterials and collectors throughout the city. The ADT may range from under 2,000 vehicles per day on a minor collector roadway to greater than 80,000 vehicles per day on a major arterial roadway. The City does not typically conduct regular counts on local access streets. However, since these streets primarily serve adjacent residential or commercial developments, they are expected to carry relatively low traffic volumes.

Drawbridges are located over the Ship Canal, Portage Bay, and Duwamish River. These bridges open regularly to allow marine vessels to pass through, resulting in vehicle delays and queues in the adjacent areas.

4.11.2.2 Parking

Parking supply and demand in Seattle varies greatly from neighborhood to neighborhood. In some neighborhoods there is ample parking, and in others, parking is extremely scarce and additional limitations would be of concern to residents. Public parking is typically provided on-street. Where on-street parking is allowed, it may be unrestricted, or it may be restricted during certain times of day. In higher density or commercial areas where available parking is limited, the City controls on-street parking through the use of Restricted Parking Zones (RPZs) or metered parking. RPZs may restrict the length of time or time of day when drivers may park without a permit. In neighborhoods where commercial parking demand can typically be accommodated with the available supply, on-street parking is allowed with no restrictions or cost. Private parking for residential, commercial, industrial, and institutional development is typically provided in off-street surface lots or garages.

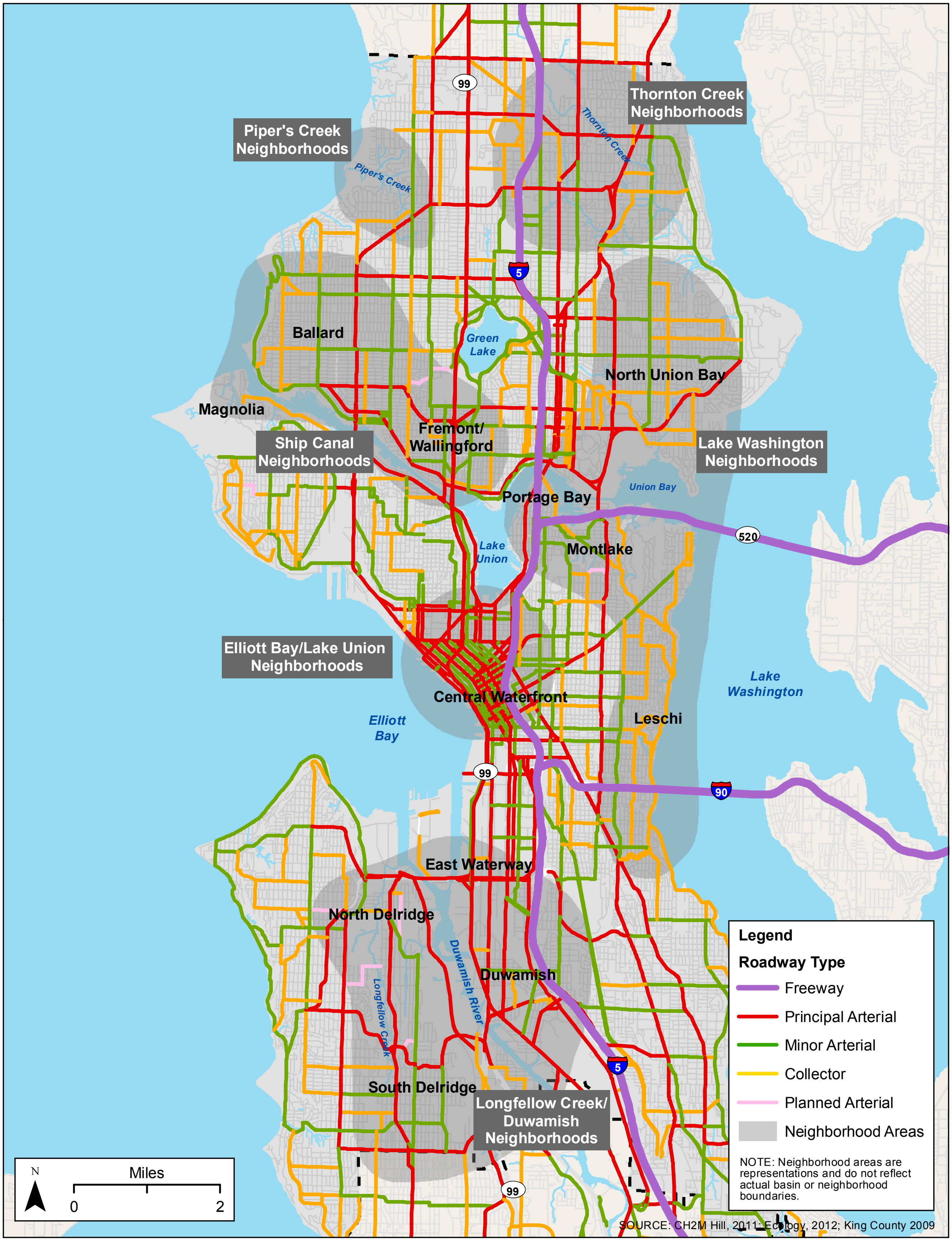


Figure 4-18 Roadways Serving Plan Area Neighborhoods.

4.11.2.3 Transit

Transit service in Seattle is provided by bus, streetcars, light rail, commuter rail, ferries, and water taxis. Figure 4-19 illustrates transit service in the Plan area.

4.11.2.4 Passenger and Freight Rail

Railroads in Seattle include the Ballard Terminal Railroad and BNSF lines. The Ballard Terminal Railroad operates trains on 3 miles of track on the north side of Salmon Bay in the Ballard area. All other railroad tracks in Seattle are owned by BNSF. The BNSF tracks are generally north-south in orientation and are located on the west side of Seattle in the Ship Canal, Longfellow Creek/Duwamish, and Elliott Bay/Lake Union Neighborhoods.

Amtrak also operates passenger rail on the BNSF tracks through Seattle. The Amtrak Cascades route operates daily trains from Seattle to Portland; Vancouver, BC; Los Angeles; and Chicago. In Seattle, passenger trains are boarded at the King Street Station, south of the Central Waterfront area.

4.11.2.5 Port of Seattle

The Port of Seattle marine port is located between the Central Waterfront and Duwamish neighborhoods. In addition to freight rail traffic, the Port of Seattle generates freight truck traffic that travels between the port and the regional highway system. Cruise ships also operate out of Port of Seattle facilities in the Central Waterfront area between May and October.

4.11.2.6 Nonmotorized Facilities

Many areas throughout Seattle have sidewalk networks or paved pedestrian pathways, but some do not, particularly in areas that are beyond the original city limits. Signalized intersections typically include marked crosswalks with pedestrian signals. Marked crosswalks are provided at some stop-controlled intersections and mid-block locations. All intersections that do not have marked crosswalks are still considered to be legal pedestrian crossings.

In addition to sidewalks, nonmotorized facilities in Seattle include pathways and trails that are separated from roadways, painted on-street bicycle lanes, and roadway lanes that are marked with “sharrows” indicating that motorists should share the lane with bicyclists. In addition, some roadways without bicycle pavement markings are designated as bicycle routes that may be either signed or unsigned (City of Seattle, 2011b). Figure 4-20 shows the major bicycle facilities that serve the Plan area.

Many neighborhoods in Seattle include parks, libraries, recreational facilities, schools and universities, and commercial development that can generate substantial pedestrian and bicycle traffic. Areas with a mixture of residential and commercial development often have a greater share of pedestrian and bicycle travel. Neighborhoods that consist primarily of low-density residential or commercial development typically have less nonmotorized activity.

The parking characteristics of a neighborhood can also affect pedestrian and bicycle traffic. In neighborhoods where parking supply is limited, parking is more likely to have time restrictions or pricing. Residents may own fewer cars, and more people may choose transit or nonmotorized modes of travel. People who drive and park in these areas are likely to stay parked in one spot and walk between destinations.

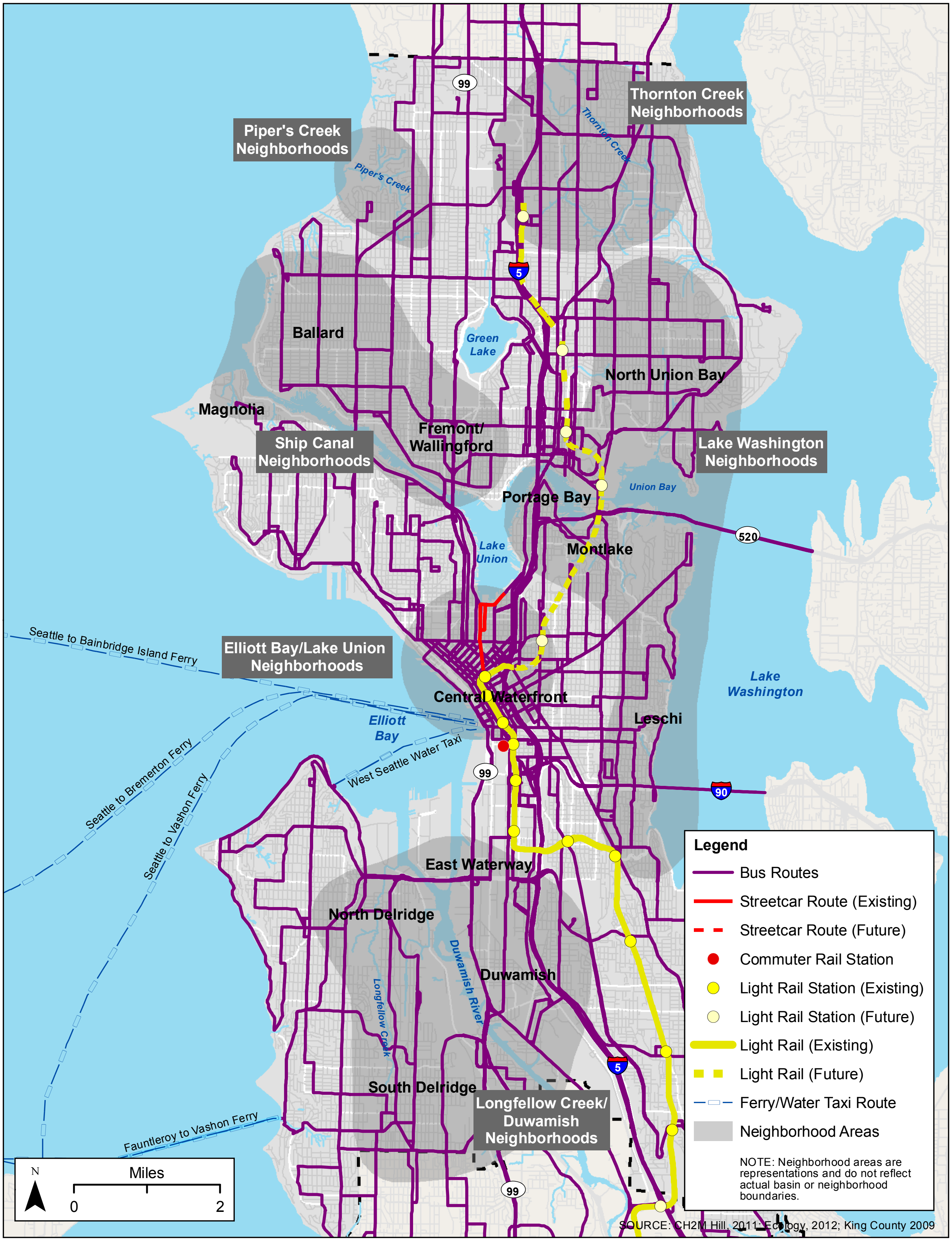


Figure 4-19 Transit Serving Plan Area Neighborhoods.

Figure 4-20 Non-Motorized Facilities Serving Plan Area Neighborhoods.

4.11.3 What transportation facilities are present in each Plan neighborhood?

4.11.3.1 Ship Canal Neighborhoods

In the Ship Canal Neighborhoods, the Ballard, Fremont, and Wallingford commercial districts and the area surrounding Seattle Pacific University have the most transportation activity. These areas are served by major roadways and also tend to have higher levels of transit service, as well as pedestrian and bicycle activity. Major off-road trails along the Ship Canal and Shilshole Bay to Golden Gardens Park are used by many pedestrians and bicyclists. Table 4-13 summarizes transportation characteristics in the Ship Canal Neighborhoods.

Table 4-13. Ship Canal Neighborhoods Transportation Characteristics

Facilities	Transportation Characteristics
Roadways	Streets with highest traffic volumes: • Holman Road, 15th Avenue NW • NW Market Street/N 46th Avenue • Leary Avenue NW • NW Leary Way/N 36th Street • Aurora Ave (SR-99) • Market Street/N 46th Avenue • Fremont Avenue • W Nickerson Street • 3rd Avenue W
Bridges	Ballard Bridge—drawbridge at 15th Avenue NW Fremont Bridge—drawbridge at Fremont Avenue N Aurora Avenue Bridge
Parking	Parking constrained in commercial districts, near: • Lincoln High School, • Seattle Pacific University On-street parking limited: • Along NW Market Street west of 15th Avenue NW • Two-block area south of Ballard Commons Park • Near Ballard Locks • Along Seaview Avenue NW • Restricted in Fremont including prohibitions during peak commute periods or all day Parking in residential neighborhoods—generally available and unrestricted
Transit	Bus routes—principal and minor arterials, RapidRide on 15th Avenue NW
Railroads	Ballard Terminal Railroad from BNSF mainline along Seaview and Shilshole Avenues to its terminus at NW 40th Street/6th Avenue NW BNSF track crosses Ship Canal west of Ballard Locks and runs north roughly parallel to Seaview Avenue Railroad spur between the rail yard and Ship Canal east of Ballard Bridge

Table 4-13. Ship Canal Neighborhoods Transportation Characteristics	
Facilities	**Transportation Characteristics**
Nonmotorized Facilities	Sidewalk system—generally complete High levels of bicycle and pedestrian activity: • Ballard commercial district, Ballard Locks, Golden Gardens Park • Fremont and Wallingford commercial districts, Woodland Park and Woodland Park Zoo • Near Seattle Pacific University Trails: • Burke Gilman Trail • Ship Canal Trail south of Ship Canal between Fremont and Ballard Bridges

4.11.3.2 Lake Washington Neighborhoods

The University of Washington and surrounding University District are served by three major roadways with a high concentration of transit service and substantial pedestrian and bicycle activity. Parking is limited in this area. Vehicular and nonmotorized traffic is also high on the roadways adjacent to Lake Washington in the North Union Bay and Leschi neighborhoods. Other parts of the Lake Washington Neighborhoods generally experience lower levels of traffic, but roads tend to be narrow or curved, with fewer options for alternate routes. Two major transportation construction projects are also occurring in the University District and Montlake neighborhoods: the SR-520 floating bridge replacement and the University Link extension of Sound Transit light rail. Table 4-14 summarizes transportation characteristics in the neighborhoods.

Table 4-14. Lake Washington Neighborhoods Transportation Characteristics	
Facilities	**Transportation Characteristics**
Roadways	Streets with highest traffic volumes: • SR-520 • I-90 (no access from neighborhoods) • 24th Avenue E • Harvard Avenue E • E Roanoke Street • Montlake Boulevard NE • 25th Avenue NE • Sand Point Way • NE Pacific Street Residential streets are narrow and curved in many areas
Bridges	Montlake—drawbridge over Canal between Portage and Union Bays
Parking	On-street parking: • Generally available and unrestricted outside University District • Permits required near University to prevent overflow parking • Constrained south of NE 55th Street and west of 25th Avenue NE • Limited on narrow and curved roadways • Prohibited on busier streets during peak commute periods • Prohibited on street approaches to the Lake Union waterfront

Table 4-14. Lake Washington Neighborhoods Transportation Characteristics	
Facilities	**Transportation Characteristics**
Transit	Bus routes: • Principal and minor arterials • Highest concentration in and near the University
Railroads	None
Nonmotorized Facilities	Sidewalk system—generally complete High levels of bicycle and pedestrian activity: • University of Washington • Ravenna Park • Along Lake Washington • Washington Park Arboretum • Neighborhood commercial districts

4.11.3.3 Longfellow Creek/Duwamish Neighborhoods

The highest level of transportation activity in the Longfellow Creek/Duwamish Neighborhoods occurs in localized areas surrounding commercial districts, the industrial area in Duwamish, and recreational areas in Delridge. The West Seattle Bridge, crossing Harbor Island and the Duwamish River, provides the major connection between these two areas. The Duwamish industrial area experiences lower levels of pedestrian activity but serves as a major hub for freight-related activity. Its roads serve major truck traffic, and freight rail lines also traverse the area. The Delridge area is primarily residential, with higher traffic volumes, transit service, and nonmotorized travel occurring near commercial strips along major roadways, parks, recreational facilities scattered throughout the area, and South Seattle Community College. Table 4-15 summarizes transportation characteristics in the neighborhoods.

Table 4-15. Longfellow Creek/Duwamish Neighborhoods Transportation Characteristics	
Facilities	**Transportation Characteristics**
Roadways	Streets with highest traffic volumes: • West Seattle Bridge and Spokane Street • 35th Avenue SW • Delridge Way SW • West Marginal Way • East Marginal Way (SR-99) • 1st, 4th and 6th Avenues S • Airport Way S
Bridges	West Seattle Bridge—primary access between west and north/central Seattle
Parking	On-street and residential parking: • Generally available and unrestricted • Limited on north-south streets north of S Spokane Street, Delridge Way SW, commercial pockets on major area roadways, and commercial portions of Beacon Avenue S and 15th Avenue S • Industrial and commercial areas west of I-5 serviced by on-site surface lots

Table 4-15. Longfellow Creek/Duwamish Neighborhoods Transportation Characteristics

Facilities	Transportation Characteristics
Transit	Bus routes: • Principal arterials • Highest concentration along West Seattle Bridge, SW Avalon Way, Delridge Way SW, and East Marginal Way
Railroads	BNSF lines in Duwamish running primarily north-south with limited east-west road crossings Major rail yard south of West Seattle Bridge
Nonmotorized Facilities	Sidewalk system—generally complete High levels of bicycle and pedestrian activity: • South Seattle Community College • West Seattle Recreation Center • Puget Park • Riverview Playfield • Jefferson Park Trails: • Duwamish Trail • Alki Trail • North-south parkway between 4th Avenue and 6th Avenue S, connecting S Royal Brougham Way to S Forest Street • Chief Sealth Trail

4.11.3.4 Elliott Bay/Lake Union Neighborhoods

The entire Elliott Bay/Lake Union area experiences very high levels of transportation activity. All Central Waterfront roadways carry notable levels of vehicular traffic. The Central Waterfront and Downtown neighborhoods serve as Seattle's major transit hub, with bus transit, light rail, streetcar, commuter rail, ferries, and water taxis all converging in this area. Parking is generally available because it is priced and tightly controlled; parking is provided on-street and in private surface lots and garages. Many pedestrians and bicyclists also travel in the Central Waterfront area. A major transportation construction project is occurring in the Central Waterfront area: the replacement of the Alaskan Way Viaduct (SR-99) with a bored tunnel. Table 4-16 summarizes transportation characteristics in the Elliott Bay/Lake Union Neighborhoods.

Table 4-16. Elliott Bay/Lake Union Neighborhoods Transportation Characteristics

Facilities	Transportation Characteristics
Roadways	Streets with highest traffic volumes: • I-5 with ramps at E Denny Way, Olive Way, University Street, Madison Street, James Street, and Yesler Way • SR-99 • Denny Way • Battery Street • Stewart Street, James Street • 1st through 6th Avenues
Parking	Generally available, but controlled and priced Surface parking lots and garages located throughout Central Waterfront On-street parking prohibited on several major streets
Transit	Bus routes throughout Central Waterfront Light rail serves areas to the east and south of Central Waterfront Ferry and water taxi service to the south of Central Waterfront
Railroads	BNSF surface from tunnels at north end of Central Waterfront, at grade along the waterfront roughly parallel to Alaskan Way and Elliott Avenue
Nonmotorized Facilities	Sidewalk system—generally complete High levels of bicycle and pedestrian activity throughout Elliott Bay Trail

4.11.3.5 Piper's Creek

In the Piper's Creek area, transportation activity is highest in the commercial areas concentrated in the southeast along Holman Road NW and Greenwood Avenue N. The commercial areas are served by principal arterials with transit service and pedestrian and bicycle activity. The remainder of the area consists mainly of residential access streets with a more rural character defined by gravel or grass street edges with intermittent sidewalks and curbs. Carkeek Park has numerous trails connecting down to the Puget Sound shoreline. Table 4-17 summarizes transportation characteristics in the Piper's Creek area.

Table 4-17. Piper's Creek Transportation Characteristics

Facilities	Transportation Characteristics
Roadways	Streets with highest traffic volumes: • Holman Road NW • Greenwood Avenue N • 3rd Avenue NW • 8th Avenue NW • 15th Avenue NW • NW 100th Place
Parking	Parking in commercial areas primarily off-street in private lots with some on-street (parallel or angle) parking along shoulders on or near Greenwood Avenue N Parking in residential neighborhoods mostly off-street with some on-street along gravel shoulders or along curbside where curbs exist. Parking is generally available and unrestricted
Transit	Bus routes—principal and minor arterials
Railroads	BNSF mainline along the Puget Sound shoreline along the west edge of Carkeek Park
Nonmotorized Facilities	Sidewalk system—intermittent with complete sidewalks along major arterials; incomplete in residential areas with some segments of curb and sidewalk along a few roadways Sharrows on segments of 3rd Avenue NW and 8th Avenue NW as well as NW 100th Place

4.11.3.6 Thornton Creek

The Thornton Creek area has substantial transportation activity, particularly in the Northgate and Lake City commercial districts. The Northgate Mall area, Northgate Transit Center, and Lake City Way NW corridor all generate high levels of pedestrian and transit activity. The area also has large residential neighborhoods including Maple Leaf, Victory Heights, Pinehurst, Lake City, Northgate, and Haller Lake. Table 4-18 summarizes transportation characteristics in the neighborhoods.

Table 4-18. Thornton Creek Transportation Characteristics

Facilities	Transportation Characteristics
Roadways	Streets with highest traffic volumes: • I-5 • NE Northgate Way • Lake City Way NE • NE 125th Street • Roosevelt Way NE/Pinehurst Way NE/15th Avenue NE
Parking	Majority of commercial parking served by off-street surface lots and structures with some on-street parking along Lake City Way NE Residential parking is served by both off-street and on-street supply that is generally available and unrestricted
Transit	Northgate Transit Center Bus routes along principal arterials
Nonmotorized Facilities	Sidewalk system—intermittent with complete sidewalks along major arterials; incomplete in residential areas with some segments of curb and sidewalk along several roadways High levels of nonmotorized activity: • Northgate Mall vicinity • Lake City Way commercial area • Northgate Transit Center • Nathan Hale High School • Meadowbrook Park

4.12 Utilities

4.12.1 What is included in this section?

This section describes plans and policies relating to utilities (largely wastewater and water utilities) within the Plan area. It summarizes existing public utilities that could be affected by the LTCP and discusses proposed future utilities within the Plan area.

The City provides wastewater service, domestic water, and storm drainage within the city limits. The City also provides water service to much of King County either directly or through other purveyors. A number of investor-owned utilities provide energy, communications, and other utilities to the city, including natural gas, telephone, cable, and steam. Seattle City Light provides electricity to the city and areas within King County. City utilities are overseen by the Mayor and the City Council.

4.12.2 What are the relevant adopted plans, policies, and regulations?

4.12.2.1 City of Seattle Comprehensive Plan

The City of Seattle is in the process of updating the City's Comprehensive Plan, anticipated to be adopted in 2015. The current *2005 City of Seattle Comprehensive Plan* has a Utilities Element which sets out goals and policies for the City's utilities. Goals include: providing reliable service at lowest cost consistent with the City's aims; maintaining service reliability; maximizing efficient use of resources; minimizing the cost and inconvenience of trenching activities; operating utilities consistent with regional growth plans; and achieving universal access to state-of-the-art technology and telecommunication services. The Comprehensive Plan also includes specific policies relating to service, infrastructure, capital expenditure planning, environmental stewardship, facility siting and design, and utility relationships.

The Utilities Element of the Comprehensive Plan includes the following goals related to the provision of stormwater management and wastewater services:

> **UG1**: Provide reliable service at lowest cost consistent with the City's aims of environmental stewardship, social equity, economic development, and the protection of public health.
>
> **UG2**: Maintain the service reliability of the City's utility infrastructure.
>
> **UG4**: Minimize the cost and public inconvenience of road and right-of-way trenching activities.

The following policies within the Utilities Element address the siting, design, construction, and maintenance of stormwater and wastewater facilities:

> **U3**: Maintain the reliability of the City's utility infrastructure as the first priority for utility capital expenditures.
>
> **U17:** Coordinate with state and federal agencies to reduce illegal discharges into water by both permitted and non-permitted sources.
>
> **U18**: Work with neighborhood and community representatives in siting utility facilities.
>
> **U19**: Continue to subject all above-grade City utility capital improvement projects to review by the Seattle Design Commission.

U20: Consider opportunities for incorporating accessible open space in the siting and design of City utility facilities.

The following policies within the Utilities Element address CSOs specifically:

U15: Strive to correct instances of combined sewer overflows by prioritizing remedial action according to the frequency and volume of the overflows and the sensitivity of the locations where the overflows occur.

U16: Work cooperatively with King County to identify and expeditiously address combined sewer overflows for which the County maintains responsibility.

4.12.2.2 City of Seattle Consent Decree

As described in Section 2.4.4, in July 2013, the City of Seattle entered into a Consent Decree with the Washington State Department of Ecology, the U.S. Environmental Protection Agency, and the U.S. Department of Justice. Requirements listed in the Consent Decree describe the actions that the City must take to address CSO overflows that violate the Clean Water Act. CSO outfalls must meet a performance standard to achieve the "greatest reasonable reduction" to be considered "controlled" in accordance with WAC 173-245-020(22). A "controlled" CSO has an average of not more than one untreated discharge event annually on a 20-year moving average. The Consent Decree has established a deadline of December 2025 for completion of all control measures.

The Consent Decree includes a number of requirements for control of CSOs, including Implementation of early action CSO control program and measures, and the development and implementation of a long-term control plan and post-construction monitoring plan.

The Consent Decree requires the City to submit an LTCP by 2015, but it allows the City to develop, as an alternative, an "Integrated Plan" that proposes stormwater control projects to be implemented by the City prior to construction of some CSO facilities. The Consent Decree includes a number of additional requirements for the Integrated Plan, including a pollutant load reduction analysis and an evaluation of projected benefits to water quality, ecology, and human health that would result from implementing the identified stormwater projects. The Integrated Plan must demonstrate that the proposed stormwater projects will provide greater water quality benefits compared to those CSO projects that would be deferred, and that they would meet the requirements of the Clean Water Act, the City's NPDES and municipal separate storm sewer system (MS4) permits, and EPA's CSO Control Policy.

The Consent Decree encourages the use of Green Infrastructure (referred to as natural drainage systems in this EIS) as appropriate to reduce or replace certain CSO control measures included in the LTCP based on demonstrated effectiveness, together with the traditional engineered measures, as long as these combined measures provide substantially the same or greater levels of control than the traditional CSO control measures alone. The Consent Decree requires construction to be completed on all CSO control measures included in the approved LTCP by December 2025, unless EPA and Ecology approve a different schedule as part of approving an Integrated Plan.

4.12.2.3 City of Seattle NPDES Stormwater Management Program

The City developed a Stormwater Management Program as part of compliance with its 2007 Phase 1 Municipal Stormwater Permit through the National Pollutant Discharge Elimination System (NPDES). As part of permit compliance, the City submits an annual report that documents actions and activities that have been undertaken to comply with permit requirements. Ten components of the Surface Water Management Plan (SWMP) require reporting, including legal authority, mapping, coordination, public participation, runoff controls, structural controls, source controls, illicit connections and discharges, operation and maintenance, and education and outreach. The City's SWMP covers the separate storm sewer system and the partially separated system only. As described in more detail in Chapter 2, the combined sewer system is subject to a separate NPDES permit. Refer to Section 4.3.1.

4.12.2.4 City of Seattle Wastewater NPDES Permit (WA0031682)

The City's most recent wastewater NPDES permit (WA0031682) was issued on October 27, 2010 and modified on September 13, 2012; it allows wet weather discharges from permitted CSO outfalls. The permit also requires implementation of the "Nine Minimum Controls" to ensure adequate capacity and maintenance of the sewer system, defines monitoring requirements, establishes requirements for detailed reporting to Ecology, and allows discharges only as a result of precipitation events. The NPDES permit also defined the performance requirements for a controlled CSO outfall as one untreated discharge per year per outfall, on a moving 20-year average. In addition, the City must identify any improvements that have occurred since the last permit authorization. The City's next CSO NPDES permit will be issued in October 2015.

4.12.2.5 King County Long-term Combined Sewer Overflow Control Plan Amendment and Consent Decree

As described in Section 2.7.1. King County's Long-term CSO Control Plan Amendment (King County, 2012a) presents nine projects to control King County's 14 remaining uncontrolled CSO locations. Four projects would be built in the Lake Washington Ship Canal/Montlake Cut area and five in the Duwamish River/Elliott Bay area. King County's LTCP Amendment describes possible collaboration with the City of Seattle on three of the nine projects in the Lake Washington Ship Canal/Montlake Cut area.

King County entered a consent decree with the U.S. Department of Justice and EPA (filed July 3, 2013) that ensures its CSO control plan is completed by 2030. King County had already committed to limiting CSOs to one per year at each outfall by 2030 through its adopted polices and a 2011 Agreement with the Department of Ecology.

Links to King County's Long-term Combined Sewer Overflow Control Plan Amendment, consent decree, and relevant CSO control policies can be found on their website.
http://www.kingcounty.gov/environment/wastewater/CSO.aspx

4.12.3 What utilities are located in the Plan area?

Public utilities potentially affected by implementation of the Plan include storm drainage and combined sewers, wastewater, and water supply. Other utilities not related to the Plan, including electricity and communications networks, are located throughout the Plan area, but are not addressed in this EIS.

4.12.3.1 Storm Drainage and Combined Sewers

The City's drainage infrastructure includes a separate storm drainage system, a partially connected system, and the combined sewer system, each of which serves approximately one-third of the geographical area of Seattle. Additional information about the drainage infrastructure is provided in Chapter 2.

4.12.3.2 Wastewater (Sewers)

Figure 2-1 illustrates the major wastewater facilities within the Plan area. The City provides wastewater collection within the city through sewer pipes that typically run along streets, and routes the untreated wastewater to collection and treatment facilities owned and operated by King County. The City's wastewater collection system sends wastewater flows to King County's West Point Wastewater Treatment Plant for treatment. King County owns and operates several major wastewater siphons that run underneath the Ship Canal and the Duwamish Waterway, including siphons crossing the Ship Canal in Ballard, Fremont, and Montlake, and two siphons crossing the Duwamish.

Because the City's wastewater collection system sends wastewater flows to King County for treatment, it will be important for any construction-related flow modifications to be coordinated closely with King County. Ongoing discussions with King County will continue, and agreements will be negotiated prior to implementing the Plan.

4.12.3.3 Water Supply

The City provides water to city residents. Major water lines owned and operated by the City cross the Ship Canal at Fremont, near I-5, and at Montlake. Major water lines also cross the Duwamish Waterway at four points: two lines from Harbor Island to West Seattle, a line from Harbor Island to the Duwamish area, and a line near the SR-99 crossing. The water supply for neighborhoods north of the Ship Canal is from the Tolt River watershed. Water for neighborhoods south of the Ship Canal is supplied from the Cedar River watershed.

4.13 Socioeconomics and Environmental Justice

4.13.1 What is environmental justice?

Environmental justice is an approach that is meant to promote decisions that are fair to all segments of the population, and avoid decisions that can have disproportionately greater negative human health and environmental effects on low-income or minority communities than on the population as a whole.

Negative effects associated with large municipal projects or programs can include disruptions in community cohesion, restricted access to a publicly funded facility, safety concerns, higher exposures to hazardous materials, raised noise levels, increased water and air pollution, and other adverse effects. Environmental justice evaluations also consider how projects can be developed to benefit low-income or minority communities, which have historically been disproportionately affected by human health and environmental hazards. To address both positive and potential negative effects of proposals, effective environmental justice approaches emphasize ways to involve affected communities through the planning process.

What is included in this section?

This section addresses the existing social and economic conditions that are relevant to the Plan area. Social and economic conditions such as population, demographic characteristics, community character, housing, and economic conditions are considered in an effort to understand the nature of the communities that would experience potential impacts through implementation of the Plan. Primary sources of information include the 2010 U.S. Census and the City of Seattle.

4.13.2 What's the relationship between CSOs and socioeconomic and environmental justice concerns?

Combined sewer overflows can pose human health risks to those who are directly or indirectly exposed to them. In many communities, environmental justice populations tend to be located in closer proximity to CSO outfalls than more affluent populations (Snider, 2002). This is not always the case, however, and in cities such as Seattle, affluent communities tend to be located along the city shorelines in some of the areas where CSO outfalls are located. As a result, the potential for direct exposure to environmental and human health threats from CSOs is more evenly spread across the populations.

Direct exposure to CSOs occurs primarily through swimming or wading in waters that have received CSO discharges. Indirect exposure to CSOs is primarily from the consumption of fish. This indirect exposure disproportionately affects low-income, tribal, and subsistence fishing communities, and immigrant families for whom fishing the Duwamish River, the Lake Washington system, and Puget Sound is rooted in cultural traditions. While CSOs are one source of contamination, contaminated sediments from a century of urban and industrial waste are also a significant source of contamination in these waterways.

Environmental Justice

The concept of environmental justice acknowledges that the quality of our environment affects the quality of our lives and that minority and low-income populations should not suffer disproportionately high and adverse effects from projects.

Although SEPA, as a state regulation, does not specifically require the analysis of environmental justice in an Environmental Impact Statement, a discussion of it is included in recognition of the City of Seattle's Race and Social Justice Initiative.

Seattle's Race and Social Justice Initiative

The Race and Social Justice Initiative is a citywide effort to realize the vision of racial equity. The initiative works within the City of Seattle government and with community leaders to get to the root cause of racial inequity: institutional racism.

The initiative is led by the Seattle Office of Civil Rights and an interdepartmental team of City of Seattle staff. All elected officials in Seattle have endorsed and are promoting the initiative.

4.13.3 What is the regulatory setting for socioeconomics and environmental justice?

While SEPA does not require analysis of environmental justice, existing local policies support the concept of environmental justice, and many of the projects implemented through the Plan may need to comply with federal environmental justice regulations during their individual project-level environmental review processes. Further, the City recognizes that CSO-related infrastructure projects have the potential to cause disproportionate impacts to environmental justice populations. Therefore, the City has prepared this environmental justice analysis to promote the principles of environmental justice, continue current environmental justice efforts, and facilitate future environmental justice analyses for projects as may be required under federal environmental justice regulations.

The Plan must be approved by EPA in compliance with the consent decree. Therefore, this assessment also considers EPA's

Environmental justice populations include minority and low-income populations. Minority populations are defined as individuals listed in the 2010 U.S. Census identifying themselves as Black or African American, American Indian and Alaskan Native, Asian, Native Hawaiian or Pacific Islander, "other race," or Hispanic or Latino (a person of Mexican, Puerto Rican, Cuban, Central or South American, or other Spanish culture or origin, regardless of race).

Low-income populations are defined as individuals listed in the 2010 U.S. Census whose median household income is at or below the United States Department of Health and Human Services (DHHS) poverty guidelines, which are updated periodically in the Federal Register by the DHHS under the authority of 42 United States Code 9902(2).

environmental justice goals and policies. In 1992, EPA created an Office of Environmental Justice to ensure that environmental justice was being integrated into the framework of EPA policies, programs, and activities. Subsequently, the National Environmental Justice Advisory Council was created in 1993 to attain further cooperation on environmental justice issues (EPA, 2011b). Further, EPA has established Environmental Justice Action Plans to measure progress on governmental environmental justice initiatives (EPA, 2011b).

4.13.4 What are the existing characteristics of the Plan area?

4.13.4.1 Population, Employment, and Housing

The City of Seattle covers about 84 square miles of land with a total population of 608,600 in the City of Seattle, as reported in the 2010 U.S. Census.

The City of Seattle had approximately 462,000 jobs, as reported in the 2010 U.S. Census, and an unemployment rate of 7.3 percent as of March 2012 (Employment Security Department, 2012). Most of the city's employed residents are working in various services, government, retail, education, and finance/insurance/real estate industries (City of Seattle, 2011a). The largest employer in the city is the University of Washington.

Demographic characteristics of the Plan neighborhoods are shown in Figures 4-21 through 4-24. The total number of households in the city was 305,522 based on the 2010 U.S. Census. Of this total, 48 percent were owner-occupied and 52 percent were renter-occupied. Within the Plan area, the total number of households was 103,424, of which 51 percent were owner-occupied and 49 percent were renter-occupied. While median house value and median household income in the overall Plan area are slightly higher than the city as a whole, there is a great deal of variation within the Plan neighborhoods.

What is a Census Tract?

Census tracts are small, relatively permanent statistical subdivisions of a county. The tracts typically have between 2,500 and 8,000 people and are designed to be homogeneous in population characteristics, economic status, and living conditions. The size of the census tract varies depending on population density. The tracts are intended to be maintained over a long period of time so that statistical comparisons can be made from one census to another.

4.13.4.2 Environmental Justice Populations

The environmental justice study area is equivalent to the Plan area, which is defined by the basin boundaries within the six neighborhood areas addressed by the Plan. For a "programmatic" analysis, the census tracts represent an appropriate scale to determine study area characteristics.

Using the most recent available data from the 2010 U.S. Census, Figures 4-25 and 4-26 summarize the minority and low-income population characteristics for the census tracts in the Plan area. The population characteristics of the Plan area residents are similar to those of the city as a whole, although the Plan area residents are somewhat less diverse.

The census tracts with the greatest percentage of minority residents are located in the East Waterway, South Delridge, and Thornton Creek neighborhoods. Certain census tracts in these areas had more than 60 percent minority residents, and in the Duwamish area, more than 80 percent. Because of this neighborhood-scale analysis, some smaller communities with higher percentages of minority populations may not be apparent.

The percentage of persons below the poverty threshold in the city as a whole (13 percent) is slightly higher than the percentage in the Plan area (11.3 percent). The census tracts with the highest percentages of low-income residents are located in the Central Waterfront, Delridge, Duwamish, and Fremont/Wallingford neighborhoods.

Further information on the economic and population characteristics of the Plan neighborhoods is summarized in Table 4-19.

Table 4-19. Plan Neighborhoods Population and Economic Characteristics
Population and Economic Characteristics
Ship Canal
Ship Canal Neighborhoods have fewer minority residents and residents living at or below the poverty level compared to the city as a whole.
Lake Washington
Lake Washington Neighborhoods include some of the most affluent neighborhoods of the city and of the Plan area as a whole, with the exception of University District where student population characteristics strongly influence census data. Most areas, including Portage Bay and North Union Bay, have fewer minority residents and residents living at or below the poverty level compared to the city as a whole, and to other neighborhoods within the Plan area.
Longfellow Creek/Duwamish
The Duwamish area is largely industrial and commercial in nature, with minimal residential areas. Though the daytime work force population is very large, few residents live in this portion of the Plan area. Many of the streets lack curb, gutter, and sidewalks, which creates potential safety issues for pedestrians. The Longfellow Creek/Duwamish area is more likely to have minority populations, and people living at or below the poverty level compared to other neighborhoods in the Plan area. Certain census tracts within this area have the highest percentage of minority residents in the Plan area.
Elliott Bay/Lake Union
Compared to the rest of the city, a larger percentage of residents in the Central Waterfront area rent rather than own. The area population is dominated by weekday employees and tourists. A number of social service agencies are clustered in the Central Waterfront area. Certain census tracts within this area have high percentages of low-income and minority residents.
Piper's Creek
The Piper's Creek area has fewer minority residents and residents living at or below the poverty level compared to the city as a whole.
Thornton Creek
The Thornton Creek area has fewer residents living at or below the poverty level compared to the city as a whole. Certain tracts have higher percentages of minority residents than the city as a whole.

Piper's Creek

16,404 Total Population

- 12,549 White
- 518 African American
- 115 American Indian
- 1,521 Asian
- 36 Native Hawaiian
- 717 Other
- 905 Hispanic (Of Any Race)
- 3,855 Persons of Color

Number of Households: 7,910
Owner Occupied: 66%
Renter Occupied: 34%
Median House Value: $444,700
Median Rent: $993
Median Household Income: $72,937

Ballard

32,502 Total Population

- 27,505 White
- 518 African American
- 190 American Indian
- 1,424 Asian
- 59 Native Hawaiian
- 1,144 Other
- 1,581 Hispanic (Of Any Race)
- 4,997 Persons of Color

Number of Households: 17,394
Owner Occupied: 53%
Renter Occupied: 47%
Median House Value: $475,560
Median Rent: $1,003
Median Household Income: $68,542

Fremont/Wallingford

19,226 Total Population

- 15,775 White
- 414 African American
- 99 American Indian
- 1,232 Asian
- 25 Native Hawaiian
- 800 Other
- 837 Hispanic (Of Any Race)
- 3,451 Persons of Color

Number of Households: 4,837
Owner Occupied: 38%
Renter Occupied: 62%
Median House Value: $501,400
Median Rent: $1,045
Median Household Income: $64,396

Magnolia

6,001 Total Population

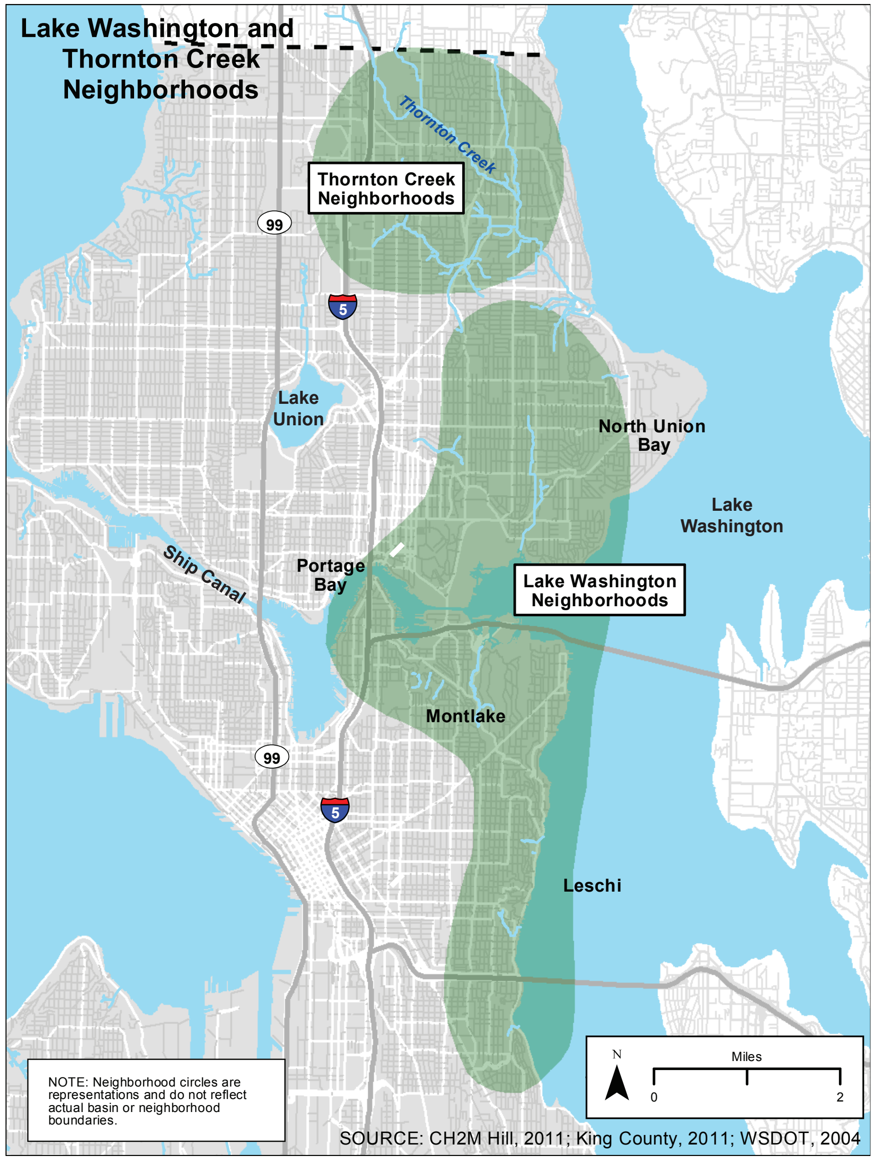
- 4,972 White
- 87 African American
- 25 American Indian
- 446 Asian
- 13 Native Hawaiian
- 229 Other
- 217 Hispanic (Of Any Race)
- 1,029 Persons of Color

Number of Households: 2,903
Owner Occupied: 68%
Renter Occupied: 32%
Median House Value: $600,600
Median Rent: $988
Median Household Income: $88,828

SOURCE: US Census, 2010.

FILE NAME: Fig_04-21_Demographics_ShipCanal.ai / CREATED BY: JAC / DATE LAST UPDATED: 04/29/14

Figure 4-21. Ship Canal Neighborhoods - Demographic Characteristics.



Portage Bay

4,796 Total Population

- 3,990 White
- 72 African American
- 7 American Indian
- 371 Asian
- 7 Native Hawaiian
- 162 Other
- 174 Hispanic (Of Any Race)
- 806 Persons of Color

Number of Households: 3,093
Owner Occupied: 42%
Renter Occupied: 58%
Median House Value: $672,600
Median Rent: $993
Median Household Income: $67,984

Montlake

3,848 Total Population

- 3,220 White
- 89 African American
- 12 American Indian
- 235 Asian
- 3 Native Hawaiian
- 155 Other
- 110 Hispanic (Of Any Race)
- 628 Persons of Color

Number of Households: 1,597
Owner Occupied: 82%
Renter Occupied: 18%
Median House Value: $778,800
Median Rent: $1,705
Median Household Income: $130,820

Leschi

19,383 Total Population

- 11,262 White
- 4,146 African American
- 84 American Indian
- 1,796 Asian
- 50 Native Hawaiian
- 9817 Other
- 1,005 Hispanic (Of Any Race)
- 8,121 Persons of Color

Number of Households: 8,672
Owner Occupied: 66%
Renter Occupied: 34%
Median House Value: $575,375
Median Rent: $918
Median Household Income: $87,255

North Union Bay

23,209 Total Population

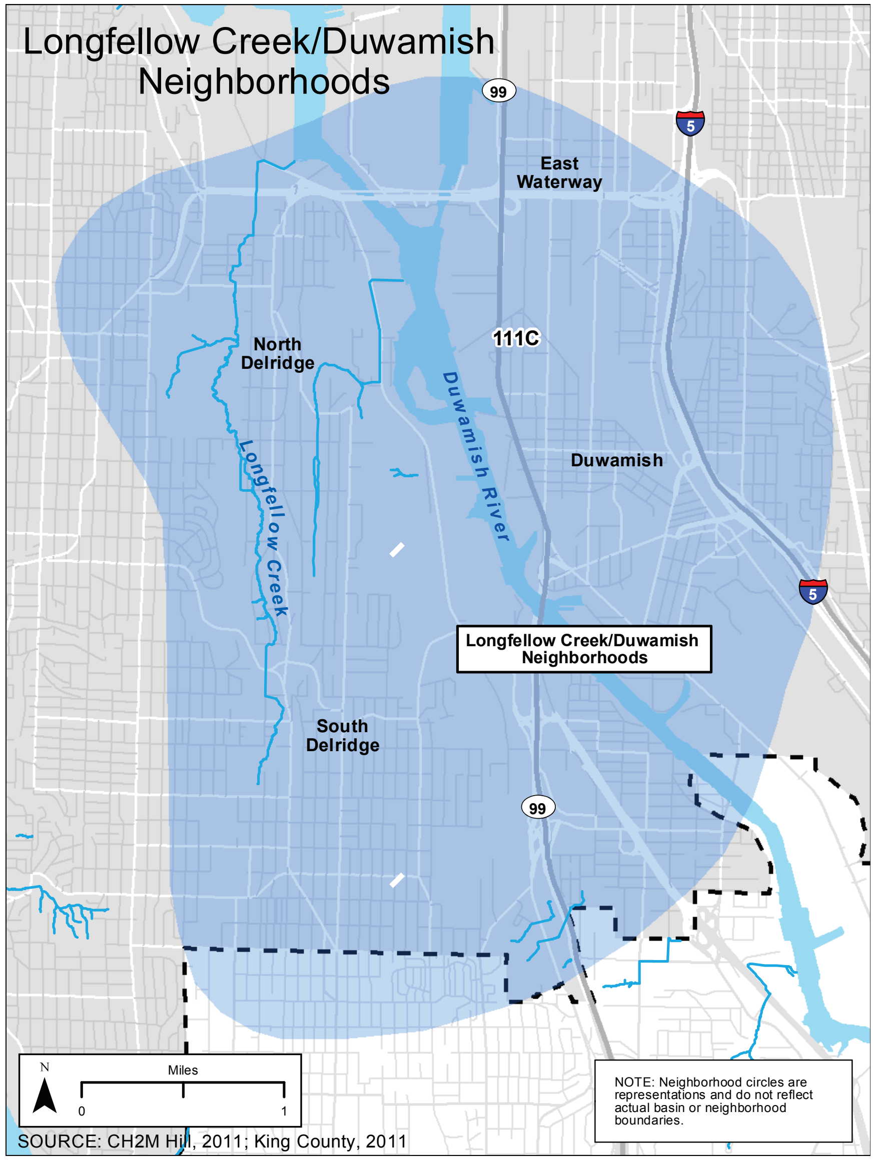
- 18,625 White
- 349 African American
- 74 American Indian
- 2,288 Asian
- 35 Native Hawaiian
- 993 Other
- 790 Hispanic (Of Any Race)
- 4,584 Persons of Color

Number of Households: 10,002
Owner Occupied: 70%
Renter Occupied: 30%
Median House Value: $621,320
Median Rent: $1,011
Median Household Income: $88,744

SOURCE: US Census, 2010.

FILE NAME: Fig_04-22_Demographics_LakeWashington.ai / CREATED BY: JAC / DATE LAST UPDATED: 04/28/14

Figure 4-22. Lake Washington Neighborhoods - Demographic Characteristics.



East Waterway

2,354 Total Population

- 1,066 White
- 238 African American
- 91 American Indian
- 532 Asian
- 14 Native Hawaiian
- 105 Other
- 296 Hispanic (Of Any Race)
- 1,288 Persons of Color

Number of Households: 1,104
Owner Occupied: 51%
Renter Occupied: 49%
Median House Value: $378,200
Median Rent: $970
Median Household Income: $54,158

South Delridge

18,781 Total Population

- 8,925 White
- 1,816 African American
- 227 American Indian
- 3,614 Asian
- 245 Native Hawaiian
- 1,003 Other
- 2,910 Hispanic (Of Any Race)
- 9,856 Persons of Color

Number of Households: 8,303
Owner Occupied: 57%
Renter Occupied: 43%
Median House Value: $316,775
Median Rent: $904
Median Household Income: $62,494

North Delridge

12,768 Total Population

- 6,886 White
- 1,580 African American
- 99 American Indian
- 2,063 Asian
- 145 Native Hawaiian
- 634 Other
- 1,325 Hispanic (Of Any Race)
- 5,882 Persons of Color

Number of Households: 5,770
Owner Occupied: 57%
Renter Occupied: 43%
Median House Value: $352,900
Median Rent: $911
Median Household Income: $59,978

Duwamish

6,123 Total Population

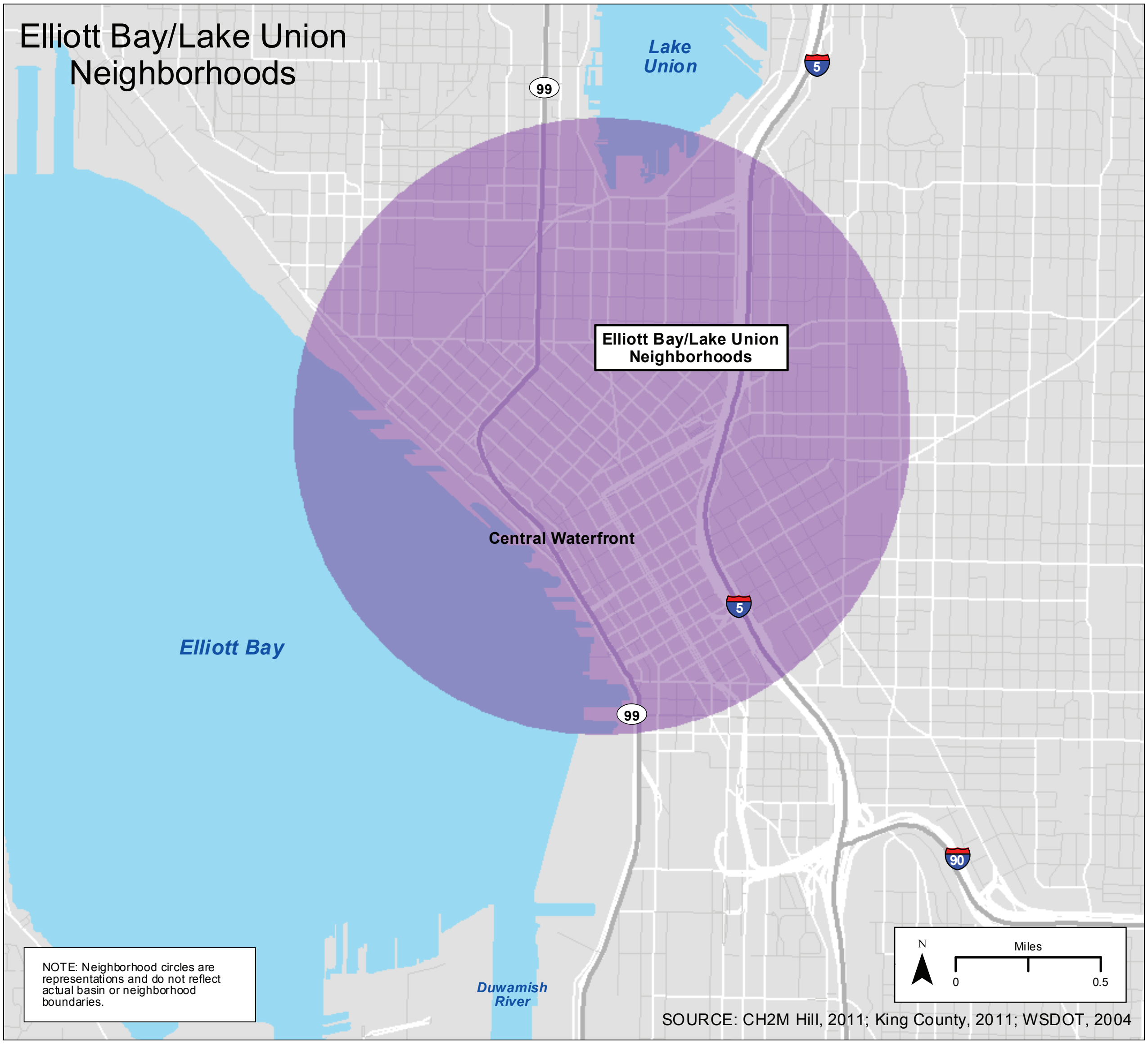
- 2,022 White
- 1,025 African American
- 105 American Indian
- 1,865 Asian
- 26 Native Hawaiian
- 291 Other
- 773 Hispanic (Of Any Race)
- 4,101 Persons of Color

Number of Households: 2,632
Owner Occupied: 48%
Renter Occupied: 52%
Median House Value: $381,350
Median Rent: $740
Median Household Income: $52,106

SOURCE: US Census, 2010.

FILE NAME: Fig_04-27_Demographics_Longfellow-Duwamish.ai / CREATED BY: JAC / DATE LAST UPDATED: 04/29/14

Figure 4-23. Longfellow Creek/Duwamish Neighborhoods - Demographic Characteristics.



Central Waterfront

13,919 Total Population

- 9,301 White
- 980 African American
- 162American Indian
- 1,946 Asian
- 51 Native Hawaiian
- 548 Other
- 901 Hispanic (Of Any Race)
- 4,618 Persons of Color

Number of Households: 11,590
Owner Occupied: 20%
Renter Occupied: 80%
Median House Value: $481,067
Median Rent: $963
Median Household Income: $51,294

SOURCE: US Census, 2010.

FILE NAME: Fig_04-24_Demographics_Downtown.ai / CREATED BY: JAC / DATE LAST UPDATED: 04/28/14

Figure 4-24. Elliott Bay/Lake Union Neighborhoods - Demographic Characteristics.

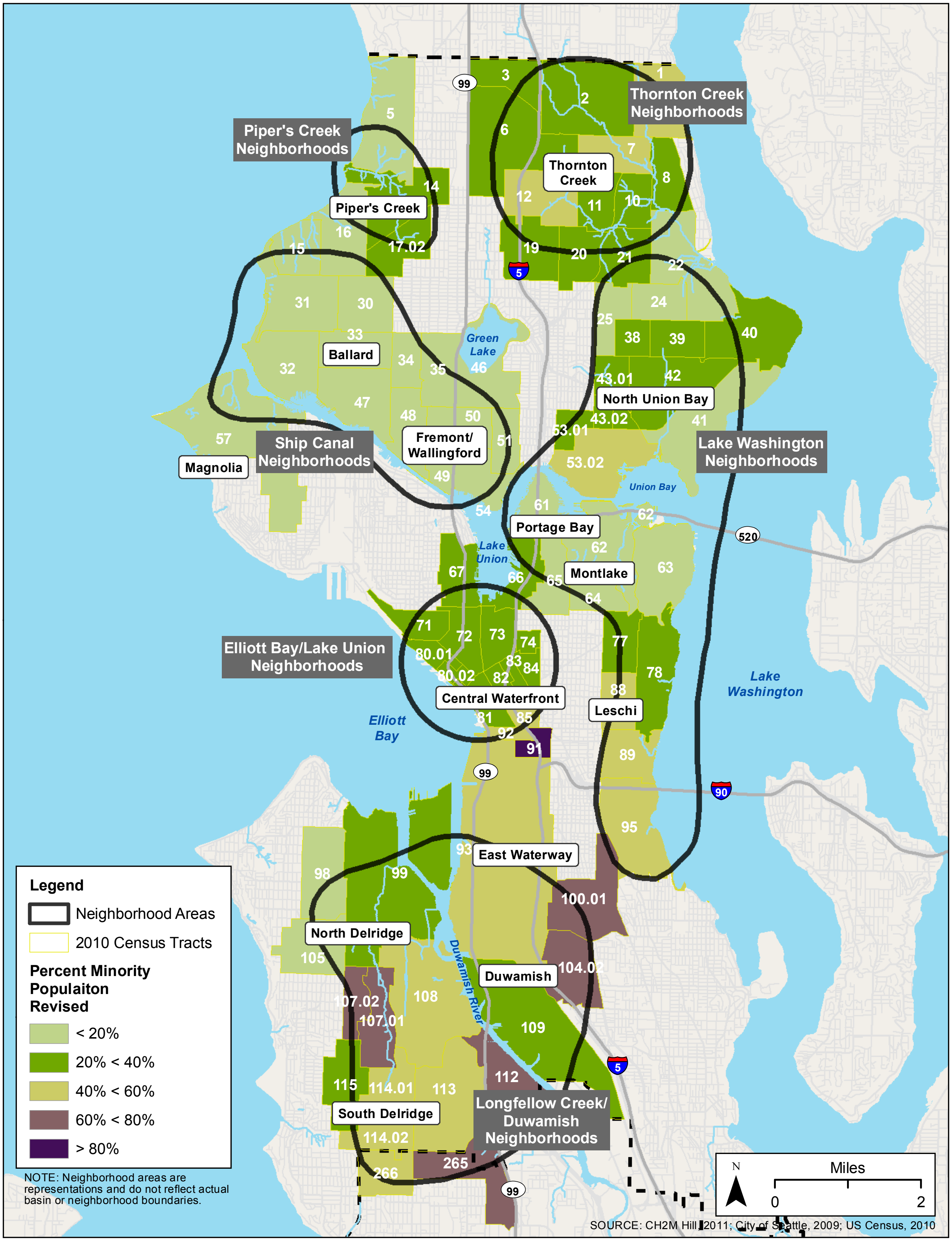


Figure 4-25 Minority Populations.

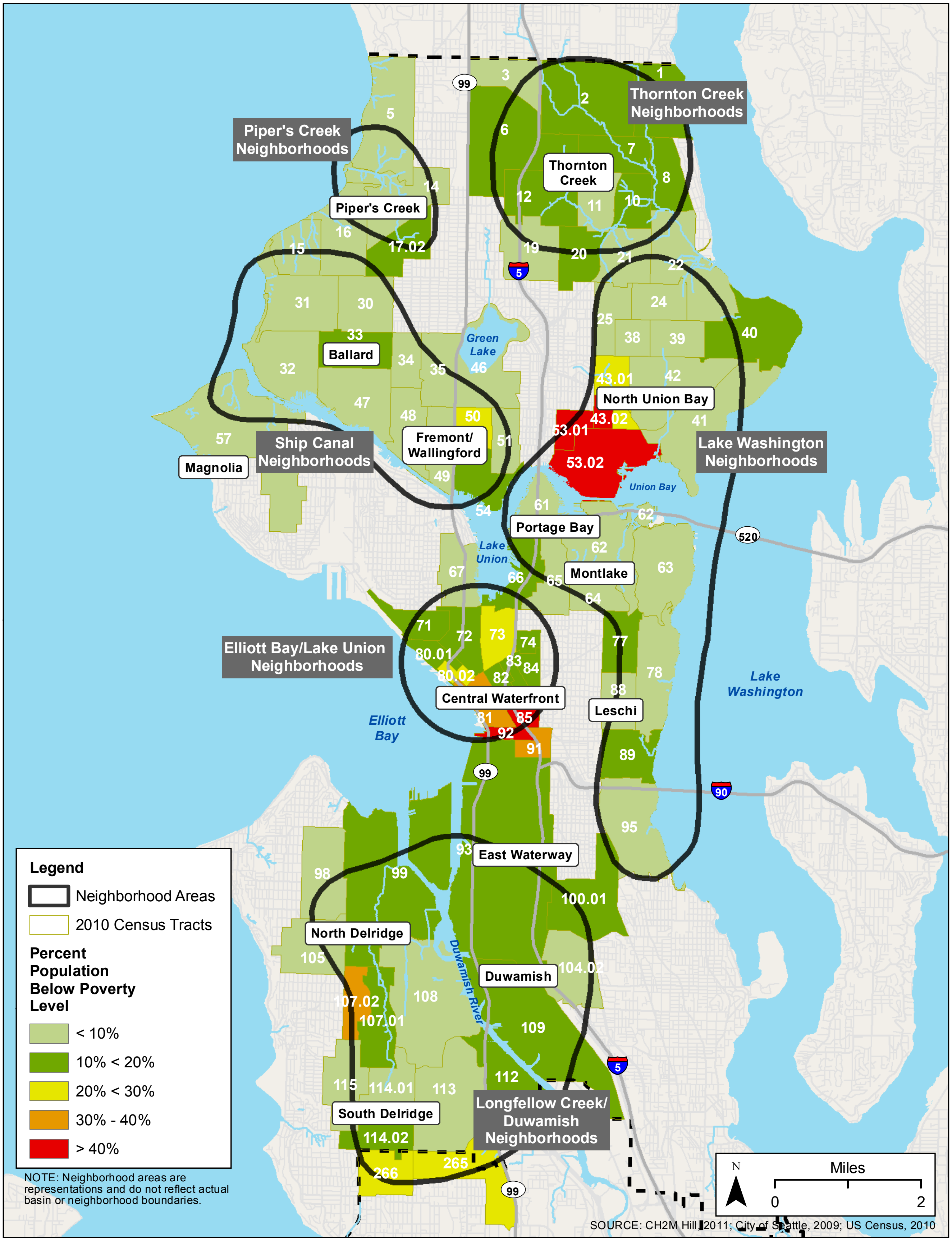


Figure 4-26 Low Income Populations.

CHAPTER 5
Construction Impacts and Mitigation

5.1 Introduction

5.1.1 What is included in this chapter?

This chapter discusses how construction of the projects under the Plan would affect the environment in the Plan area. The alternatives are compared to the extent that differences in their construction methods, timing, and effects can be determined at a programmatic level.

Construction of projects under the Plan would occur over a total period of nine years for the LTCP Alternative and 15 years or more for the Integrated Plan Alternative. Within this overall timeframe, specific construction activities would affect portions of the Plan area for varying amounts of time.

Both the LTCP Alternative and the Integrated Plan Alternative would implement one of the four LTCP options, though some of these CSO control projects would be deferred under the Integrated Plan Alternative. This chapter begins with a general description of construction activities associated with the types of projects included in the LTCP options, and types of stormwater projects specific to the Integrated Plan Alternative. Following this is a discussion of how construction would affect the resources in the Plan area. Since project and site-specific details are not known at this time, the analysis takes a programmatic approach and evaluates resources on a larger, Plan- and neighborhood-scale rather than at a site-level scale (the scale at which project-specific impacts would occur).

As described in Chapter 3, the No Action Alternative includes ongoing sewer system improvements and natural drainage systems under the City's Right-of-Way program and RainWise to reduce CSOs and infiltrate stormwater runoff. Planned projects identified in the City's NPDES Waste Discharge Permit would also be implemented. Most of these projects are identified in the 2010-2015 Implementation Plan for the *2010 CSO Reduction Plan Amendment* (2010 Plan Amendment). Those projects have either been completed or will undergo separate SEPA analysis, as appropriate, and are not discussed further in this EIS.

5.1.2 What are the typical construction scenarios that would occur under the LTCP options?

CSO control projects included under the LTCP options – and common to both the LTCP Alternative and the Integrated Plan Alternative –would involve construction of a combination of sewer system improvements, flow diversions, and underground storage. The general project areas for these CSO control projects under the LTCP options are shown on Figures 5-1 though 5-3. Because this is a plan-level evaluation, project details and construction methods have not yet been defined. However, the information provided in Table 5-1 and the descriptions provided below are a reasonable estimate of the nature, extent, and duration of anticipated construction activities under the types of projects being considered. Actual construction activities would vary as determined during subsequent, project-specific review.

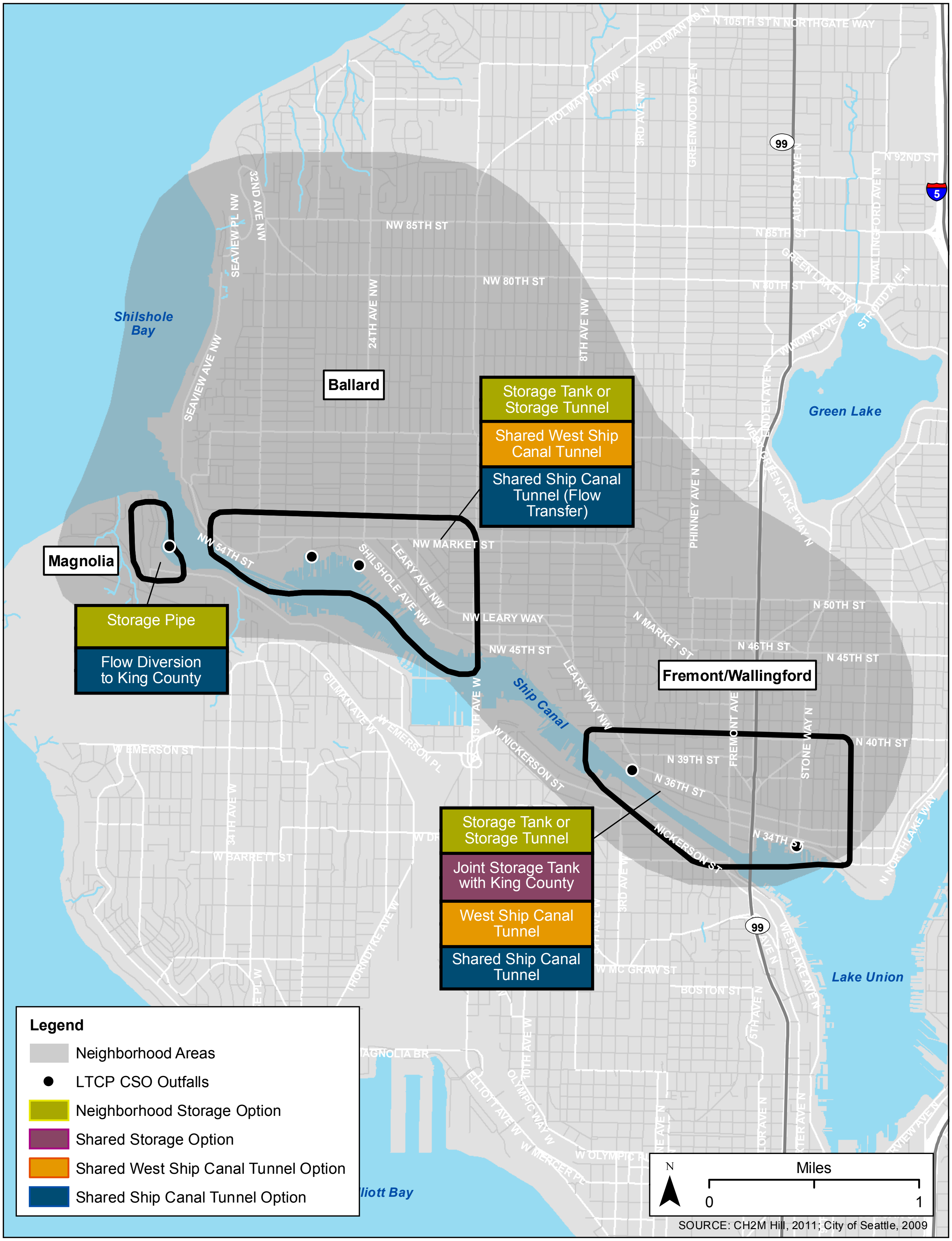


Figure 5-1 General Project Areas – Ship Canal Neighborhoods.

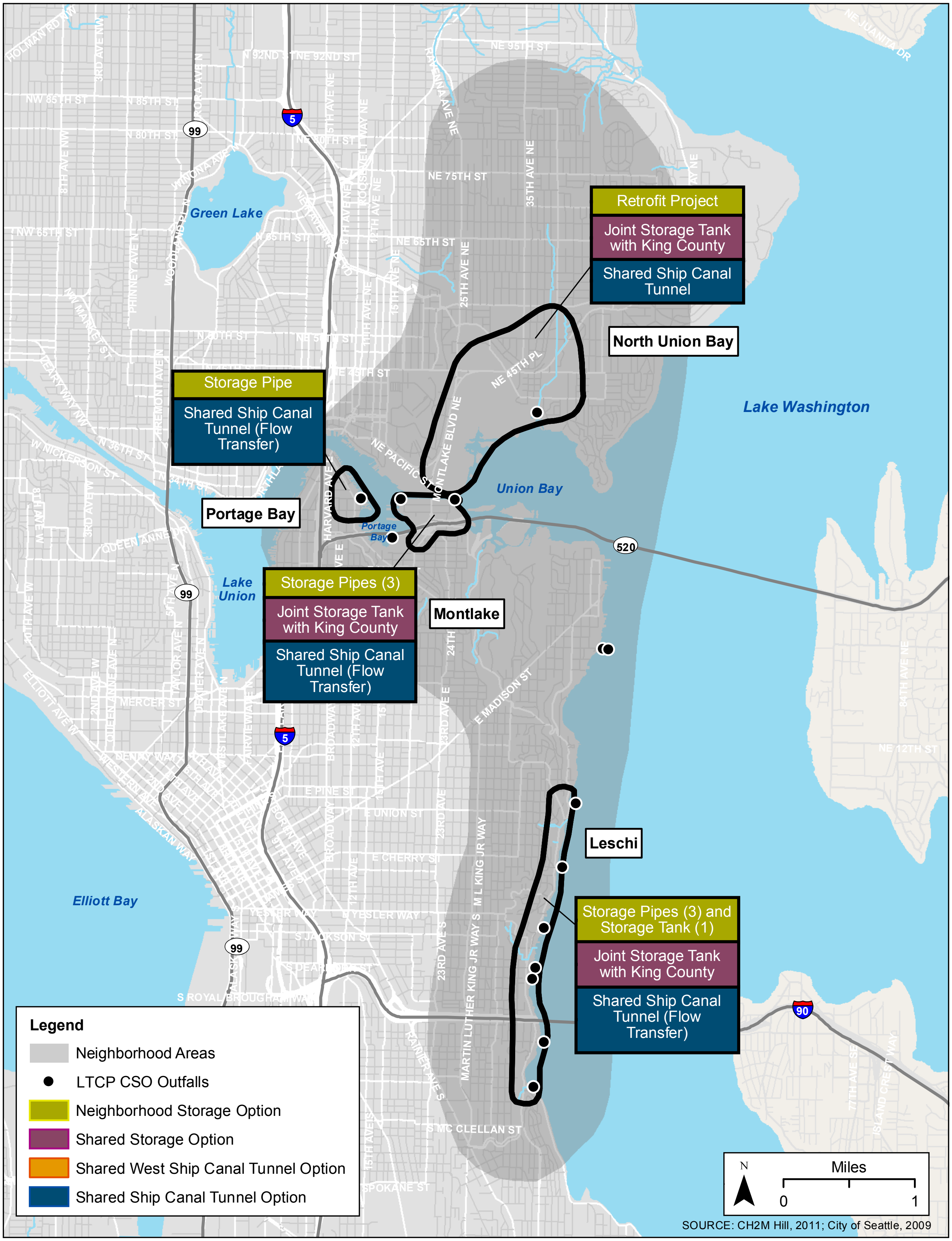


Figure 5-2 General Project Areas – Lake Washington Neighborhoods.

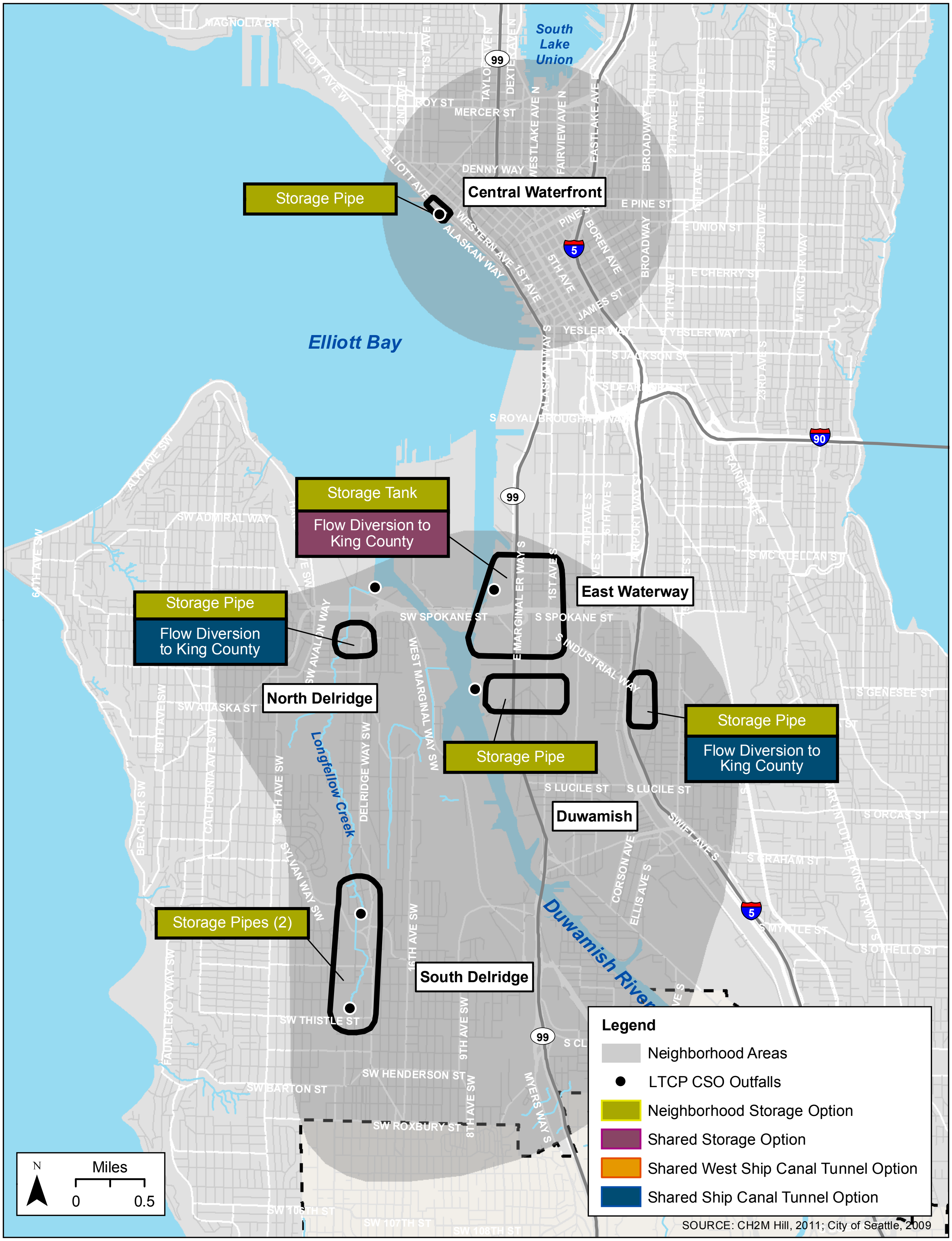


Figure 5-3 General Project Areas – Longfellow Creek/Duwamish & Elliott Bay/Lake Union Neighborhoods.

Table 5-1. LTCP Alternative Options – Estimated Project Details[1]

	CSO Control Measure	Potential Property	Description	Storage Facility Dimensions	Pump Stations	Construction Duration (years)	Excavation Quantities (CY)	Surface Disturbance (acre)	Truck Trips	Concrete (CY)
Neighborhood Storage Option										
Ship Canal Neighborhoods										
Ballard	Storage Tank	Private Property	Construct an offline storage tank to divert and convey combined sewer flows to and from storage.	Tank - 275 ft x 225 ft x 26 ft deep	1	5	76,000	2	12,000	16,690
	Or Neighborhood Tunnel	*Same or similar details as Shared West Ship Canal Tunnel Option below*								
Fremont / Wallingford	Storage Tank	City or Private Property	Construct an offline storage tank to divert and convey combined sewer flows to and from storage.	Tank – 235 ft x 75 ft wide x 26 ft deep	3	3.5	39,000	2	7,000	6,800
	Or Neighborhood Tunnel	*Same or similar details as Shared West Ship Canal Tunnel Option below*								
Magnolia	Storage Pipe	ROW	Construct an offline storage pipe in street ROW. A new flow diversion structure with an overflow weir and real-time control gate would also be installed. All of the stored flow would discharge back into the existing sewer system within 12 hours after a storm event.	Pipe Length 530 ft Pipe Diameter - 6 ft	1	1.5	3,000	0.2	600	320
*Ship Canal Neighborhoods (Tanks/Pipes) Construction Detail Totals**							120,000 CY	4 acres	19,500 trips	24,000 CY
*Ship Canal Neighborhoods (Neighborhood West Ship Canal Tunnel) Construction Detail Totals**							165,000 CY	4 acres	51,500 trips	51,000 CY

[1] All details estimated for main storage facility components only (e.g., storage tank construction and tunnel launch and retrieval portal construction). Additional construction would be required for associated conveyance systems, especially for shared options involving transfer of flows from one neighborhood to another.

Table 5-1. LTCP Alternative Options – Estimated Project Details[1]

	CSO Control Measure	Potential Property	Description	Storage Facility Dimensions	Pump Stations	Construction Duration (years)	Excavation Quantities (CY)	Surface Disturbance (acre)	Truck Trips	Concrete (CY)
Lake Washington Neighborhoods										
North Union Bay	Sewer System Improvement	ROW	Minor construction (e.g., flow gates work inside underground vaults/chambers).							
Portage Bay	Storage Pipe	ROW	Construct an offline storage pipe in street ROW. A new flow diversion structure with an overflow weir and real-time control gate would also be installed. All of the stored flow would discharge back into the existing sewer system within 12 hours after a storm event.	Pipe Length - 210 ft Pipe Diameter - 10 ft		1.5 years	5,000	0.2	900	270
Montlake	Storage Pipes (3)	ROW	Construct offline storage pipes in street ROWs.	Pipe Length – 75 to 200 ft Pipe Diameter – 5 to 12 ft	1	1.5 years	7,000	0.4	1,400	220
Leschi	Storage Pipes (3) and Storage Tank (1)	Storage Pipes in ROW, Storage Tank in City or Private Property	Construct three storage pipes in ROWs and one storage tank in City or private property.	Pipe Lengths - 120 to 210 ft Pipe Diameters – 3 to 7 ft Tank – 65 ft long x 60 ft wide x 15 ft deep	2	2 years	14,000	0.6	2,000	1,780
*Lake Washington Neighborhoods Construction Detail Totals**							26,000 CY	1 acre	4,500 trips	2,500 CY
Longfellow Creek/Duwamish Neighborhoods										
North Delridge	Storage Pipe	ROW	Construct offline storage pipe in street ROW.	Pipe Length - 210 ft Pipe Diameter - 12 ft	1	1.5	6,000	0.2	800	830
South Delridge	Storage Pipes (2)	ROW	Construct two offline storage pipes in street ROWs. A new flow diversion structure with an overflow weir and real-time control gate would also be installed. All stored flow would discharge to the existing sewer system within 12 hours after a storm event.	Pipe Length - 450 to 550 ft Pipe Diameters – 9 to 10 ft	2	1.5	12,000	0.8	2,300	1,480

Table 5-1. LTCP Alternative Options – Estimated Project Details[1]

	CSO Control Measure	Potential Property	Description	Storage Facility Dimensions	Pump Stations	Construction Duration (years)	Excavation Quantities (CY)	Surface Disturbance (acre)	Truck Trips	Concrete (CY)
Duwamish	Storage Pipe and In-Line Storage	ROW	Construct an offline storage pipe in street ROW. Modify two existing CSO control structures to be used as inline storage facilities.	Pipe Length - 100 ft Pipe Diameter - 5 ft	2	1.5	2,000	0.1	500	480
East Waterway	Storage Tank	City or Private Property	Construct offline storage tank; construct a diversion structure with real-time control gate.	90 ft long x 50 ft wide x 15 ft deep	1	2	14,000	0.8	2,600	4,370
*Longfellow Creek/Duwamish Neighborhoods Construction Detail Totals**							34,000 CY	2 acres	6,000 trips	7,000 CY
Elliott Bay/Lake Union Neighborhoods										
Central Waterfront	Storage Pipe	ROW	Construct offline storage pipe in street ROW; an access shaft will be located in the ROW.	Pipe Length - 600 ft Pipe Diameter - 6 ft		2 years	5,000	0.1 acre	900	60
*Elliott Bay/Lake Union Neighborhoods Totals**							5,000	0.1 acre	900	60
Neighborhood Storage Option (Tanks/Pipes) Totals*							**185,000 CY**	**7.5 acres**	**31,000 trips**	**33,500 CY**
Neighborhood West Ship Canal Tunnel Totals*							**230,000 CY**	**7.5 acres**	**63,000 trips**	**60,000 CY**

Table 5-1. LTCP Alternative Options – Estimated Project Details[1]										
	CSO Control Measure	**Potential Property**	**Description**	**Storage Facility Dimensions**	**Pump Stations**	**Construction Duration (years)**	**Excavation Quantities (CY)**	**Surface Disturbance (acre)**	**Truck Trips**	**Concrete (CY)**
Shared Storage Option										
Ship Canal Neighborhoods										
Ballard	*Same as Neighborhood Storage Option*									
Fremont / Wallingford	Shared Storage Facility with King County 3rd Ave W (Total 7.4 MG)	ROW	The City and King County would jointly build a storage facility in street ROW to store flows from the City's Fremont/Wallingford basins and the King County 3rd Avenue West Regulator. The facility will have a southern discharge point near the Fremont Siphon and be sloped upward to the north.	3,000 ft long x 21 ft diameter	2	3	113,000	3	11,000	11,100
Magnolia	*Same as Neighborhood Storage Option*									
*Ship Canal Neighborhoods Construction Details Totals**							192,000 CY	5 acres	24,000 trips	28,000 CY
Lake Washington Neighborhoods										
North Union Bay	Shared Storage Tank with King County University Regulator (Total 5.23 MG)	City or Private Property	The City and King County would jointly build a storage tank in City or private property. New diversion structures will be built to divert flow into storage, and the tank will be emptied by an effluent pump station.	185 ft long x 185 ft wide x 18 ft deep	1	4	89,000	3	16,200	22,300
Portage Bay	*Same as Neighborhood Storage Option*									
Montlake Leschi	Shared Storage Tank with King County Montlake Regulator (Total 7.87 MG)	City or Private Property	The City and King County would jointly build a storage tank in City or private property. New diversion structures will be built to divert flow into storage, and the tank will be emptied by an effluent pump station. Several existing City pump stations will be upgraded, and a portion of an existing City sewer mainline will be replaced and/or increased in size.	200 ft long x 200 ft long x 25 ft deep	5	4.5	92,000	2	15,600	15,400
*Lake Washington Neighborhoods Construction Details Totals**							186,000 CY	5 acres	33,000 trips	38,000 CY

Table 5-1. LTCP Alternative Options – Estimated Project Details[1]

	CSO Control Measure	Potential Property	Description	Storage Facility Dimensions	Pump Stations	Construction Duration (years)	Excavation Quantities (CY)	Surface Disturbance (acre)	Truck Trips	Concrete (CY)
Longfellow Creek/Duwamish Neighborhoods										
North Delridge	*Same as Neighborhood Storage Option*									
South Delridge	*Same as Neighborhood Storage Option*									
Duwamish	*Same as Neighborhood Storage Option*									
East Waterway	Flow Diversion to King County HLKK Treatment Plant	ROW	Some conveyance construction – minor compared to storage projects.		1	1	5,000	0.4	1,100	2,400
*Longfellow Creek/Duwamish Neighborhoods Construction Details Totals**							25,000 CY	1.5 acre	4,700 trips	5,200 CY
Elliott Bay/Lake Union Neighborhoods										
Central Waterfront	*Same as Neighborhood Storage Option*									
*Elliott Bay/Lake Union Neighborhoods Totals**							5,000 CY	0.1 acre	900 trips	60 CY
Shared Storage Option Totals*							**408,000 CY**	**12 acres**	**61,900 trips**	**71,500 CY**

Table 5-1. LTCP Alternative Options – Estimated Project Details[1]

	CSO Control Measure	Potential Property	Description	Storage Facility Dimensions	Pump Stations	Construction Duration (years)	Excavation Quantities (CY)	Surface Disturbance (acre)	Truck Trips	Concrete (CY)
Shared West Ship Canal Tunnel Option										
Ship Canal Neighborhoods										
Ballard; Fremont / Wallingford	Shared Deep Tunnel with King County	City or Private Property	The City and King County would jointly build a deep offline storage tunnel along the west end of the Ship Canal from Ballard to Fremont/Wallingford. The tunnel would provide the storage capacity needed to address sewage overflows in the Ballard and Fremont/Wallingford Neighborhoods.	2.7 miles long x 13 ft diameter	1 in Ballard	3.5	162,000	4 (launch and retrieval portals only)	50,900	32,800
Magnolia	Flow Diversion to King County North Interceptor	ROW	Some conveyance construction – minor compared to storage projects.		1	< 0.5	600	0.2	300	1,000
*Ship Canal Neighborhoods Construction Details Totals**							163,000 CY	4 acres	51,000 trips	34,000 CY
Lake Washington Neighborhoods										
North Union Bay	*Same as Neighborhood Storage Option*									
Portage Bay	*Same as Neighborhood Storage Option*									
Montlake	*Same as Neighborhood Storage Option*									
Leschi	*Same as Neighborhood Storage Option*									
*Lake Washington Neighborhoods Construction Details Totals**							26,000 CY	1 acre	4,300 trips	2,300 CY
Longfellow Creek / Duwamish Neighborhoods										
North Delridge	*Same as Neighborhood Storage Option*									

Table 5-1. LTCP Alternative Options – Estimated Project Details[1]

	CSO Control Measure	Potential Property	Description	Storage Facility Dimensions	Pump Stations	Construction Duration (years)	Excavation Quantities (CY)	Surface Disturbance (acre)	Truck Trips	Concrete (CY)
South Delridge	*Same as Neighborhood Storage Option*									
Duwamish	*Same as Neighborhood Storage Option*									
East Waterway	*Same as Shared Storage Option*									
*Longfellow Creek/Duwamish Neighborhoods Construction Details Totals**							83,000 CY	1.5 acre	3,700 trips	5,200 CY
Elliott Bay/Lake Union Neighborhoods										
Central Waterfront	*Same as Neighborhood Storage Option*									
*Elliott Bay/Lake Union Neighborhoods Total**							5,000 CY	0.1 acre	900 trips	60 CY
Shared West Ship Canal Tunnel Option Totals*							**276,600 CY**	**7 acres**	**60,100 trips**	**41,300 CY**

Table 5-1. LTCP Alternative Options – Estimated Project Details[1]

	CSO Control Measure	Potential Property	Description	Storage Facility Dimensions	Pump Stations	Construction Duration (years)	Excavation Quantities (CY)	Surface Disturbance (acre)	Truck Trips	Concrete (CY)
Shared Ship Canal Tunnel Option										
Ship Canal Neighborhoods										
Ballard	*Shared Deep Tunnel with King County (see South Ship Canal)*									
Fremont / Wallingford										
South Ship Canal	Shared Deep Tunnel with King County (+NUB, Portage Bay, Montlake, Leschi)	City or Private Property	The City and King County would jointly build a deep offline storage tunnel along the east end of the Ship Canal from south side of Ship Canal to North Union Bay. The tunnel would provide the storage needed to address sewage overflows in Ballard, Fremont/Wallingford, Portage Bay, Montlake, North Union Bay, and Leschi Neighborhoods.	2.9 miles long x 18 ft diameter	2 in Ballard 2 in Montlake 1 in Leschi (upgrade only) 1 in Queen Anne	7	465,000	4 (launch and retrieval portals only)	106,200	70,700
Magnolia	*Same as West Ship Canal Tunnel Option*									
*Ship Canal Neighborhoods Construction Details Totals**							465,600 CY	4.2 acres	106,500 trips	71,700 CY
Lake Washington Neighborhoods										
North Union Bay	*Shared Deep Tunnel with King County (see Ballard and Fremont/Wallingford) – all construction details included under Ship Canal Neighborhoods*									
Portage Bay										
Montlake										
Leschi										
Longfellow Creek/Duwamish Neighborhoods										
North Delridge	Flow Diversion to King County	ROW	Some conveyance construction – minor compared to storage projects.			1	5,400	0.8	1,200	4,000

Table 5-1. LTCP Alternative Options – Estimated Project Details[1]

	CSO Control Measure	Potential Property	Description	Storage Facility Dimensions	Pump Stations	Construction Duration (years)	Excavation Quantities (CY)	Surface Disturbance (acre)	Truck Trips	Concrete (CY)
South Delridge	*Same as Neighborhood Storage Option*									
Duwamish	Flow Diversion to King County	ROW	Some conveyance construction – minor compared to storage projects.			1	14,000	1	3,000	6,300
East Waterway	*Same as Shared Storage Option*									
*Longfellow Creek/Duwamish Neighborhoods Construction Details Total**							36,400 CY	3 acres	5,600 trips	14,200 CY
Elliott Bay/Lake Union Neighborhoods										
Central Waterfront	*Same as Neighborhood Storage Option*									
*Elliott Bay/Lake Union Neighborhoods Totals**							5,000 CY	0.1 acre	900 trips	60 CY
Shared Ship Canal Tunnel Option Totals*							**507,000 CY**	**7.3 acres**	**113,000 trips**	**86,000 CY**

**Numbers are an estimate of the project totals.*

5.1.2.1 Sewer System Improvements

Sewer system improvements typically include minor modifications to the existing underground system components, such as modifying existing flow-regulating equipment and installing electrical/control systems. Construction would occur at existing access points but may involve small areas of surface disturbance to access the system.

5.1.2.2 Flow Transfers and Flow Diversions

Flow transfers and flow diversions involve constructing varying lengths of gravity sewer pipeline connections, generally within paved street rights-of-way, or pumped force mains/pump stations. Construction activities are similar to those described below for associated pipelines. Flow transfers involve transferring flow within the City's sewer system. Flow diversions involve diverting flows to King County's sewer system.

5.1.2.3 Storage Tanks and Pipes

Underground storage tanks and pipes are constructed using common open-cut excavation techniques. The key steps in the construction process would be as follows: (1) surface preparation; (2) excavation, dewatering, and shoring; (3) concrete tank structure or pipe installation; (4) backfilling and compacting; (5) mechanical and electrical equipment installation; and (6) surface restoration. Surface preparation could involve removing existing structures (such as fences), sawcutting and removing pavement, or removing vegetation from the surface of the excavation area. Dewatering could include well points or dewatering sump pumps to lower the groundwater level to allow installation of structures or pipelines. Excavation would be done using a backhoe or excavator. Other equipment could include jackhammers, pavement saws, vibratory hammer, crane, graders, and loaders. Excavated soil of suitable quality would be stockpiled for later reuse as backfill. Where excavated soil is not of suitable quality, engineered fill could be trucked to the site for backfilling. Excess soil would be hauled offsite for disposal.

Figure 5-4. Storage Tank Construction

Depending on the site, construction could require grading and construction of an access road and staging areas for construction office trailers, equipment and materials storage, and temporary stockpiling. Excavation typically requires shoring and associated supports or dewatering systems. Equipment installation could require crane, welding, and delivery trucks. Upon completion of tank construction, the area above the tank would be restored, or public amenities provided where appropriate. For storage pipes located within paved roadways, surface restoration would involve repaving the area with new asphalt or concrete pavement.

5.1.2.4 Storage Tunnels

Tunnel construction would typically occur in three 8-hour shifts, operating six days a week with a seventh day for maintenance of tunneling equipment. Tunneling operations typically take place 24 hours a day to maximize efficiency, since most activities occur underground and cause limited surface disturbance. However, surface activities at the tunnel portals could be suspended during nighttime shifts, depending on the location. Depending on the size and depth of the tunnel, construction could last one to five years.

Surface construction activities would be focused at two locations (the launch and recovery tunnel portals) for the duration of tunnel construction. The launch portal would serve as the main access for installation of equipment as well as for removal of tunnel spoils. Access shafts for connecting the tunnel to existing sewers would also be constructed along the tunnel alignment.

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 tunnel boring machines 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.

Spoils from tunnel excavations are typically removed from the tunnel face and deposited outside the portal using various methods, such as a conveyor belt, front-end loader, hoppers, or tunnel train (also known as a muck train). The conveyor system transporting the muck from the tunnel would be enclosed once the muck leaves the bored tunnel, reducing the potential for dust and noise, as well as improving the appearance of the work area. Excavated material stockpiled outside the portal is then loaded onto trucks or barges (if applicable) and transported offsite.

Other related tunneling equipment includes a tunnel ventilation fan, muck removal equipment, dewatering and groundwater treatment system, etc. Depending on the tunnel design, vent shafts could be required at certain locations along the tunnel alignment, with associated surface disturbance occurring outside of the tunnel portal areas.

Figure 5-5. Tunnel Boring Machine

Tunnel construction would start at the tunnel launch portal, which would serve as the primary staging area for tunnel construction. This large construction staging area would provide laydown areas for materials, maintenance workshops, storage areas for excavated spoils and precast-concrete segments, along with parking and field offices. The launch portal site would also require a temporary electrical substation and electrical systems to provide power to the tunnel boring machine (TBM). This extension of electrical systems to feed the machine could require improvements to the Seattle City Light electrical distribution system facilities outside the project area.

Removal and transport of tunnel spoils would generally occur at the launch portal, as would equipment storage and deliveries. Tunnel portal construction could require grading and construction of an access road and staging areas for construction office trailers, equipment and materials storage, and temporary stockpiling. Tunnel construction would include excavation and construction of the tunnel launch and recovery portal. Depending on the depth, size, and location of the tunnel, the portal entry could require shoring and associated supports or dewatering systems.

Removal of the tunnel boring machine would generally occur at a second tunnel portal entry or machine recovery shaft. Construction of the tunnel recovery portal would be similar to the launch portal except the construction staging area would be smaller.

5.1.2.5 Associated Pipelines

New pipelines would be required for many of the storage options to convey flows to and from the new storage facilities. Larger, shared tanks and tunnels would require more conveyance connections than smaller, neighborhood tanks and tunnels in order to transfer flows from other basins. Both force mains and gravity pipelines would be required. Construction of pipelines would be accomplished using standard pipeline installation methods, generally the open-cut trench method (also referred to as the cut-and-cover construction method) where feasible. In general, cut-and-cover pipeline construction would progress at a rate of approximately 50 to 100 feet per day depending on traffic conditions, the length and size of the pipe segment, number of utility crossings, traffic congestion, and any restrictions on work schedules. 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 alignment.

The key steps in the cut-and-cover construction process would be as follows: (1) surface preparation, (2) trench excavation and shoring, (3) pipe installation, (4) trench backfilling and compacting, (5) pipeline testing, and (6) surface restoration. Surface preparation could involve removing structures (such as fences), sawcutting and removing pavement, or removing vegetation from the surface of the trench area. Equipment used could include jackhammers, pavement saws, mowers, graders, and loaders. Trench excavation would be done using a backhoe or excavator, and excavated soil of suitable quality would be stockpiled along the trench for later reuse as backfill. Where excavated soil is not of suitable quality, engineered fill could be trucked to the site for backfilling. Excess soil would be hauled offsite for disposal. Pipeline testing could require air testing or water testing equipment including pumps and water supply equipment.

The depth and width of the trench would depend on the size of the pipeline to be installed. Shoring would be required for trenches over five feet deep. If groundwater is encountered during trench excavation, dewatering would typically be required so that the pipe could be installed in dry conditions.

For pipelines located within paved roadways, surface restoration would involve repaving the area with new asphalt or concrete pavement.

5.1.2.6 Associated Pump Stations

Underground pump stations are constructed using common open-cut excavation techniques. The key steps in the construction process would be as follows: (1) surface preparation; (2) excavation, dewatering, and shoring; (3) belowgrade concrete structure; (4) backfilling and compacting; (5) mechanical and electrical equipment installation; and (6) surface restoration. Surface preparation could involve removing existing structures (such as fences), sawcutting and removing pavement, or removing vegetation from the surface of the excavation area. Dewatering could include well points or dewatering sump pumps to lower the groundwater level to allow structure installation. Excavation would be done using a backhoe or excavator. Other equipment used for this activity could include jackhammers, pavement saws, vibratory hammer, crane, graders, and loaders. Excavated soil of suitable quality would be stockpiled for later reuse as backfill. Where excavated soil is not of suitable quality, engineered fill could be trucked to the site for backfilling. Excess soil would be hauled offsite for disposal. Equipment installation could require crane, welding, and delivery trucks.

Depending on the site, construction could require grading and construction of an access road and staging areas for construction office trailers, equipment and materials storage, and temporary stockpiling. Excavation typically requires shoring and associated supports or dewatering systems. Upon completion of pump station construction, the area above ground would be restored or public amenities provided where appropriate. For storage pipes located within paved roadways, surface restoration would involve repaving the area with new asphalt or concrete pavement. Depending on the size of the pump station, construction could last one to two years.

5.1.3 What are the general construction scenarios for stormwater projects that would occur under the Integrated Plan Alternative?

Construction associated with NDS Partnering projects and the South Park Water Quality Facility involve some of the same general types of construction activities associated with the LTCP Alternative projects. NDS Partnering projects would generally include the following activities: excavation, soil importing, drain / pipe work, site grading, landscaping, and paving. The South Park Water Quality Facility would generally include the following activities: excavation, relocation of utilities, demolition, site grading, landscaping mechanical/process system work, electrical work, and instrumentation and controls. No construction would be required to expand street sweeping.

5.1.4 How were construction impacts estimated for the LTCP options?

To evaluate impacts at a programmatic level, certain estimated construction details were used as a proxy to compare the potential for impacts among the LTCP options, which involve larger, more complex construction activities than the stormwater projects of the Integrated Plan. Construction details were estimated for main project components only. For example, the area of surface disturbance was estimated for construction of the storage facility sites only. For many of the projects – especially shared projects that would involve combining flows from different areas – there would be additional surface disturbance related to constructing pipelines and pump stations to transfer flows from other basins, and access portals for tunnels.

Estimated construction details include: (1) number of truck trips; (2) amount of excavated material; (3) overall size of the construction footprint (amount of surface disturbance); and (4) length of construction period. For the LTCP options, these construction details were estimated as follows:

Truck trips. Project components requiring numerous truck trips could affect air quality, energy and climate change, recreation, transportation, socioeconomics, and environmental justice. The main components of the LTCP options were estimated to have the following numbers of truck trips during project construction:

- Sewer system improvements: minor number of truck trips (not estimated)
- Flow diversion: 200 to 3,000 truck trips
- Storage pipes: 600 to 2,300 truck trips
- Storage tanks: 2,600 to 12,000 (City-only); or 11,000 to 16,000 (shared) truck trips
- Shared West Ship Canal Tunnel: 60,000 truck trips
- Shared Ship Canal Tunnel: 106,000 truck trips

Excavation quantities. Project components requiring a substantial amount of earthwork (excavation) could affect earth, air quality, and surface water. The main components of the LTCP options were estimated to have the following amounts (cubic yards or CY) of excavation during project construction:

- Sewer system improvements: minor quantities (not estimated)
- Flow diversion: 600 to 14,000 CY
- Storage pipes: 2,000 to 14,000 CY
- Storage tanks: 14,000 to 76,000 CY (City-only); or 89,000 to 113,000 CY (shared)
- Shared West Ship Canal Tunnel: 162,000 CY
- Shared Ship Canal Tunnel: 465,000 CY

Surface disturbance. The larger the surface disturbance area of a project, the greater the potential for impacts to environmental resources discussed in this EIS. The main components of the LTCP options were estimated to have the following levels of surface disturbance during construction:

- Sewer system improvements: minor amount of surface disturbance (not estimated)
- Flow diversion: 0.2 to 1 acre
- Storage pipes: 0.1 to 0.8 acre
- Storage tanks: 0.8 to 2 acres (City-only); or 2 to 3 acres (shared)
- Shared West Ship Canal Tunnel: 4 acres (launch and retrieval portals only)
- Shared Ship Canal Tunnel: 4 acres (launch and retrieval portals only)

Duration. Project construction ranges in length from a few months to seven years. The longer the duration of construction, the greater the potential for impacts to most of the resources considered in this EIS. The main components of the LTCP options were estimated to have the following construction durations:

- Sewer system improvements: minor construction duration (not estimated)
- Flow diversion: 4 months to 1 year
- Storage pipes: 1.5 to 2 years
- Storage tanks: 2 to 5 years
- Shared West Ship Canal Tunnel: 3.5 years
- Shared Ship Canal Tunnel: 7 years

From the estimated construction details listed above, the total estimated truck trips and excavation quantities were summarized at the neighborhood level for each LTCP option (Figures 5-6 through 5-9).

LTCP Options Potential Construction Details[1]

SHIP CANAL NEIGHBORHOODS

A - NEIGHBORHOOD STORAGE OPTION

1 - Ballard
TRUCK TRIPS - 12,000
EXCAVATED MATERIAL - 76,000 CY

2 - Fremont/Wallingford
TRUCK TRIPS - 7,000
EXCAVATED MATERIAL - 39,000 CY

3 - Magnolia
TRUCK TRIPS - 600
EXCAVATED MATERIAL - 3,000 CY

B - SHARED STORAGE OPTION

1 - Ballard
TRUCK TRIPS - 12,000
EXCAVATED MATERIAL - 76,000 CY

2 - Fremont/Wallingford
TRUCK TRIPS - 11,000
EXCAVATED MATERIAL - 113,000 CY

3 - Magnolia
TRUCK TRIPS - 600
EXCAVATED MATERIAL - 3,000 CY

C - SHARED WEST SHIP CANAL TUNNEL OPTION

1 - Ballard
TRUCK TRIPS - 48,355
EXCAVATED MATERIAL - 153,900 CY

2 - Fremont/Wallingford
TRUCK TRIPS - 2,545
EXCAVATED MATERIAL - 8,000 CY

3 - Magnolia
TRUCK TRIPS - 300
EXCAVATED MATERIAL - 600 CY

D - SHARED SHIP CANAL TUNNEL OPTION

1 - Ballard
TRUCK TRIPS - 0
EXCAVATED MATERIAL - 0 CY

2 - Fremont/Wallingford
TRUCK TRIPS - 0
EXCAVATED MATERIAL - 0 CY

3 - Magnolia
TRUCK TRIPS - 500
EXCAVATED MATERIAL - 600 CY

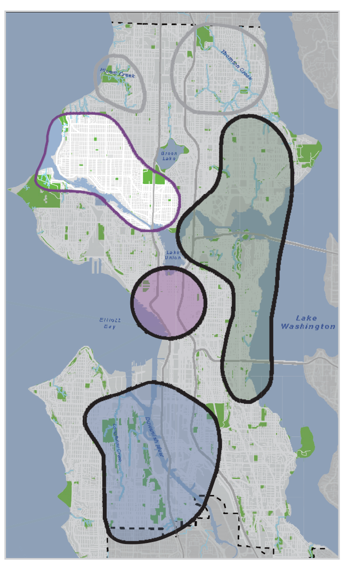
4 - South Ship Canal
TRUCK TRIPS - 100,000
EXCAVATED MATERIAL - 442,000 CY

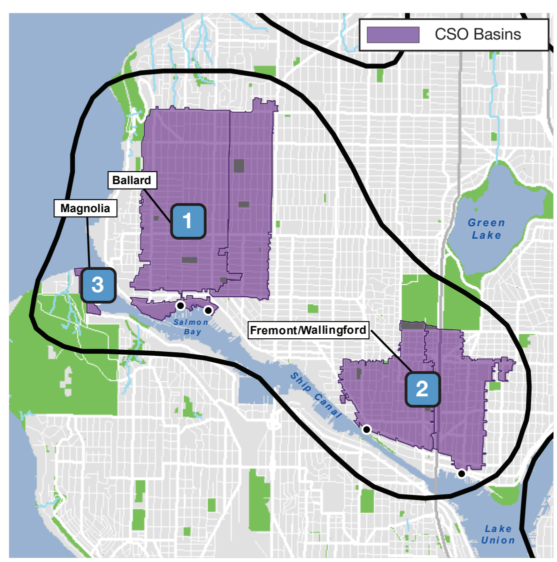
[1]All details are approximate, based on plan-level information only; reflects construction for the City and shared facilities only.

LEGEND

1 = 1,000 Truck Trips

1 = 5,000 cy Excavated Material





SOURCE: SPU, 2013; CH2M Hill, 2013.

FILE NAME: Fig05-06_AltLTCP_ShipCanal.ai / CREATED BY: JAC / DATE LAST UPDATED: 05/09/14

Figure 5-6. LTCP Options Potential Construction Details - Ship Canal Neighborhoods.

LTCP Options Potential Construction Details[1]

LAKE WASHINGTON NEIGHBORHOODS

A - NEIGHBORHOOD STORAGE OPTION

	1 - North Union Bay	2 - Portage Bay	3 - Montlake	4 - Leschi
TRUCK TRIPS	0	900	1,400	2,000
EXCAVATED MATERIAL	0 CY	5,000 CY	7,000 CY	14,000 CY

B - SHARED STORAGE OPTION

	1 - North Union Bay	2 - Portage Bay	3 - Montlake	4 - Leschi
TRUCK TRIPS	16,200	900	15,500	0
EXCAVATED MATERIAL	89,000 CY	5,000 CY	92,000 CY	0 CY

C - SHARED WEST SHIP CANAL TUNNEL OPTION

	1 - North Union Bay	2 - Portage Bay	3 - Montlake	4 - Leschi
TRUCK TRIPS	0	900	1,400	2,000
EXCAVATED MATERIAL	0 CY	5,000 CY	7,000 CY	14,000 CY

D - SHARED SHIP CANAL TUNNEL OPTION

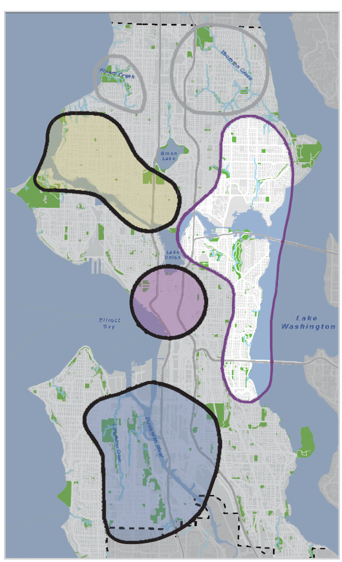
	1 - North Union Bay	2 - Portage Bay	3 - Montlake	4 - Leschi
TRUCK TRIPS	6,000	0	0	0
EXCAVATED MATERIAL	23,000 CY	0 CY	0 CY	0 CY

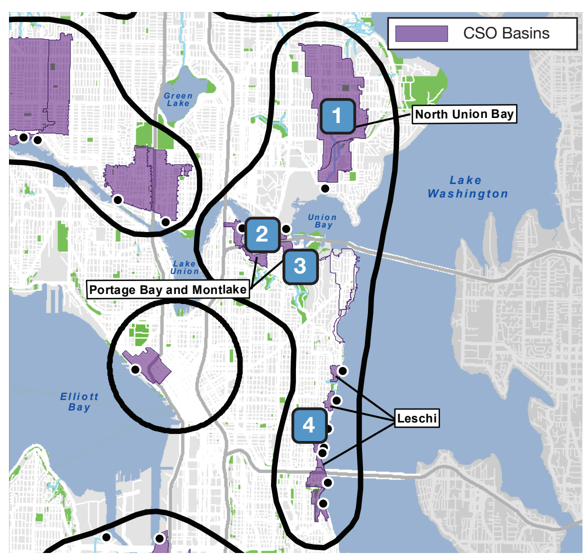
[1]All details are approximate, based on plan-level information only; reflects construction for the City and shared facilities only.

LEGEND

1 = 1,000 Truck Trips

1 = 5,000 cy Excavated Material





SOURCE: SPU, 2013; CH2M Hill, 2013.

FILE NAME: Fig05-07_AltLTCP_LakeWashington.ai / CREATED BY: JAC / DATE LAST UPDATED: 05/08/14

Figure 5-7. LTCP Options Potential Construction Details - Lake Washington Neighborhoods.

LTCP Options Potential Construction Details[1]

LONGFELLOW CREEK/DUWAMISH NEIGHBORHOODS

A - NEIGHBORHOOD STORAGE OPTION

1 - North Delridge	2 - South Delridge	3 - Duwamish	4 - East Waterway
TRUCK TRIPS - 800	TRUCK TRIPS - 2,300	TRUCK TRIPS - 500	TRUCK TRIPS - 2,600
EXCAVATED MATERIAL - 6,000 CY	EXCAVATED MATERIAL - 12,000 CY	EXCAVATED MATERIAL - 2,000 CY	EXCAVATED MATERIAL - 14,000 CY

B - SHARED STORAGE OPTION

1 - North Delridge	2 - South Delridge	3 - Duwamish	4 - East Waterway
TRUCK TRIPS - 800	TRUCK TRIPS - 2,300	TRUCK TRIPS - 500	TRUCK TRIPS - 1,100
EXCAVATED MATERIAL - 6,000 CY	EXCAVATED MATERIAL - 12,000 CY	EXCAVATED MATERIAL - 2,000 CY	EXCAVATED MATERIAL - 5,000 CY

C - SHARED WEST SHIP CANAL TUNNEL OPTION

1 - North Delridge	2 - South Delridge	3 - Duwamish	4 - East Waterway
TRUCK TRIPS - 800	TRUCK TRIPS - 2,300	TRUCK TRIPS - 500	TRUCK TRIPS - 2,600
EXCAVATED MATERIAL - 6,000 CY	EXCAVATED MATERIAL - 12,000 CY	EXCAVATED MATERIAL - 2,000 CY	EXCAVATED MATERIAL - 14,000 CY

D - SHARED SHIP CANAL TUNNEL OPTION

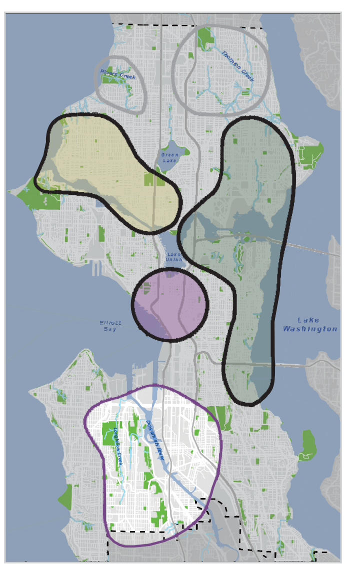
1 - North Delridge	2 - South Delridge	3 - Duwamish	4 - East Waterway
TRUCK TRIPS - 1,200	TRUCK TRIPS - 2,300	TRUCK TRIPS - 3,000	TRUCK TRIPS - 2,600
EXCAVATED MATERIAL - 5,400 CY	EXCAVATED MATERIAL - 12,000 CY	EXCAVATED MATERIAL - 14,000 CY	EXCAVATED MATERIAL - 14,000 CY

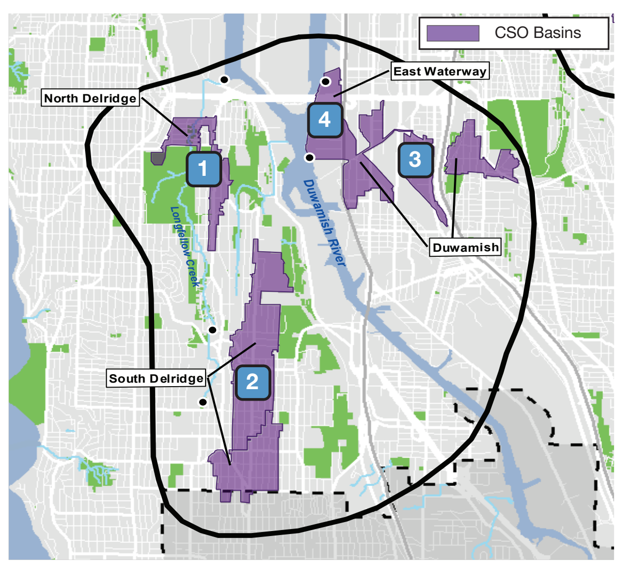
[1]All details are approximate, based on plan-level information only; reflects construction for the City and shared facilities only.

LEGEND

1 = 1,000 Truck Trips

1 = 5,000 cy Excavated Material





SOURCE: SPU, 2013; CH2M Hill, 2013.

FILE NAME: Fig05-08_AltLTCP_LongfellowCreek-Duwamish.ai / CREATED BY: JAC / DATE LAST UPDATED: 05/08/14

Figure 5-8. LTCP Options Potential Construction Details - Longfellow Creek/Duwamish Neighborhoods.

LTCP Options Potential Construction Details[1]

ELLIOTT BAY/LAKE UNION NEIGHBORHOODS

A - NEIGHBORHOOD STORAGE OPTION

1 - Downtown

TRUCK TRIPS - 900

EXCAVATED MATERIAL - 5,000 CY

B - SHARED STORAGE OPTION

1 - Downtown

TRUCK TRIPS - 900

EXCAVATED MATERIAL - 5,000 CY

C - SHARED WEST SHIP CANAL TUNNEL OPTION

1 - Downtown

TRUCK TRIPS - 900

EXCAVATED MATERIAL - 5,000 CY

D - SHARED SHIP CANAL TUNNEL OPTION

1 - Downtown

TRUCK TRIPS - 900

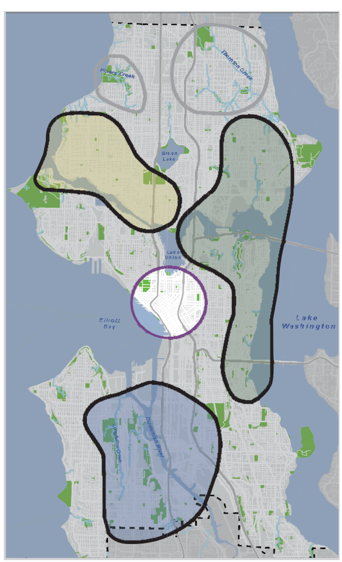
EXCAVATED MATERIAL - 5,000 CY

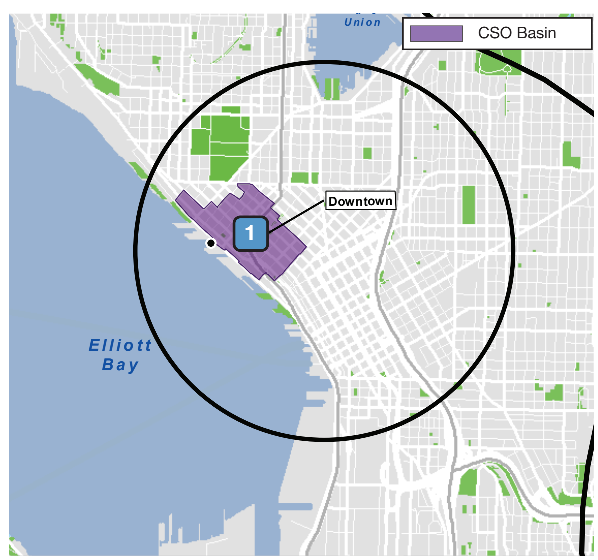
[1]All details are approximate, based on plan-level information only; reflects construction for the City and shared facilities only.

LEGEND

1 = 1,000 Truck Trips

1 = 5,000 cy Excavated Material





SOURCE: SPU, 2013; CH2M Hill, 2013.

Figure 5-9. LTCP Options Potential Construction Details - Elliott Bay/Lake Union Neighborhoods.

FILE NAME: Fig05-09_AltLTCPElliottBay-LakeUnion.ai / CREATED BY: JAC / DATE LAST UPDATED: 05/09/14

5.2 Earth and Groundwater

This section describes the types of impacts that could occur to the geological setting, soils, and groundwater within the Plan area during implementation of Plan alternatives.

5.2.1 What potential earth-related construction impacts are common to all of the alternatives?

Construction activities and equipment have the potential to cause short-term impacts to earth and groundwater during construction. CSO control projects included in the LTCP – and common to both the LTCP Alternative and the Integrated Plan Alternative – range from those that would cause minimal displacement of soil, to major projects involving substantial excavation, trenching, or tunneling and removal of large soil quantities. These common impacts are described below.

> **Key Findings**
>
> ***Earth and Groundwater***
>
> Construction activities under the *LTCP Alternative* have the potential to cause short-term impacts to earth and groundwater during construction of major projects involving substantial excavation, trenching or tunneling, and removal of large quantities of soil. Any areas that are disturbed during construction would be subject to increased erosion, and control measures would be required. Dewatering could cause ground settlement of nearby structures, roadways and utilities.
>
> The primary differences in potential effects of the LTCP options are related to amount of surface disturbance and excavation potentially required. Overall, there would be the greatest number of projects with associated impacts under the Neighborhood Storage Option, and least under the Shared West Ship Canal and Ship Canal Tunnel Options. Impacts would be concentrated and of longer duration at fewer locations under the shared options.
>
> The *Integrated Plan Alternative* would have minor, additional short-term impacts.

Erosion

Erosion by rain, runoff, or wind may occur as a result of clearing vegetation, placing fill, and removing, grading, or stockpiling uncovered spoils during construction. The potential for erosion depends on the area, slope, and characteristics of exposed soils; the volume and configuration of spoils piles; and the intensity and duration of rain, runoff, or wind.

Slope Failure

Depending on individual project designs, construction has the potential to cause hillside slumping or sliding due to changes in grade, removal of vegetation, and introduction of new loads to the hillside. Construction on steep slopes or areas with inappropriate geological conditions would be especially susceptible to slope instability. Excavations and trenching for structure foundations and pipe installation in any location, if not shored correctly, could fail and result in damage to adjacent utilities, roadways, and structures.

Unsuitable or Excess Soils

Existing soils that cannot be reused as structural fill or landscape material would require removal and disposal. Liquefiable soils, particularly peat and other organic-rich soils, may be especially unsuitable for use as structural fill. Offsite disposal would result in temporary truck traffic, dust, road runoff, and other construction-related impacts.

Dewatering Impacts

Dewatering of excavations below the groundwater table could result in settlement of nearby structures, roadways, and utilities. Potential for impact is considered low if proper measures to minimize and avoid dewatering are used. Dewatering also has the potential to encounter contaminated groundwater requiring special disposal. Refer to Section 5.4, Surface Water, for additional discussion.

Vibration

Use of construction equipment can cause ground vibration. The magnitude of vibration depends on type of equipment, distance to source, and soil conditions. Tunneling and pile driving (if required) are two of the major activities that can cause vibration impacts. Apart from discomfort to people living and working within the area of vibration, the main concern is potential damage to structures arising from excessive levels of vibration.

Spoils Disposal

Spoils that are unsuitable for project reuse would require disposal at an appropriate facility. Fill material with appropriate engineering properties may be required for most projects.

5.2.2 What are the potential earth and groundwater impacts of the LTCP options?

Table 5-2 summarizes the types of earth impacts that could occur under the four options of the LTCP Alternative. Many of the impacts are associated with earthwork quantities, which are summarized for the options in Figures 5-6 through 5-9.

Table 5-2. Summary of Potential Earth and Groundwater Impacts for LTCP Options
Neighborhood Storage Option*
This option has the greatest number of City and King County independently constructed CSO storage facilities. Construction of distributed tanks and pipes throughout the Plan area would have substantial impacts to earth due to the magnitude of excavation, dewatering, and special construction requirements, such as installation of shoring (sheet piles). Storage tank and storage pipe construction would result in approximately 7.5 acres of surface disturbance (the second highest of all the LTCP options) and total excavation volume of 185,000 cubic yards (the lowest of all the LTCP options). Most projects would require substantial dewatering, which could result in settling of nearby structures. The neighborhoods that would be most affected are as follows: • <u>Ship Canal Neighborhoods</u>. Large storage tanks would be built in both the Ballard and Fremont/Wallingford neighborhoods, resulting in approximately 2 acres of surface disturbance at each site. Extensive areas of artificial fill exist along the Ship Canal waterfront. Construction has the potential to result in vibration damage to nearby structures within this highly urbanized area. Dewatering has the potential to encounter contaminated groundwater or result in settlement of nearby structures. • <u>Lake Washington Neighborhoods</u>. Three pipes, one storage tank, and associated pump stations would be constructed in Leschi, which contains steep slopes and known or potential landslide zones. Projects near these zones would be at heightened risk for erosion and slope instability. The proximity to Lake Washington could increase potential for erosion and sedimentation in site runoff. • <u>Longfellow Creek/Duwamish Neighborhoods</u>. Three pipes and associated pump stations would be constructed in North and South Delridge. These neighborhoods contain steep slopes and known or potential landslide zones. Projects near these zones could be at heightened risk for erosion and slope instability. <u>East Waterway</u>. One tank would be constructed in East Waterway, resulting in approximately 1 acre of surface disturbance. The neighborhood contains extensive areas of organic and liquefiable soils that may require additional excavation and imported fill.

Table 5-2. Summary of Potential Earth and Groundwater Impacts for LTCP Options
Shared Storage Option
Construction of storage tanks and storage pipes under this option would result in approximately 12 acres of surface disturbance (the highest of all the LTCP options) and 408,000 CY of excavation (the second highest of all the LTCP options). Additional construction would be required for associated conveyance (pipelines, pump stations). Overall impacts would be reduced compared to the Neighborhood Storage Option because the shared tanks would eliminate the need for several City and King County independently constructed CSO storage facilities. The neighborhoods that would be most affected are as follows: • Ship Canal Neighborhoods. Impacts of shared storage tanks would be similar to but greater than the Neighborhood Storage Option because the Fremont/Wallingford tank would be larger, resulting in more excavation and soil disposal. Depending on siting, increased dewatering could be required, increasing the risk for encountering contaminated groundwater. • North Union Bay. Construction of a shared storage tank near Union Bay has increased potential to encounter organic or liquefiable soils. Dewatering has the potential to encounter contaminated groundwater or result in settlement of nearby structures due to the presence of historic landfill deposits, as well as natural organic deposits. • Montlake/ Leschi. A shared storage tank would be constructed in these neighborhoods, which contain steep slopes and known or potential landslide zones. Projects near these zones could be at heightened risk for erosion and slope instability. • Other neighborhoods would experience similar level of impacts as under the Neighborhood Storage Option except the East Waterway neighborhood, where a flow transfer with limited conveyance construction would replace the storage tank and cause potentially fewer earth impacts.
Shared West Ship Canal Tunnel Option
The Shared West Ship Canal Tunnel Option would result in total surface disturbance of 7 acres and 276,000 CY of excavation for construction of the tunnel and tunnel launch and retrieval portals. Additional construction would be required for associated conveyance (pipelines, pump stations). Overall impacts would be reduced compared to the Neighborhood Storage Option as this option eliminates City and King County independently constructed CSO storage facilities that would otherwise be constructed in the same neighborhoods. The neighborhoods that would be most affected are as follows: • Ballard and Fremont/ Wallingford. Tunneling would displace more soil than storage tanks under the Neighborhood Storage Option, but less than shared storage tanks under the Shared Storage Option. Installation of sheet piles for the portals could result in vibration. Movement of the tunnel boring machine could result in vibration and settling if project controls are not implemented according to plan, or unforeseen conditions are encountered. Location of the portals and tunnel near extensive areas of liquefiable soils in Fremont could result in soil settling. • Leschi. Impacts of constructing three pipes, one tank, and associated pump stations in the confined neighborhood would have the same earth impacts as the Neighborhood Storage Option. • Other neighborhoods would have similar impacts as the Neighborhood Storage Option except in Magnolia and East Waterway. In Magnolia, a flow diversion to King County facilities would replace the storage pipe, but would have similar potential earth impacts. The East Waterway area would have the same flow diversion as under the Shared Storage Option.

Table 5-2. Summary of Potential Earth and Groundwater Impacts for LTCP Options
Shared Ship Canal Tunnel Option
Compared to all other LTCP options, the Shared Ship Canal Tunnel Option would have the fewest City and King County independently constructed CSO storage facilities, and therefore the lowest level of surface disturbance. While construction of the tunnel and tunnel launch and retrieval portals under this option would result in approximately 7.5 acres of surface disturbance and total excavation of 507,000 CY (the highest of all the LTCP options), overall impacts would be reduced because the shared tanks would eliminate the greatest number of City and King County independently constructed CSO storage facilities. The neighborhoods that would be most affected are as follows: • Ship Canal and Lake Washington Neighborhoods. Major construction impacts would occur at the portal locations (up to 4 acres of disturbance). Small areas of organic soils exist, but soils are otherwise generally suitable for construction. Installation of pilings could result in vibration. Movement of the tunnel boring machine could result in vibration and settling. Compared with the West Ship Canal Tunnel, the longer Ship Canal Tunnel has greater potential to encounter earth hazards. • Other neighborhoods would have similar impacts or reduced impacts as compared to the Neighborhood Storage Option.

*The Neighborhood West Ship Canal Tunnel would have similar impacts in Ballard and Fremont/Wallingford as described for the Shared West Ship Canal Tunnel Option.

5.2.3 What are the potential earth and groundwater impacts of the Integrated Plan Alternative?

Construction of storage pipes, tanks, and tunnels under the Integrated Plan Alternative would have the same potential earth and groundwater impacts as under the LTCP Alternative, but construction would be delayed in some neighborhoods. In addition to construction of CSO control projects under the selected LTCP option, additional construction would occur to construct NDS Partnering projects and the South Park Water Quality Facility project. The street sweeping expansion program does not involve construction; therefore, no earth or groundwater impacts would occur.

NDS Partnering projects would be constructed in public road rights-of-way of the Piper's, Thornton, and Longfellow Creek neighborhoods and cause minimal earth impacts. Natural drainage system projects are constructed in relatively flat public rights-of-way within developed areas. These areas are typically characterized by previous grading, filling, paving, landscaping, or utility installation. Individual NDS Partnering projects would be evaluated with respect to geological hazards, would be relatively small in size, and would be conducted with appropriate erosion control measures in place.

Construction of the South Park Water Quality Facility would involve approximately one acre of surface disturbance. The facility is expected to be located in an industrial area near the Duwamish River. Depending on specific site location, the soils may be susceptible to liquefaction and compaction. The City would take appropriate engineering measures to account for these hazards.

5.2.4 What are the potential earth and groundwater impacts of the No Action Alternative?

Under the No Action Alternative, the CSO control projects included in the LTCP would not be built. However, the City would continue with two of its ongoing programs to reduce CSOs—sewer system improvements and natural drainage systems.

RainWise and roadside rain garden projects are constructed in relatively flat public rights-of-way or private property within developed areas. These areas are typically characterized by previous grading, filling, paving, landscaping, or utility installation. Individual projects constructed under these programs generally have a limited footprint and depth, and they are unlikely to result in substantial erosion or dewatering.

During scoping, several comments were received regarding the history of unsuccessful roadside rain gardens in the Ballard neighborhood due to unsuitable soils, and the potential for continued impacts associated with rain gardens. The City has incorporated the lessons learned from the previous projects into its voluntary RainWise program, including detailed evaluation of subsurface conditions prior to implementation of rain gardens.

5.2.5 What measures are proposed to reduce or minimize earth and groundwater impacts?

Potential construction impacts include erosion, failure, excess/unsuitable soils, settling or encountering contaminated groundwater during dewatering, and vibration damage. The City would undertake the following measures to reduce or minimize these impacts for all four proposed options:

- Avoid construction on steep slopes, known and potential landslide zones, and areas with organic or liquefiable soils, where feasible.
- Use appropriate shoring during construction.
- Use erosion and runoff control measures, including retention of vegetation, replanting, ground cover, etc.
- Comply with relevant federal, state, and local critical areas and groundwater requirements.
- Dispose of soils at approved disposal sites.

If site-specific earth or groundwater impacts are identified during future review of individual projects, additional measures to reduce or minimize those impacts may be identified.

5.3 Air Quality and Odors

This section describes the types of air quality and odor impacts that could occur within the Plan area during implementation of the Plan alternatives.

Key Findings

Air Quality and Odors

Construction of the *LTCP Alternative* or *Integrated Plan Alternative* would not have a significant effect on air quality in the Seattle area, but may result in moderate localized impacts during the construction periods largely related to vehicle emissions and dust.

The primary differences in potential air quality and odor effects of the LTCP options are related to the length of construction period and estimated number of truck trips. More dispersed impacts would occur under the Neighborhood Storage Option. Impacts would be concentrated at fewer locations under the shared options.

5.3.1 What construction impacts are common to all of the alternatives?

Air emissions during construction are influenced by construction techniques, types of equipment used, truck trips, worker commute trips, and construction duration. Reduced air quality from construction emissions has a greater impact in residential areas than in commercial and industrial areas. In addition, sensitive receptors – those structures and uses that are most sensitive to reduced air quality, such as hospitals, nursing homes, daycare centers, and schools – are located throughout the Plan area (see Figure 5-10).

Many of the potential construction-related air quality and odor impacts would be common to all of the alternatives and options. These common impacts are described below.

Dust

Air quality impacts resulting from construction-related dust would vary during the stage of construction. Impacts would likely be greatest at the beginning of a project as a result of earth moving, land clearing, and excavation. Sources of construction-related dust would include disturbed soils at the construction sites and trucks carrying loads of soils. If not properly controlled, vehicles leaving the site could deposit mud on local streets, which could be an additional source of airborne dust after it dries.

Odors and Emissions

Some projects would require a substantial amount of construction equipment operation and truck trips which would result in increased emissions. Emissions from gasoline and diesel-powered construction equipment and trucks would include carbon monoxide, particulate matter, sulfur dioxide, nitrogen oxides, and volatile organic compounds. Particularly in low-traffic residential areas, increases in truck trips would substantially increase odors and emissions over background conditions. If construction traffic were to reduce the speed of hauling trucks and other vehicles in the area, carbon monoxide emissions from traffic would increase slightly while those vehicles are delayed. These emissions would be limited to peak construction periods and to the immediate area surrounding the construction site. In general, emissions would vary depending on the project and construction phase. The longer project construction lasts, the longer nearby land uses would be impacted by construction emissions.

Sulfur dioxide is an odorous compound generated during combustion of diesel fuel. Some phases of construction, particularly asphalt paving, would result in short-term odors in the immediate area of paving sites. Such odors would be quickly dispersed below detectable thresholds as distance from the site increases.

5.3.2 What are the potential air quality and odor impacts of the LTCP options?

Short-term, minimal to moderate localized effects on air quality would be expected from construction activities under any of the LTCP options. Use of heavy equipment and trucks would end once construction is completed and would not be concentrated in any one area over the duration of construction. However, construction would take place over several years in many locations and affect a wide variety of both residential and commercial properties.

Each of the four LTCP options would cause different levels of air quality and odor impacts to different neighborhoods. Table 5-3 summarizes the air quality and odor impacts for each option.

Table 5-3. *Comparison of Potential Air Quality and Odor Impacts among LTCP Options*

Neighborhood Storage Option*
The Neighborhood Storage Option has the most individual project locations compared to the other options. Consequently, this option would have dispersed short-term air and odor impacts throughout the city. The neighborhoods that would be most affected are as follows: • Ballard, Fremont/Wallingford, Magnolia. Storage tank and pipe construction would result in intermittent increases in dust, emissions, and odors in these largely residential neighborhoods over the 5-year (Ballard), 3.5-year (Fremont/Wallingford), and 1.5-year (Magnolia) construction periods. Multi-family residential units and a number of sensitive receptors, including Swedish Ballard Hospital, could be affected. • Leschi. Storage pipes and associated pump stations would be constructed in Leschi near residential areas. Intermittent dust, emissions, and odors would temporarily impact air quality over the 2-year construction period.
Shared Storage Option
Generally, air quality impacts from approximately 10 smaller projects in the Ship Canal and Lake Washington Neighborhoods (under the Neighborhood Storage Option) would be consolidated into three larger projects producing air quality impacts in more concentrated locations. Overall impacts would be reduced compared to the Neighborhood Storage Option because the shared tanks would eliminate the need for several City and King County independently constructed CSO storage facilities. The neighborhoods that would be most affected are as follows: • Ballard and Fremont/Wallingford. Impacts of storage tanks would be the same as for the Neighborhood Storage Option. Potentially impacted receptors include high-density residential areas. • North Union Bay. A shared storage tank would take 3 years to construct and require approximately 11,000 truck trips, resulting in longer duration of construction-related air quality and emissions impacts compared to the Neighborhood Storage Option. High-density residential areas and a number of sensitive receptors including the University of Washington and Children's Hospital could be affected. • Montlake. A shared storage tank would take 4.5 years to construct and require approximately 15,600 truck trips, resulting in longer term air quality and emissions impacts to residential areas. • Other neighborhoods would experience the same level of impacts as the Neighborhood Storage Option. Exceptions include the East Waterway neighborhood (where a flow diversion would replace the storage tank and cause fewer impacts due to reduced construction areas and timeframes); and the Leschi neighborhood (where conveyance construction would replace three storage pipes and a tank resulting in less construction emissions).

***Table 5-3**. Comparison of Potential Air Quality and Odor Impacts among LTCP Options*
Shared West Ship Canal Tunnel Option
Overall impacts would be reduced compared to the Neighborhood Storage Option as this option eliminates several City and King County independently constructed CSO control facilities in the same neighborhoods. However, impacts would be concentrated in fewer areas (Ship Canal Neighborhood). The neighborhoods that would be most affected are as follows: • Ballard and Fremont/Wallingford. Construction for the storage tunnel would last 3.5 years and require approximately 60,000 or more truck trips, a substantially higher number than for storage tanks under the Neighborhood Storage Option or Shared Storage Option. Construction would be concentrated at the portal areas located in Ballard along the Ship Canal commercial area and in Fremont/Wallingford. • Other neighborhoods would experience similar level of impacts as the Neighborhood Storage Option.
Shared Ship Canal Tunnel Option
Compared to all other options, the Shared Ship Canal Tunnel Option would have the fewest City and King County independently constructed CSO storage facilities, and therefore the fewest areas that would experience air quality and odor impacts. In the Ship Canal and Lake Washington Neighborhoods, air quality and odor impacts would be consolidated to two portal sites instead of spread across numerous sites for storage tanks and pipes. In the Longfellow Creek/Duwamish Neighborhoods, several storage pipes and a storage tank proposed under the Neighborhood Storage Option would be replaced with conveyance construction, which would have similar construction-related air quality and emission impacts. The neighborhoods that would be most affected are as follows: • Ship Canal and Lake Washington Neighborhoods. Air quality and odor impacts would occur at the portal locations. An estimated 106,000 or more truck trips occurring over 7 years would result in increased exhaust emissions. Construction activities would be concentrated at the portal areas located along the south side of the Ship Canal and in the North Union Bay neighborhood. • Other neighborhoods would experience similar or reduced level of impacts as compared to the Neighborhood Storage Option.

*The Neighborhood West Ship Canal Tunnel would have similar impacts in Ballard and Fremont/Wallingford as described for the Shared West Ship Canal Tunnel Option.

5.3.3 What are the potential air quality and odor impacts of the Integrated Plan Alternative?

Construction of storage pipes, tanks, and tunnels under the Integrated Plan Alternative would have the same air quality impacts as under the LTCP Alternative, but construction would be delayed in some neighborhoods. Construction-related dust and emissions associated with the Integrated Plan would be minimal, as construction activities would be minimal. Construction for NDS projects would be of short duration and would have minimal air quality impacts. The South Park Water Quality Facility would involve a small construction footprint, which would result in short-term, localized emissions. The facility would be located in an industrial area and emissions would not impact residential properties or other sensitive receptors.

5.3.4 What are the potential air quality and odor impacts of the No Action Alternative?

Ongoing sewer system improvements and RainWise program projects have minimal air quality impacts because they are small and located within public rights-of-way or private property that is typically already developed or landscaped. Emissions during construction would include dust from grading, sod-cutting, and rototilling activities and exhaust from vehicles and construction equipment. These emissions are minimal, localized, and temporary.

5.3.5 What measures are proposed to reduce or minimize air quality and odor impacts?

Construction-related dust and emissions would be minimized by implementation of construction best management practices. The City would comply with all applicable regulations for air quality and would use the mitigation techniques listed below. Additional site-specific mitigation measures may be developed when project locations are determined.

- Use 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.
- Incorporate specifications into construction contracts that encourage use of well maintained construction vehicles to reduce vehicle emissions.
- Encourage contractors to offer carpooling options for employees.
- When possible, use local building materials to reduce transport distances.

5.4 Surface Water

This section describes the types of surface water impacts that could occur within the Plan area during construction of the Plan alternatives.

Key Findings

Surface Water

Construction effects on surface water from the *LTCP Alternative* or *Integrated Plan Alternative* could include increased pollutants and sediments from site runoff, requiring control measures. Discharges of dewatering water could introduce contaminants and sediments into local water bodies if not properly managed.

The primary differences in potential effects of the LTCP options are related to amount of surface disturbance and excavation potentially required. Overall impacts would potentially be greatest under the Neighborhood Storage Option, and least under the Shared West Ship Canal and Ship Canal Tunnel Options. Impacts would be concentrated at fewer locations under the shared options.

5.4.1 What potential construction impacts are common to all of the alternatives?

Many of the construction impacts to surface water would be common to all of the projects included in the options and alternatives, as described below. No in-water construction is anticipated for any of the alternatives or options.

Construction Site Runoff

Construction and excavation at project sites would expose bare soils, making the sites more susceptible to erosion during rain events. In general, larger sites have a greater potential for releases of turbid site runoff due to the larger area of exposed soils. Surface water runoff could increase sedimentation and turbidity if the runoff is allowed to discharge untreated or uncontrolled to surface waters. Runoff may also carry other contaminants, such as fuels, oil, metals, and organic compounds from construction operations. Both sediment and contaminants can increase turbidity and affect other water quality parameters such as the amount of available oxygen in the water.

Stormwater runoff from construction sites would drain to either sewers or surface waters depending on the specific location. In general, most construction sites for the LTCP options would drain to combined or partially combined sewer systems. However, some construction sites could drain to surface waters or into isolated storm drains. In addition, stormwater discharged to the combined sewer system could enter surface waters during CSOs caused by large storm events.

Because the City would comply with state and City stormwater permit requirements and would employ best management practices to control surface water runoff from project sites, no major surface water impacts are expected. Uncontrolled runoff could occur during heavy rainstorms, but best management practices to contain sediment are expected to minimize impacts.

Dewatering Discharge

Dewatering would be required to remove water that seeps into soil excavation areas during construction of storage pipes, tanks, pump stations, and tunnels. Water present in the excavation areas would be pumped to sedimentation tanks to settle soil particles and could be treated further depending on the water quality and discharge location. Dewatering could also use temporary, shallow wells to lower the groundwater elevation and reduce seepage into excavation areas. Direct rainfall or local drainage into excavation areas could also be removed by dewatering.

The amount of dewatering would vary depending on the excavation duration, area, and quantity, and on the groundwater elevation and amount of rainfall. Dewatering waters would be either discharged to adjacent surface waters or the sewer system depending on the water quality and quantity and site constraints. Dewatering waters discharged to the combined sewer system could enter surface waters during CSOs caused by large storm events.

Where feasible, uncontaminated dewatering water would be discharged to surface waters in accordance with the Construction Stormwater General Permit issued by Ecology, employing best management practices and meeting water quality standards established for stormwater. Highly turbid or contaminated dewatering water would be discharged to the sewer system in accordance with the Wastewater Discharge Permit issued by King County. Discharges to the sewer system must meet requirements for quality (less than 7 milliliters of settleable solids per liter of water) and quantity (less than 25,000 gallons per day during the wet months from November through April and an unlimited quantity during dry months). Alternatively, highly turbid or contaminated dewatering water could be treated to meet water quality criteria and discharged to adjacent surface waters, or it could be trucked offsite for appropriate disposal. Potential impacts to groundwater are discussed in Section 5.2, Earth and Groundwater.

Inadvertent Discharges of Toxic Materials

Oils, fuels, solvents, and other chemicals could spill or leak from construction equipment, inadvertently contaminating stormwater or dewatering water that discharges to surface waters. If the spills are large and uncontrolled, the spills could flow to adjacent storm drainage systems or surface water bodies or seep into groundwater. The highest probability for spills is at staging areas. Because the City would follow the requirements of all applicable permits and would implement Spill Prevention and Control Plans for each project, the potential for uncontrolled spills is minimal.

5.4.2 What are the potential surface water impacts of the LTCP options?

Table 5-4 summarizes the types of surface water impacts that could occur under the LTCP options. Substantial construction would occur in areas draining to the combined sewer system for each of the LTCP options. Surface water resources could be impacted if construction activities result in uncontrolled spills or releases of turbid and contaminated stormwater to adjacent water bodies. While unlikely, uncontrolled releases could occur due to unanticipated conditions such as failure of best management practices or treatment systems that discharge directly to surface waters, particularly during large winter storm events. Uncontrolled releases could also occur from discharges to the combined sewer system during large storm events. Surface waters with the greatest potential to be affected by uncontrolled releases of turbid or contaminated water include the Ship Canal and Portage Bay/Union Bay area of Lake Washington where large storage tanks and major tunnels would be constructed adjacent to these water bodies. The City would comply with all applicable requirements for control of stormwater, dewatering, and spills, resulting in minimal potential for these releases.

Table 5-4. Comparison of Potential Surface Water Impacts among LTCP Options
Neighborhood Storage Option*
This option would have a higher potential for construction site runoff impacts relative to the other options because of the greater number of storage facilities potentially constructed near surface water bodies, and related surface disturbance and excavation. Storage tank and pipe construction under this option would result in approximately 7.5 acres of surface disturbance and a total excavation volume of approximately 185,000 cubic yards. The neighborhoods that would be most affected are as follows: • Ship Canal Neighborhoods. Construction in Ballard and Fremont/Wallingford would involve open excavations over extended periods to construct storage tanks and pipes. Substantial dewatering and

Table 5-4. Comparison of Potential Surface Water Impacts among LTCP Options
stormwater control would be needed. Potential temporary surface water quality impacts to the Ship Canal, Salmon Bay, or Puget Sound could occur as a result of increased turbidity in runoff to nearby streams, ditches, and stormwater collection systems, if not properly controlled. • Lake Washington Neighborhoods. Construction of three storage pipes and one tank would require open excavations over extended periods, and substantial dewatering and stormwater control would be required. There is a potential for construction-related sediment to enter Portage Bay, the Montlake Cut, or Lake Washington, potentially increasing turbidity, if not controlled. • Longfellow Creek/ Duwamish Neighborhoods. Construction of several storage pipes/tanks would require open excavations over extended periods, and substantial dewatering and stormwater control would be required. Excavation in contaminated areas could result in contaminated sediments entering Longfellow Creek or the Duwamish River. • Other neighborhoods would have a minor potential for construction site runoff impacts.
Shared Storage Option
The Shared Storage Option would have a similar potential for surface water impacts as the Neighborhood Storage Option, but it includes larger construction areas and excavation quantities concentrated at shared storage tank locations. While construction of storage tanks under this option would result in approximately 12 acres of surface disturbance (the highest of all the LTCP options) and 408,000 CY of excavation, overall impacts would be reduced compared to the Neighborhood Storage Option because the shared tanks would eliminate the need for several City and King County independently constructed CSO storage facilities. The neighborhoods that would be most affected are as follows: • Ship Canal Neighborhoods. The potential for impacts would be slightly greater than the Neighborhood Storage Option because the shared storage tank in Fremont/ Wallingford would have a greater disturbance area and excavation quantities. • Lake Washington Neighborhoods. The potential for impacts would be greater than the Neighborhood Storage Option because the shared storage tanks in North Union Bay and Montlake would result in a greater disturbance area with an extended period of open excavation, increasing the potential for turbid discharges to Lake Washington. • East Waterway Neighborhood. The potential for impacts would be less than the Neighborhood Storage Option because flow diversion in the East Waterway neighborhood would reduce the amount of disturbance and excavation required.
Shared West Ship Canal Tunnel Option
The Shared West Ship Canal Tunnel Option would require a similar amount of surface disturbance as the Neighborhood Storage Option, and therefore a similar potential for surface water impacts during construction. The Shared West Ship Canal Tunnel Option would result in total surface disturbance of approximately 7 acres and an excavation volume of 276,000 CY. Overall impacts would be reduced compared to the Neighborhood Storage Option as this option eliminates City and King County independently constructed CSO storage facilities that would otherwise be constructed in the same neighborhoods. The neighborhoods that would be most affected are as follows: • Ship Canal Neighborhoods. The potential for temporary surface water quality impacts to the Ship Canal would be less than the Neighborhood Storage and Shared Storage Options because the tunnel would eliminate the need for construction of several large storage tanks involving large areas of exposed earth. Site runoff or dewatering associated with construction of a tunnel portal could result in discharges to the Ship Canal if not properly controlled. • Lake Washington Neighborhoods. Potential impacts would be the same as the Neighborhood Storage Option. • Longfellow Creek/Duwamish Neighborhoods. Potential impacts would be the same as the Shared Storage Option.

Table 5-4. Comparison of Potential Surface Water Impacts among LTCP Options
Shared Ship Canal Tunnel Option
The Shared Ship Canal Tunnel Option would have a similar overall amount of surface disturbance as the Neighborhood Storage Option, and therefore a similar potential for surface water impacts during construction. While construction under this option would result in approximately 7.5 acres of surface disturbance and total excavation of 507,000 CY (the highest of all the LTCP options), overall impacts would be reduced because the shared tanks would eliminate the greatest number of City and King County independently constructed CSO storage facilities. The neighborhoods that would be most affected are as follows: • Ship Canal Neighborhoods As described for the Shared West Ship Canal Tunnel, the potential for temporary surface water quality impacts to the Ship Canal would be less than the Neighborhood Storage and Shared Storage Options because the tunnel would eliminate the need for construction of several large storage tanks involving large areas of exposed earth. Site runoff or dewatering associated with construction of a tunnel portal could result in discharges to the Ship Canal if not properly controlled. • Lake Washington Neighborhoods. Flow transfers in these neighborhoods to the tunnel would have a potential for increased sedimentation and turbidity in Lake Washington due to construction runoff. Tunnel portal construction could generate surface water runoff or construction dewatering, which could affect water quality in Portage Bay and Lake Washington if not properly controlled. • Longfellow Creek/Duwamish Neighborhoods. The potential for impacts would be similar to the Neighborhood Storage Option. Flow diversions under this option would disturb slightly less area than the tanks under the Neighborhood Storage Option.

*The Neighborhood West Ship Canal Tunnel would have similar impacts in Ballard and Fremont/Wallingford as described for the Shared West Ship Canal Tunnel Option.

5.4.3 What are the potential surface water impacts of the Integrated Plan Alternative?

Construction-related impacts associated with the Integrated Plan Alternative would largely depend on the LTCP option implemented. Construction of storage pipes, tanks, and tunnels under the Integrated Plan Alternative would have the same potential impacts to surface water as under the LTCP Alternative, with some impacts delayed until after 2028. In addition to construction of CSO control projects under the selected LTCP option, additional work would occur to construct NDS Partnering projects and the South Park Water Quality Facility project

NDS Partnering projects would be constructed in public road rights-of-way of the Piper's, Thornton, and Longfellow Creek neighborhoods and cause minimal surface water impacts. Natural drainage system projects are constructed in relatively flat public rights-of-way within developed areas, with low potential to generate runoff. Individual NDS Partnering projects would be relatively small in size with appropriate erosion control measures in place.

Construction of the South Park Water Quality Facility would involve approximately one acre of surface disturbance. The facility is expected to be located in an industrial area near the Duwamish River. Considering historic land uses in the area, the soils at the site may include contaminated materials. The City would conduct appropriate studies during predesign and design to determine this potential and develop appropriate measures to ensure that contaminated runoff or groundwater does not leave the site.

5.4.4 What are the potential surface water impacts of the No Action Alternative?

Construction activity associated with ongoing sewer system improvements and natural drainage solution program projects is not expected to result in surface water impacts due to the limited construction areas. Sewer system improvements are not likely to result in vegetation removal or grading that would have potential for impacts from runoff because work would occur within underground vaults/chambers at existing CSO or stormwater facilities, and within street rights-of-way. RainWise program projects and roadside rain gardens would have minimal potential for surface water impacts due to their small footprint. Refer to the SEPA Checklist completed for the RainWise program for an evaluation of program impacts (SPU, 2013a).

5.4.5 What measures are proposed to reduce or minimize surface water impacts?

Compliance with the requirements of the Construction Stormwater General Permit issued by Ecology and the City of Seattle's stormwater code and manual would minimize potential surface water runoff and sedimentation. Dewatering impacts would be minimized by compliance with the King County Wastewater Discharge Permit requirements. Additional measures to minimize surface water runoff, dewatering, and spills include the following:

- Limit the area of construction disturbances.
- Implement stormwater best management practices identified in the City of Seattle's Stormwater Code (SMC 22.800 – 22.808), Director's Rule: 2009-004 SPU/16-2009 DPD, and Volume 2 Construction Stormwater Control Technical Requirements Manual to control erosion and sediment transport from the project sites. Typical measures include silt fencing, plastic sheeting, and straw wattles to prevent sediment discharge, and wheel washing stations to prevent sediment from entering nearby roadways.
- Provide water quality treatment as necessary to improve the quality of intercepted stormwater flows from adjacent impervious surfaces.
- Develop and implement a Construction Stormwater and Erosion Control Plan, including a Stormwater Pollution Prevention Plan and Spill Prevention and Countermeasures Plan, to reduce the potential for sediment, waste materials, construction-related leaks, and spills to contaminate surface water, groundwater, and stormwater runoff.
- Adhere to the requirements of Seattle Director's Rule DWW-201.1 / 15-2012 and DWW-201.2 / 16-2012, requiring all projects to implement green stormwater infrastructure (GSI) to the maximum extent feasible.

5.5 Biological Resources

This section describes the types of impacts that could occur to biological resources within the Plan area during implementation of Plan alternatives.

> **Key Findings**
>
> ***Biological Resources***
>
> No direct impacts to aquatic habitats, plants, and invertebrates would occur, and only minor indirect impacts from construction noise are anticipated. The potential for direct losses of terrestrial habitat associated with facility construction would be minimal under both the *LTCP Alternative* and *Integrated Plan Alternative* because the facilities are likely to be located in developed areas with low habitat value.
>
> The primary differences in potential effects of the LTCP options are related to amount of construction activity (surface disturbance) and proximity to mapped priority habitats or species. Overall disturbance would potentially be greatest under the Neighborhood Storage Option, and least under the Shared West Ship Canal and Ship Canal Tunnel Options. However, impacts to priority species would potentially be higher under the Shared Storage and Shared Ship Canal Tunnel Options due to construction activity in proximity to priority habitats along the Lake Washington shoreline and Union Bay Natural Area.

5.5.1 What potential construction impacts are common to all of the alternatives?

The majority of impacts to fish and wildlife and their habitats during construction would be common to all of the alternatives and options as described below. No in-water construction would occur for any of the alternatives or storage options.

Direct Loss of Terrestrial Habitat

The majority of the CSO control projects would be located within paved rights-of-way or on previously developed parcels. However, some projects could require grading or removal of vegetation that currently provides wildlife habitat. It is anticipated that direct losses of terrestrial habitat would be minimal because most of the remaining patches of wildlife habitat in the city are within undeveloped areas of public parks, riparian corridors, and steep slope areas, which would not be targeted for CSO control projects. Storage pipes and flow diversions would likely be located in paved or developed rights-of-way and would not affect wildlife habitat.

Because specific sites have not been chosen for CSO control projects, this EIS does not evaluate habitat impacts for specific properties. An evaluation of wildlife habitat would be conducted as part of project-level SEPA analyses performed for each project, as appropriate. To evaluate programmatic impacts, the overall size of the construction footprint (amount of surface disturbance) associated with each project was used to compare the potential for impacts associated with the options.

Disturbance to Wildlife from Noise and Human Activity

Indirect impacts to wildlife would be associated with increased noise and human activity during construction. Wildlife in the vicinity (e.g., terrestrial birds and mammals, waterfowl, seabirds) could be displaced and move to adjacent suitable habitats if available. Many wildlife species in the urbanized areas of the city are generally tolerant of high noise levels and would not be disturbed. Some of the projects, such as sewer system improvements, would cause only short-term increases in noise and activity, while other projects, such as storage tanks and tunnels, could require multiple years to construct and some wildlife could be permanently displaced as a result of sustained periods of disturbance. Projects that require pile driving and other high-impact activity would have a higher potential to disturb wildlife in the vicinity. In addition, those projects located closest to mapped priority habitats or documented species locations have the highest potential to disturb wildlife in the vicinity during construction.

Sedimentation of Aquatic Habitats from Construction Site Runoff

As described previously in Section 5.4, Surface Water, surface water runoff from construction and excavation at project sites could increase sedimentation and turbidity if allowed to discharge untreated or uncontrolled. Uncontrolled runoff could result in sedimentation of aquatic habitats near project sites, which would impact aquatic species including threatened and endangered salmonids. However, best management practices to control surface water runoff would be employed at all construction sites to comply with state and City stormwater permit requirements. With implementation of the required best management practices, the potential for uncontrolled runoff is minimal.

Contamination of Aquatic Habitats from Construction Equipment Spills

As described previously in Section 5.4, Surface Water, there is a potential for accidental spills of oils, solvents, and other chemicals from equipment during construction. If the spills are large and uncontrolled, the spills could flow to adjacent surface water and impact aquatic habitats and species. However, the City would follow the requirements of all applicable permits and would implement Spill Prevention and Control Plans for each project. Thus, the potential for uncontrolled spills is minimal.

5.5.2 What are the potential biological resource impacts of the LTCP options?

Table 5-5 summarizes the general types of impacts to biological resources that could occur under the type of CSO control projects proposed under the LTCP Alternative. Each of the four LTCP options would cause different levels of impacts to different neighborhoods. Indirect impacts to wildlife would be highest for those alternatives and storage options that have multiple project locations, require high-impact activities, have mapped priority habitats or species use nearby, and require multiple years to construct. Neighborhoods where wildlife and habitat would be especially affected by construction include the Ship Canal and Lake Washington Neighborhoods because the proposed storage tanks and major tunnels are adjacent to mapped priority habitats and species.

Table 5-5. Summary of Potential Biological Resource Impacts for LTCP Options
Neighborhood Storage Option*
The total amount of surface disturbance and potential for direct impacts to habitat is approximately 7.5 acres, which is second highest of all the storage options. This storage option has the most individual project locations compared to the other options. The neighborhoods that would be most affected are as follows: • Ballard and Fremont/Wallingford. A storage tank would be built in each neighborhood. Ballard would have the most construction disturbance for the longest duration (up to 5 years) with the potential to disrupt wildlife in the vicinity. However, impacts are anticipated to be minimal as there is no mapped priority habitat near the west segment of the Lake Washington Ship Canal. Habitat potentially affected is largely landscaped vegetation consisting of native and nonnative species. • Magnolia. A storage pipe would be built adjacent to mapped priority habitats (natural areas and riparian corridors in Discovery Park) and species (great blue heron in Kiwanis Ravine, bald eagle); therefore, there is some potential for disturbance to wildlife. • Leschi. Storage pipes and associated pump stations would be constructed in areas adjacent to mapped priority habitats (natural areas and riparian corridors of Madrona, Frink, and Mount Baker Creeks) and species (peregrine falcon). Construction could disrupt wildlife in the vicinity for up to 1.5 years. • Delridge. Storage pipes and associated pump stations would be constructed in areas adjacent to mapped priority habitats (natural areas and riparian corridors of Longfellow Creek). Construction could disrupt wildlife in the vicinity for 1 year.

Table 5-5. Summary of Potential Biological Resource Impacts for LTCP Options
Shared Storage Option
Shared storage tanks would reduce the total number of new storage tanks required in the city (by both the City and King County) as compared to the Neighborhood Storage Option. The total amount of surface disturbance (12.0 acres) is the highest of all options, which suggests a higher potential for habitat impacts. However, this option has the second to least number of individual project locations, and therefore a lower potential to cause indirect impacts to wildlife through construction-related noise and activity. The shared storage projects would occur along the shoreline of the Lake Washington Ship Canal near high-value habitat and could disturb priority wildlife species such as bald eagle and great blue heron. The neighborhoods that would be most affected are as follows: • Ballard and Fremont/Wallingford. Impacts of storage tanks would be the same as for the Neighborhood Storage Option except the Fremont/ Wallingford tank site would require slightly more surface disturbance and potentially more vegetation removal. • North Union Bay. A shared storage tank in this neighborhood would involve high levels of noise and human activity for up to 3.5 years. The location is largely high-density residential with pockets of forested habitat and in the vicinity of mapped priority habitats (wetlands associated with Lake Washington shoreline and Yesler Creek). • Montlake. A shared storage tank would involve high levels of noise and human activity for up to 4.5 years. The location is largely high-density residential with pockets of forested habitat and in the vicinity of mapped priority habitats (wetlands associated with Lake Washington shoreline) and mapped bald eagle nest sites. The Union Bay Natural Area is proximate to both sites. No direct impacts to wildlife habitat within the Union Bay Natural Area are anticipated, but indirect impacts to wildlife could occur due to elevated noise and human activity during construction. Some individual animals could be permanently displaced as a result of the sustained period of disturbance. • Other neighborhoods would experience the same or similar level of impacts for constructing storage pipes and tanks as under the Neighborhood Storage Option.
Shared West Ship Canal Tunnel Option
The Shared West Ship Canal Tunnel Option would require a similar amount of surface disturbance as the Neighborhood Storage Option, and therefore a similar potential for direct and indirect impacts to wildlife and habitat during construction. Overall impacts would be reduced compared to the Neighborhood Storage Option as this option eliminates City and King County independently constructed CSO storage facilities that would otherwise be constructed in the same neighborhoods. The neighborhoods that would be most affected are as follows: • Ballard and Fremont/Wallingford. Construction of the storage tunnel would require less surface disturbance than tanks, and therefore less potential for direct impacts to wildlife habitat because construction disturbance would largely be limited to tunnel portals. Also, tunnel construction requires less surface activity than with tank construction, resulting in potentially shorter duration of disturbance to wildlife in the vicinity. Both portal locations would be in areas that are generally developed as commercial or industrial and not near mapped priority habitats or species. • Other neighborhoods would experience the same or similar level of impacts associated with storage pipes as the Neighborhood Storage Option.

Table 5-5. Summary of Potential Biological Resource Impacts for LTCP Options
Shared Ship Canal Tunnel Option
There is a potential for wildlife disturbance during the 7-year construction duration based on mapped priority habitats and species near potential tunnel portal areas. While the total amount of surface disturbance and potential for direct impacts to habitat is similar to the Neighborhood Storage Option, the overall impact is lower (and lowest for all options) because the Shared Ship Canal Tunnel Option would eliminate the greatest number of the City and King County independently constructed CSO storage facilities. The neighborhoods that would be most affected are as follows: • Ship Canal and Lake Washington Neighborhoods. Construction of the storage tunnel would require less surface disturbance than tanks, and therefore less potential for direct impacts to wildlife habitat because construction disturbance would largely be limited to tunnel portals. Also, tunnel construction requires less surface activity than with tank construction, resulting in potentially shorter duration of disturbance to wildlife in the vicinity. Tunnel portals potentially could be located near priority habitat (wetlands associated with Lake Washington shoreline and Union Bay Natural Area). Other neighborhoods would experience the same or reduced level of impacts as compared to the Neighborhood Storage Option.

*The Neighborhood West Ship Canal Tunnel would have similar impacts in Ballard and Fremont/Wallingford as described for the Shared West Ship Canal Tunnel Option.

5.5.3 What are the potential biological resource impacts of the Integrated Plan Alternative?

In addition to construction of CSO control projects under the selected LTCP option, additional construction would occur to construct NDS Partnering projects and the South Park Water Quality Facility project. The street sweeping expansion program does not involve construction.

NDS Partnering projects would be constructed in public road rights-of-way of the Piper's, Thornton, and Longfellow Creek neighborhoods, causing minimal to no impacts to terrestrial habitat and wildlife. It is not possible to identify all potential project locations at this time, but most projects will likely occur in paved or developed rights-of-way in residential areas and would not affect wildlife habitat. Construction of NDS projects would cause minimal indirect impacts to wildlife in the vicinity as increases in noise and activity would be short-term. Projects located closest to mapped priority habitats or documented species locations have a higher potential to disturb wildlife in the vicinity during construction because these areas have higher concentrations of wildlife. Prior to installation of NDS projects, a site-specific evaluation of impacts to biological resources would be completed as part of the City's acquisition of applicable land use permits and approvals.

Construction of the South Park Water Quality Facility would involve approximately one acre of surface disturbance and high levels of noise and human activity for approximately two years. The facility is expected to be located on previously developed City-owned property in an industrial area and not near mapped priority habitats or species. Therefore, no direct loss of habitat is expected to occur and indirect impacts to wildlife associated with the increased level of noise and human activity during construction would be minimal.

5.5.4 What are the potential biological resource impacts of the No Action Alternative?

Sewer system improvements are not likely to result in vegetation removal or grading that would affect wildlife habitat because work would occur within underground vaults/chambers at existing CSO or stormwater facilities, and within street rights-of-way. Construction activities would temporarily cause elevated levels of noise and human activity that could disturb wildlife, if present, near the project. However, system improvements are not anticipated to require pile driving, the construction technique that would cause the most noise and the greatest potential to disturb wildlife in the vicinity.

RainWise program projects and roadside rain gardens would have minimal direct impact on wildlife and habitat due to their small footprint and location within public rights-of-way or private property, both of which are typically developed or landscaped. (Refer to the SEPA Checklist completed for the RainWise program for an evaluation of program impacts (SPU, 2013c).)

5.5.5 What measures are proposed to reduce or minimize impacts to biological resources?

Construction effects on fish, wildlife, and habitat adjacent to future projects would primarily relate to elevated levels of noise and human activity during construction. Measures that minimize these effects are described in Section 5.8.5, Noise and Vibration.

In addition, the City would undertake the following measures to mitigate impacts to biological resources for all four options.

- Site projects away from mapped priority habitats and species locations where possible.
- Follow federal, state, and local permit conditions for managing construction site runoff and protecting habitats for federally listed species.
- Retain site vegetation as much as possible.
- Provide prompt revegetation with native species after construction is complete.
- Adhere to development conditions within City of Seattle’s Director Rule 5-2007 for construction within Great Blue Heron Management Areas and Colony Nesting Areas.

Additional measures would be identified during future review of individual projects to mitigate biological resource impacts on specific properties. The City would coordinate with regulatory agencies on mitigation efforts as appropriate.

5.6 Energy and Climate Change

This section describes the types of energy and greenhouse gas impacts that could occur within the Plan area during construction of the Plan alternatives. Because specific projects have not been identified, estimates of energy consumption are generalized based on plan-level information.

> **Key Findings**
>
> ***Energy and Climate Change***
>
> Neither the *LTCP Alternative* nor the *Integrated Plan Alternative* would have a significant impact on energy resources in the Seattle area.
>
> The primary difference in energy consumption and greenhouse gas (GHG) emissions between the LTCP options relates to the type of storage facility (e.g., tank or tunnel) and whether it is part of the Neighborhood Storage Option or one of the shared options. While the shared options would have higher energy consumption and GHG emissions per facility, there would be fewer new storage facilities built by the City and King County. Therefore, overall emissions would likely be lower.

5.6.1 What potential construction impacts are common to all of the alternatives?

Energy and greenhouse gas impacts that would be common to all of the alternatives and options are described below.

Energy Consumption during Construction

Project construction would consume energy during the initial mining and production of construction materials, during transportation of materials to the project sites, and during operation of construction equipment and worker vehicles.

Diesel and gasoline would be consumed to fuel construction equipment and worker vehicles. Energy consumption is expressed in gallons of diesel consumed. Quantities of fuel consumed would be considerably greater for storage facilities than for sewer system improvements or natural drainage systems. Compared to storage tanks and pipes, diesel fuel consumption would likely be somewhat lower and electricity consumption would likely be measurably higher for construction of storage tunnels due to use of electric tunnel boring machines.

Estimated numbers of truck trips, hours of pile driving, hours of earthwork, and hours of dewatering associated with construction were used to provide an estimate of fuel consumption. Electricity, either produced by diesel generators or from the grid, would be used to power machinery such as tunnel boring machines. Electricity consumption is typically expressed as millions of British Thermal Units (MBtu).

> **Fuel Consumption Calculation Assumptions**
>
> 1 truck trip = 50 miles
>
> Truck fuel efficiency = 5 miles per gallon
>
> Pile driver fuel efficiency = 30 gallons per hour
>
> Excavator fuel efficiency = 17 gallons per hour
>
> Dewatering pump fuel efficiency = 24 gallons per hour

Greenhouse Gas Emissions

During construction, the primary source of greenhouse gas emissions would be fuel combustion, with the greenhouse gas emissions being proportional to the amount of energy used. Following is a list of terms used to discuss greenhouse gas emissions.

Greenhouse Gas Terms

Greenhouse gas emission estimates are expressed in metric tons of **carbon dioxide equivalents** (MT CO2e).

Global Warming Potential (GWP): A measure of the total energy that a gas absorbs over a particular period of time (usually 100 years), compared to carbon dioxide.

CO2 equivalents (CO2e) provide a universal standard of measurement against which the impacts of releasing different greenhouse gases can be evaluated. Every greenhouse gas has a global warming potential (GWP), a measure of the impact that particular gas has on the additional heat/energy that is retained in the Earth's ecosystem through the addition of this gas to the atmosphere.

Diesel Emission Factor: Emission factors assume a linear relationship between the intensity of the activity and the emission resulting from this activity. Carbon dioxide emissions from the combustion of diesel fuel can be estimated with a high degree of certainty, as these emissions depend almost exclusively on the carbon content of the fuel. Multiplying the gallons of diesel by the emissions factor provides an estimate of the CO2 produced during combustion.

Diesel Emission Factor = 0.01 MT CO2e per unit volume (from U.S. Energy Information Administration)

Emissions from combustion of diesel fuel during construction were estimated and compared between the Plan alternatives. Numbers of truck trips, hours of heavy equipment use, hours of earthwork, and hours of dewatering associated with construction of each project alternative were used to provide an estimate of gallons of diesel fuel consumed. An emission factor was applied to the gallons of diesel consumed to provide an estimate of MT CO2e produced under each alternative.

5.6.2 What are the potential energy and greenhouse gas impacts of the LTCP options?

Table 5-6 summarizes the types of energy and greenhouse gas impacts that could occur under the four LTCP options.

Table 5-6. Summary of Potential Energy and Greenhouse Gas Impacts for LTCP Options
Neighborhood Storage Option
Construction of distributed storage pipes or tanks would consume roughly 2,000,000 gallons of diesel. Greenhouse gas emissions would be proportional to petroleum-based fuel consumption and are estimated to be 30,000 MT CO2e. Under this option King County would independently construct CSO storage tanks. Construction of the King County facilities would consume additional energy and emit greenhouse gases. Construction of a Neighborhood West Ship Canal Tunnel would consume roughly 2,000,000 gallons of diesel and would produce roughly 40,000 MT CO2e. Construction of the West Ship Canal Tunnel would require use of roughly 6 megavolt amperes (MVA) of electricity in addition to diesel fuel. The tunnel boring machine used to construct the deep tunnel would be powered by electricity "from the grid". Greenhouse gas emissions associated with the tunnel boring machine are expected to be small because electricity supplied to the greater Seattle area is typically generated by low-emission hydroelectric facilities.
Shared Storage Option
Shared storage tanks would reduce the total number of new storage tanks required in the city and would reduce the number of City and King County storage facilities that would be constructed as compared to the Neighborhood Storage Option. Construction of fewer storage tanks and pipes would reduce construction-related energy consumption and greenhouse gas emissions as compared with the Neighborhood Storage Option. Construction of the Shared Storage Option would consume roughly 4,000,000 gallons of diesel and emit roughly 60,000 MT CO2e.
Shared West Ship Canal Tunnel Option
The Shared West Ship Canal Tunnel would reduce the total number of City and King County storage projects in the Ship Canal Neighborhoods, reducing construction-related fuel consumption and resulting greenhouse gas emissions. Construction of pipes, tanks, and a tunnel under this option is estimated to consume roughly 2,000,000 gallons of diesel and emit roughly 30,000 MT CO2e. Construction of the Shared West Ship Canal Tunnel would require use of roughly 6 MVA of electricity, in addition to diesel fuel. See the Neighborhood West Ship Canal Tunnel Option (under Neighborhood Storage Option) for impacts associated with use of the tunnel boring machine.
Shared Ship Canal Tunnel Option
The Shared Ship Canal Tunnel Option would further reduce the total number of City and King County independently constructed CSO storage facilities. Construction of this option would consume approximately 4,000,000 gallons of diesel and emit 70,000 MT CO2e, roughly the same as the Shared Storage Option. Construction of the Ship Canal Tunnel would require use of roughly 8 MVA of electricity, in addition to diesel fuel. See the Neighborhood West Ship Canal Tunnel Option (under Neighborhood Storage Option) for impacts associated with use of the tunnel boring machine.

5.6.3 What are the potential energy and greenhouse gas impacts of the Integrated Plan Alternative?

The greenhouse gas emissions and energy consumption associated with construction of the Integrated Plan Alternatives are very low. On-road vehicle operation is the primary contributor to greenhouse gas emissions (compared with materials and off-road vehicle operation) for NDS Partnering projects and for the South Park Water Quality Facility.

Street sweeping would not result in any construction emissions. Greenhouse gas emissions associated with construction of the NDS Partnering projects range from 200 MT CO_2e to almost 1,000 MT CO_2e. Emissions of greenhouse gas associated with constructing the South Park Water Quality Facility would be approximately 300 MT CO_2e.

5.6.4 What are the potential energy and greenhouse gas impacts of the No Action Alternative?

Under the No Action Alternative, the Plan would not be implemented. No additional construction-related energy consumption and emissions would occur related to CSO control other than those from existing plans and programs. Project construction under ongoing programs to implement sewer system improvements and natural drainage systems would have minor energy consumption and greenhouse gas emissions.

5.6.5 What measures are proposed to reduce or minimize energy and greenhouse gas impacts?

Measures to minimize air quality impacts may also contribute to reduced energy consumption and greenhouse gas emissions (see Section 5.3.5). In addition, the City would undertake the following measures to mitigate energy and greenhouse gas impacts for all four proposed options.

- Incorporate specifications into construction contracts that encourage the use of fuel-efficient construction equipment.
- Minimize engine idling during construction.

5.7 Environmental Health and Public Safety

This section describes the types of environmental health and public safety impacts that could occur during implementation of the Plan alternatives.

5.7.1 What potential construction impacts are common to all of the alternatives?

Many of the construction-related environmental health and public safety impacts would be common to all of the alternatives and options, as described below.

Contaminated Sites

Projects under each alternative have the potential to be constructed in or near sites contaminated with hazardous materials. The types of hazardous materials that could be encountered during excavation or dewatering would depend on previous uses of the sites. Disturbance of these materials during construction could release hazardous materials to the air or water, or could expose construction workers to hazardous substances unless proper handling methods are used. This analysis considers quantities of excavation and whether or not dewatering would be necessary for each project type in order to estimate the likelihood of encountering hazardous materials. Since project sites have not been determined, this analysis does not include detailed information.

Equipment Leaks and Spills

Accidental spills of hazardous materials from equipment and vehicles could occur during construction. Spilled materials could include fuels, lubricants, solvents, antifreeze, and similar materials. If not contained, these contaminants could enter groundwater or surface water and pose a health risk.

Key Findings

Environmental Health and Public Safety

Ground excavations and dewatering have the potential to encounter contaminated materials and may require special handling methods depending on the site and type of materials encountered. In general, environmental health risks associated with construction under both the *LTCP* Alternative and *Integrated Plan Alternative* are low, and the potential for the public to encounter contaminated soils or groundwater is low.

The primary differences in potential effects of the LTCP options are related to the potential for large excavations and dewatering outside of the right-of-way in potentially contaminated areas (typically industrial lands). Potential impacts would be similar among all options. Overall, the greatest number of projects with associated impacts would occur under the Neighborhood Storage Option, and the least under the Shared West Ship Canal and Ship Canal Tunnel Options. Impacts would be concentrated and of longer duration at fewer locations under the shared options.

5.7.2 What are the potential environmental health and public safety impacts of the LTCP options?

Construction activities under any of the LTCP options have the potential to release hazardous materials into the environment. Larger projects, such as storage tanks and tunnels, have a greater potential for environmental health and public safety impacts than smaller projects such as storage pipes and flow diversions. Table 5-7 summarizes the environmental health and public safety impacts for projects that could occur under each option.

Table 5-7. Comparison of Potential Environmental Health and Public Safety Impacts among LTCP Options

Neighborhood Storage Option*

Construction of distributed storage facilities disperses the potential for environmental health and public safety impacts to numerous locations throughout the city. For storage pipes, the potential to encounter unknown contaminated sites is relatively low because pipes would be built in previously disturbed areas in the right-of-way. The highest potential for impacts would occur at the site of storage tanks due to the large volumes of excavation required and, for some tanks, the need for substantial dewatering.

The neighborhoods that would be most affected are as follows:

- Ship Canal Neighborhoods. Storage tank construction would require substantial excavation and in some cases substantial dewatering. Storage tanks would likely be built in commercial/industrial areas near the Ship Canal, which have a high concentration of known contaminated sites.
- Lake Washington Neighborhoods. Storage pipes with relatively low potential for environmental health impacts would be built in these neighborhoods. These neighborhoods have the lowest concentration of known contaminated sites of any LTCP neighborhoods so the potential to encounter contaminated sites is lower than for other neighborhoods.
- Longfellow Creek/Duwamish Neighborhoods. Storage pipes would be built in the Delridge and Duwamish neighborhoods. The Duwamish and East Waterway neighborhoods consist mostly of industrial areas and have a particularly high concentration of known contaminated sites where the potential to encounter hazardous materials is higher.
- Elliott Bay/Lake Union Neighborhoods. A storage pipe with relatively low potential for environmental health impacts would be built in this neighborhood. However, the neighborhood has a particularly high concentration of known contaminated sites.

Shared Storage Option

The larger, shared storage tanks under this option have a higher potential to cause environmental health and public safety impacts due to substantially greater volumes of excavation increasing the risk of encountering contaminated materials. However, overall impacts would be reduced because the shared tanks would eliminate the need for 10 City and 3 King County independently constructed CSO control facilities. Construction required to implement flow diversions under this option would have a very low potential to cause environmental health and public safety impacts because excavation volumes would be minimal and dewatering would not be significant.

The neighborhoods that would be most affected are as follows:

- Ship Canal Neighborhoods. Impacts of storage tanks would be similar to the Neighborhood Storage Option. The shared Fremont/Wallingford tank would require substantially more excavation and would therefore have a higher potential to encounter hazardous materials.
- Lake Washington Neighborhoods. Shared storage tanks constructed in the North Union Bay and Montlake neighborhoods would have a greater potential to encounter hazardous materials than storage pipes due to the increased need for excavation. Storage pipes and a tank would not be built in the Leschi neighborhood, thereby reducing the number of construction sites with the potential for environmental health impacts.
- Longfellow Creek/Duwamish Neighborhoods. Impacts would be similar to the Neighborhood Storage Option.
- Elliott Bay/ Lake Union Neighborhoods. Impacts would be similar to the Neighborhood Storage Option.

Shared West Ship Canal Tunnel Option

The Shared West Ship Canal Tunnel Option would replace four City and one King County CSO independently constructed CSO control facilities with a large storage tunnel. Consequently, overall impacts would be reduced compared to the Neighborhood Storage Option.

The neighborhoods that would be most affected are as follows:

- Ship Canal Neighborhoods. Tunnel and portal sites and associated construction in these neighborhoods would require substantial excavation, so the potential to encounter contaminated materials is high.
- Lake Washington Neighborhoods. Impacts would be similar to the Neighborhood Storage Option.

Table 5-7. Comparison of Potential Environmental Health and Public Safety Impacts among LTCP Options
• Longfellow Creek/Duwamish Neighborhoods. Impacts would be similar to the Neighborhood Storage Option. • Elliott Bay/Lake Union Neighborhoods. Impacts would be similar to the Neighborhood Storage Option.
Shared Ship Canal Tunnel Option
The Shared Ship Canal Tunnel Option would replace numerous construction sites, each with the potential to encounter contaminated materials, with one larger project. This tunnel would have the most excavation of any of the CSO control projects, increasing the risk of encountering contaminated materials. However, for the option as a whole, the potential impacts would be concentrated in fewer locations throughout the city as a result of eliminating 15 City and 3 King County independently constructed CSO control facilities, the most of all the options. The neighborhoods that would be most affected are as follows: • Ship Canal and Lake Washington Neighborhoods. Tunnel portal sites and associated construction in these neighborhoods would require substantial excavation. Industrial areas along the Ship Canal in these neighborhoods have a high concentration of known contaminated sites. • Longfellow Creek/Duwamish Neighborhoods. Impacts would be similar to the Neighborhood Storage Option. • Elliott Bay/Lake Union Neighborhoods. Impacts would be similar to the Neighborhood Storage Option.

*The Neighborhood West Ship Canal Tunnel would have similar impacts in Ballard and Fremont/Wallingford as described for the Shared West Ship Canal Tunnel Option.

5.7.3 What are the potential environmental health and public safety impacts of the Integrated Plan Alternative?

Construction of storage pipes, tanks, and tunnels under the Integrated Plan Alternative would have the same potential environmental health impacts as under the LTCP Alternative, but construction would be delayed in some neighborhoods. The potential for environmental health and public safety impacts from the projects specific to the Integrated Plan Alternative would be low. Excavation for natural drainage systems is limited to the top few feet of soil, reducing the chances of encountering contaminated material. It is unlikely that contaminated sites would be located in the rights-of-way where the natural drainages systems are implemented. Construction of the South Park Water Quality Treatment Facility has the potential to encounter contaminated materials as the facility is located in an industrial area in the South Park neighborhood.

5.7.4 What are the potential environmental health and public safety impacts of the No Action Alternative?

The potential for environmental health and public safety impacts from the No Action Alternative would be low. Sewer system improvements occur at existing CSO or stormwater drainage locations. These locations have previously been excavated; therefore, the risk of encountering contaminated soil is minimal.

Excavation for rain gardens is limited to the top few feet of soil, reducing the chances of encountering contaminated material. It is unlikely that contaminated sites would be located on the residential properties where the RainWise Program is implemented. It is possible that contamination could have occurred in commercial or business properties, in public rights-of-way, and on public parcels selected for rain gardens. Equipment used for the projects in public rights-of-way could cause spills of contaminants such as petroleum products, but equipment would be limited to small trucks and backhoes, which would be well-maintained and would remain onsite for a limited time.

5.7.5 What measures are proposed to reduce or minimize environmental health and public safety impacts?

Measures to minimize impacts from hazardous materials would include site-specific investigations to determine the potential for hazardous materials and to develop site-specific cleanup or pollution prevention plans. For all sites, City would develop plans for sediment and groundwater handling, testing, and disposal. Spill prevention and control plans would be developed to prevent the accidental release of contaminants into the environment.

5.8 Noise and Vibration

This section describes the types of noise and vibration impacts that could occur within the Plan area during implementation of the Plan alternatives.

5.8.1 What potential construction impacts are common to all of the alternatives?

Many of the construction noise and vibration impacts would be common to all of the alternatives and options. These common impacts are described below.

Noise Generated by Construction Equipment and Activities

Construction noise levels vary depending upon the type and intensity of activity, with the highest levels of intensity typically occurring during earthwork. The most common noise source in construction areas would be engine-powered machinery such as earthmoving equipment (bulldozers and excavators), material-handling equipment (cranes), and stationary equipment (compressors, generators, and pumps). The loudest and most disruptive construction activities would be from driving sheet piles (if required). Installation of shoring for storage tanks, pipes, and tunnels would also be a source of construction noise. Other noise sources include tools such as jackhammers. Noise generated by mobile equipment would occur intermittently, while stationary equipment would generate sound fairly constantly. Backup alarms from onsite construction vehicles would add to the overall increased noise levels.

Sound Levels Produced by Construction Equipment

Equipment	Maximum Sound Level at 50 Feet (dB)
Backhoe	85
Compressor	80
Concrete pump	82
Concrete saw	90
Cement mixer	80
Crane	85
Drill rig	84
Dump or boom truck	84
Excavator	85
Fork lift	65
Generator	82
Jet grouter	70
Light plant	70
Front-end loader	80
Pickup truck	55
Pile driver (Impact)	101
Pump	81
Street sweeper	80
Vibratory hammer	95
Water truck	84
Welder	74

Source: FHWA, 2006

Key Points

Noise and Vibration

Construction of projects under the *LTCP Alternative* would result in short-term moderate to substantial increases in noise, lasting from one to as much as seven years, depending upon the LTCP option selected.

The primary differences in potential effects of the LTCP options are related to the amount of noise-generating earthwork and the length of construction period. The primary differences in potential effects of the LTCP options are related to the amount of noise-generating earthwork and the length of construction period. In general, storage pipes/tanks would result in shorter duration but more geographically distributed impacts, while the tunnels would result in longer duration impacts in relatively smaller areas.

The Neighborhood Storage Option would have the most dispersed noise and vibration impacts throughout the Plan area. Impacts would be of potentially higher intensity but concentrated at fewer locations under the shared options. Vibration impacts along the tunnel routes are likely to be a concern to property owners.

Noise and vibration impacts from the projects specific to the *Integrated Plan*

Increased Noise Levels in Residential Areas and near Sensitive Receptors

Sensitive receptors are those building occupants and uses that are most susceptible to noise, such as hospitals and schools. Noise from construction could interfere with activities that require a quiet atmosphere, including sleep if construction occurs at night. Construction noise could also cause impacts to wildlife (see Section 5.5, Biological Resources). Figure 5-10 shows sensitive receptors in the project area.

Residential areas are more sensitive to noise impacts than commercial and industrial areas because they tend to have lower baseline noise levels. Residential neighborhoods typically have baseline noise levels of around 50 dBA. Construction-related noise levels can range from 70 to over 100 dB during peak activity. The top end of this range (100 dB) is the same sound level as a lawn mower 3 feet away.

Vibration

Construction techniques have the potential to cause ground vibration. The closer a person or building is to the source of vibration, the more likely the vibration would be perceptible to humans and to cause structural damage to buildings. Ground vibration associated with general construction equipment (i.e., nonimpact equipment) would dissipate more quickly (over a shorter distance) than vibration from pile driving. Tunneling could cause vibration along the route, which could impact structures sensitive to vibration or cause unconsolidated soils to settle. Generally, however, vibration from tunneling would not be noticeable.

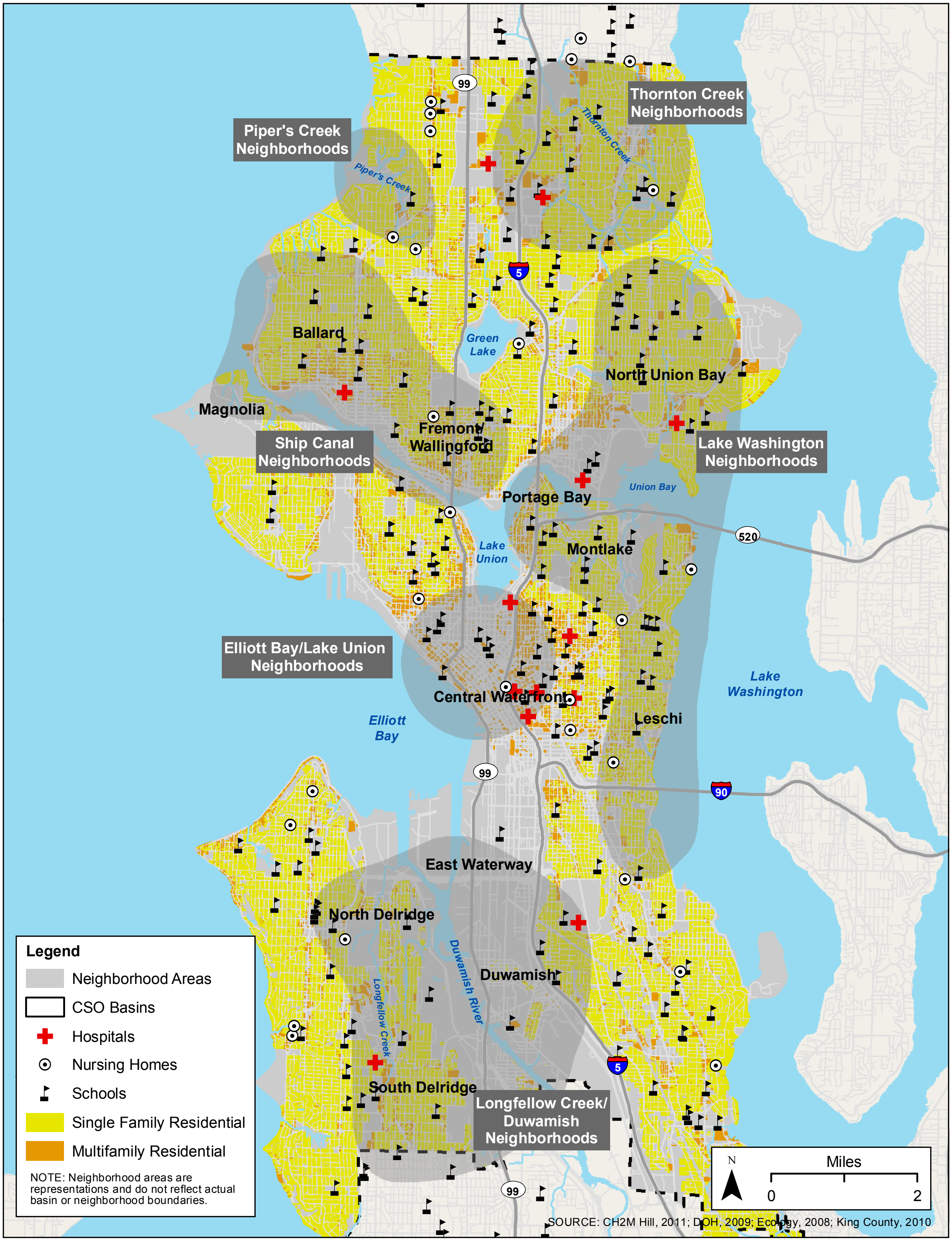


Figure 5-10 Sensitive Receptors.

5.8.2 What are the potential noise and vibration impacts of the LTCP options?

Construction-related noise impacts would occur under all of the LTCP options. Heavy equipment operation, earthwork, and other construction-related activities would result in short-term increases in noise by as much as 30 to 40 dB compared to baseline conditions. Construction would take place over several years in many locations and affect a wide variety of both residential and commercial properties. Table 5-8 summarizes the noise and vibration impacts for projects that would occur for each option.

Table 5-8. Comparison of Potential Noise and Vibration Impacts among LTCP Options
Neighborhood Storage Option*
The Neighborhood Storage Option would have the most dispersed noise impacts throughout the Plan area. The neighborhoods that would be most affected are as follows: • <u>Ship Canal Neighborhoods</u>. Storage tanks would be constructed in Ballard and Fremont/Wallingford, with construction noise lasting up to 5 years. Tanks would likely be built in industrial and commercial areas near the Ship Canal, but adjacent to residential areas which could be affected. Both neighborhoods include sensitive receptors, including a hospital in Ballard. Construction of a storage pipe in Magnolia would require less time and fewer truck trips, but the project would likely be in a residential area and single-family homes would be subject to construction noise for up to 1 year. • <u>Lake Washington Neighborhoods</u>. Construction noise from storage pipe construction could be disruptive to residential properties and other sensitive receptors such as schools, daycare centers, and nursing homes, though they tend to be concentrated away from shorelines. In Leschi, steep slopes could create a canyon effect, concentrating noise from construction of three storage pipes and one storage tank. Noise impacts in this neighborhood in particular could be substantial during peak construction periods. • <u>Longfellow Creek/Duwamish Neighborhoods</u>. Storage pipes in the Delridge neighborhoods could have greater noise impacts due to the presence of sensitive receptors and the proximity to residential areas. If trucks are required to use residential streets, they could add to the impacts from construction noise. • <u>Elliott Bay/Lake Union Neighborhoods</u>. A storage pipe would be built in the Central Waterfront area. The neighborhood is primarily commercial and industrial, and very few sensitive receptors are located near the shoreline. Therefore, construction noise is not expected to impact sensitive receptors.
Shared Storage Option
Generally, noise impacts from 10 smaller storage projects would be consolidated into 3 larger storage projects, producing noise impacts in fewer but more concentrated locations. The shared storage tanks would eliminate the need for several City and King County storage facility construction sites in the Ship Canal and Lake Washington Neighborhoods. In other neighborhoods, storage pipes or tanks would be replaced by flow diversions, which would cause less noise but could still be disruptive if located next to sensitive receptors. The neighborhoods that would be most affected are as follows: • <u>Ship Canal Neighborhoods</u>. Impacts would be similar to the Neighborhood Storage Option, except a shared storage tank in the Fremont/Wallingford area would concentrate impacts in one area. • <u>Lake Washington Neighborhoods</u>. Shared storage tanks would be built in North Union Bay and Montlake. The storage tank in North Union Bay could be located in proximity to the University of Washington, which features sensitive receptors such as educational facilities and the University of Washington Medical Center. The storage tank in Montlake would likely be located near residential areas. Construction noise from storage tanks would last for approximately 4.5 years, and in Montlake in particular, truck trips on residential roads could add additional noise. Storage pipes in the Leschi neighborhood would be replaced with flow transfer to the new shared storage tank. Flow transfer would likely still be built in residential areas, but construction duration would be shorter and construction noise would not be as substantial. • <u>Longfellow Creek/Duwamish Neighborhoods</u>. Impacts would be similar to the Neighborhood Storage Option. • <u>Elliott Bay/Lake Union Neighborhoods</u>. Impacts would be similar to the Neighborhood Storage Option.

Table 5-8. Comparison of Potential Noise and Vibration Impacts among LTCP Options
Shared West Ship Canal Tunnel Option
The Shared West Ship Canal Tunnel would reduce the number of City and King County independently constructed storage facilities compared to the Neighborhood Storage Option. Fewer areas in the Ship Canal and Lake Washington Neighborhoods would experience construction noise, but noise would be concentrated at tunnel portal locations. Following initial tunnel portal site construction, most work would occur underground, which would not produce noticeable street-level noise or vibration. The neighborhoods that would be most affected are as follows: • Ship Canal Neighborhoods. The tunnel portal sites would likely be located in commercial and industrial areas, but near residential areas that could be affected. Tunnel boring would occur underneath Ship Canal Neighborhoods, but ground-borne noise and vibration would not be noticeable at street level. Additional evaluation of vibration potential may be needed during project-level evaluations, as vibration-related impact to structures is likely to be a concern to area property owners. Unlike the Neighborhood Storage Option, King County would not need to build its own new storage tank, which would reduce the overall number of construction sites in the neighborhood. Once initial construction is complete at storage tunnels, the majority of work would occur underground so there would be less construction noise than for storage tanks with open construction areas. • Lake Washington Neighborhoods. Impacts would be similar to the Neighborhood Storage Option. • Longfellow Creek/Duwamish Neighborhoods. Impacts would be similar to the Shared Storage Option. • Elliott Bay/Lake Union Neighborhoods. Impacts would be similar to the Neighborhood Storage Option.
Shared Ship Canal Tunnel Option
Compared to all other options, construction noise from the Shared Ship Canal Tunnel Option would affect the fewest areas, but similar to the Shared West Ship Canal Tunnel Option, it would result in concentrated impacts in the Ship Canal and Lake Washington Neighborhoods. Following initial tunnel portal site construction, most work would occur underground, which would not produce noticeable street-level noise or vibration. The neighborhoods that would be most affected are as follows: • Ship Canal and Lake Washington Neighborhoods. Tunnel portal sites would be built along the Ship Canal, potentially on the south side of the Ship Canal and in North Union Bay. Haul trucks may be required to use roads adjacent to residential areas or sensitive receptors. Construction noise impacts would be focused at the portal sites. If a portal site is near sensitive receptors associated with the University of Washington, impacts could be substantial during peak construction periods. Construction noise would occur over the 7-year duration of the project. Tunnel boring would occur underneath the Ship Canal and Lake Washington Neighborhoods, but ground-borne noise and vibration would not be noticeable at building level. As noted for the Shared West Ship Canal Tunnel Option, potential vibration impacts to structures may require additional evaluation. Storage tanks and pipes would not need to be built in these neighborhoods, but flow diversions to the tunnel would be required. Construction of conveyance lines would still cause construction noise in residential areas in the Lake Washington Neighborhoods, but the construction techniques are likely to be less noisy and would occur over a shorter duration (two months). • Longfellow Creek/Duwamish Neighborhoods. Impacts would be similar to the Shared Storage Option. • Elliott Bay/Lake Union Neighborhoods. Impacts would be similar to the Neighborhood Storage Option.

*The Neighborhood West Ship Canal Tunnel would have similar impacts in Ballard and Fremont/Wallingford as described for the Shared West Ship Canal Tunnel Option.

5.8.3 What are the potential noise and vibration impacts of the Integrated Plan Alternative?

Construction of storage pipes, tanks, and tunnels under the Integrated Plan Alternative would have the same noise impacts as under the LTCP Alternative, but construction would be delayed in some neighborhoods. Noise and vibration impacts from the projects specific to the Integrated Plan Alternative would be minor. Construction for natural drainage system projects is not likely to require high-impact noise equipment and construction noise would be of short duration. The South Park Water Quality Facility would generate typical construction noise similar to projects implemented under the LTCP Alternative and is anticipated to last two years.

5.8.4 What are the potential noise and vibration impacts of the No Action Alternative?

Noise and vibration impacts from the No Action Alternative would be minor. Sewer system improvements and projects implemented under natural drainage systems programs (RainWise and roadside rain gardens) are not likely to require high-impact noise equipment, and construction noise would be of short duration.

5.8.5 What measures are proposed to reduce or minimize noise and vibration impacts?

When project sites are selected, City would identify potentially impacted receptors and buildings and determine whether noise would exceed permitted levels or vibration would exceed applicable structural damage thresholds. If necessary, the City could perform baseline noise and vibration surveys at selected locations.

If construction activities exceeded permitted noise levels established in Seattle Noise Control Ordinance (SMC 25.08.425), the City would instruct the contractor to implement measures to reduce noise impacts to comply with the Noise Ordinance. Onsite noise monitoring could be used to ensure compliance with City code if necessary.

Construction noise could be minimized by implementation of construction best management practices, including the following:

- Identify potentially impacted receptors and buildings and determine whether noise and vibration levels at those sites would exceed permitted levels.
- Encourage noise-reducing measures, such as using sound-control devices on equipment, prohibiting equipment with unmuffled exhaust, minimizing idling time of equipment and vehicles, and installing acoustic barriers around stationary sources of construction noise.
- Conduct onsite noise monitoring to ensure compliance with SMC provisions, if necessary.
- Coordinate with Seattle City Light to ensure electrical power is available to construction sites during construction dewatering (to avoid using diesel powered generators).

Mitigation for vibration impacts would be determined on a site-by-site basis depending on impacts. Mitigation measures could include shoring of impacted buildings, coordination of vibration-causing construction with sensitive activities in impacted buildings, or onsite vibration-minimizing practices.

5.9 Land Use and Visual Quality

This section describes the types of land use and visual impacts that could occur within the Plan area during implementation of the Plan alternatives.

5.9.1 What potential construction impacts are common to all of the alternatives?

Many of the potential construction-related impacts to land use and visual resources would be common to all of the alternatives and options. These common impacts are described below.

Acquisition of Property and Easements

As with other large public infrastructure projects, CSO control projects can require the acquisition of easements or property for construction access, facilities, and staging areas.

Property acquisition could be required for storage tank locations, although public property would be preferred when available. For storage pipes and flow diversions, construction would occur primarily in street rights-of-way. For storage tunnels, potential property acquisition could be required for tunnel portals in industrial or residential areas. Acquisition could also be required for temporary and permanent easements for access or staging areas and for pump stations, conveyance lines, and other facilities.

To the extent possible, the City would avoid private property acquisition and displacement of residents or businesses. For each project, the City would conduct a siting process as described in Section 3.2.2.2 of this EIS. A top priority is to locate facilities on public property if possible. If acquisition of private property or displacement of residents or businesses is necessary, the City would attempt to find willing property sellers, and would follow federal, state, and local requirements for property acquisition, compensation, and relocation (Seattle Municipal Code Title 20).

> **Key Findings**
>
> ***Land Use and Visual Quality***
>
> CSO control projects included under the *LTCP Alternative* range from those that would be located in the public right-of-way or streets and cause little or no land use or visual impact, to major infrastructure projects that could require acquisition of property or easements. The acquisitions /easements could be temporary to accommodate access to a site or a location for project staging, or they could be permanent for locating storage tanks or tunnels. Impacts to visual quality during construction would be minor under all LTCP options.
>
> The primary differences in potential effects of the LTCP options are related to the types of projects and their potential location and length of construction. Overall impacts would potentially be greatest under the Neighborhood Storage Option, and least under the Shared West Ship Canal and Ship Canal Tunnel Options. Impacts from storage facility construction would be concentrated at fewer locations under the shared options.
>
> Only minor land use and visual quality impacts would occur as a result of stormwater projects implemented under the *Integrated Plan Alternative.*

Incompatibility with Surrounding Land Uses

The availability of sites suitable for CSO control facilities is limited, particularly for larger facilities such as storage tanks. This could result in the City needing to locate facilities in areas surrounded by residential or other types of land uses that could be affected during the construction period. These impacts would be noticeable throughout the construction period, but they would not likely continue following construction because most of the facilities would be underground.

Conflicts with Existing Plans and Policies

As described in Section 4.8, the City has established land use plans and regulations that determine what types of facilities are permitted in neighborhoods. The City's land use regulations acknowledge that public facilities may need to be located in areas where the facility would not be compatible. The City has included specific permit requirements for locating public facilities. When individual projects are carried forward under the Plan, the City would apply for land use permits as appropriate using the Master Use Permit process and would comply with the requirements of those permits. Proposed CSO projects are expected to require compliance with the Shoreline Master Program, environmentally critical areas reports, SEPA, and other land use and zoning regulations.

Changes to Views

Construction activities, equipment, and stockpiled materials would change the appearance of work sites and could temporarily modify the views from surrounding neighborhoods. Construction activities would be visible from nearby residences, commercial areas, and surrounding streets. None of the projects are anticipated to interfere with public views protected under the City Public View Protection Policy, such as views of the Space Needle and Mount Rainier. View impacts would be limited because many of the projects would be constructed underground with a limited aboveground footprint, and most construction equipment would be small and not obstruct views. Larger scale construction projects would require larger construction equipment, such as cranes and pile drivers, but even that equipment would have relatively small visual impacts.

Light and Glare

Most construction is expected to occur between 7 a.m. and 7 p.m. on weekdays and 9 a.m. and 7 p.m. on weekends and legal holidays. Consequently, light and glare impacts associated with construction site lighting would be limited to early morning and evenings during winter months. The tunnel projects could include nighttime construction and require round-the-clock lighting. This would introduce new sources of light and glare into the portal neighborhoods. In addition, safety lighting may be required at some construction sites during nighttime hours.

5.9.2 What are the potential land use and visual resources impacts of the LTCP options?

Table 5-9 summarizes the types of impacts to land use and visual resources that could occur under the four options of the LTCP. Proposed projects range from those that would be located in the public right-of-way or streets and cause little or no land use or visual impact, to major infrastructure projects that could require acquisition of property or easements. The acquisitions/easements could be temporary to accommodate access to a site or a location for project staging, or they could be permanent for locating storage tanks or tunnels.

Table 5-9. Summary of Potential Land Use and Visual Resource Impacts for LTCP Options
Neighborhood Storage Option*
This option has the largest number of City and King County independently constructed CSO storage facilities and the most areas that would experience temporary land use and visual resource impacts from storage facility construction. If public property is not available, acquisition of private property would be required. Because this option has the highest number of tanks, it may be difficult to site all facilities on public property. Property acquisition in most neighborhoods would be limited to construction easements or access. Storage pipe construction in streets could intermittently block or modify access to businesses and residences for a year or more.

Table 5-9. Summary of Potential Land Use and Visual Resource Impacts for LTCP Options

The neighborhoods that have the highest potential to be affected are as follows:
• Ballard and Fremont/Wallingford. A storage tank would be built in each neighborhood. While public property or right-of-way may be available for tank locations, the tanks could require property or easement acquisition in industrial or residential neighborhoods.
  ◦ In the Ballard neighborhood, construction could disrupt adjacent property and business access for up to five years. The storage tank would require as much as 2 acres, likely on private property because of the limited availability of public property. The storage tank would likely be located in an industrial area.
  ◦ In the Fremont/Wallingford neighborhood, a storage tank would be constructed on an approximately 2-acre site. Construction duration would be up to 3.5 years. It is possible that City-owned property would be available for this tank. Three pump stations would be constructed in support of the storage tank.
• Leschi. Storage pipes and associated pump stations would be constructed in a neighborhood with steep topography, a limited road network, and dense development. Construction would take place primarily in the right-of-way along Lake Washington Boulevard and would likely intermittently disrupt access to residences and businesses, potentially requiring detours around the construction sites. Construction could occur in the designated shoreline zone and would require compliance with the Shoreline Master Program. Views of Lake Washington could be temporarily disrupted by construction activities.
• Longfellow Creek/Duwamish. Storage pipes constructed in the Delridge and Duwamish neighborhoods could largely be constructed in the rights-of-way, causing localized intermittent disruptions to access for up to 1.5 years.
• East Waterway. Construction could require property and easement acquisition for a storage tank requiring up to an acre of surface disturbance. Access to adjacent residences and businesses could be intermittently disrupted for up to 2 years.
• Central Waterfront. A storage pipe would be located within the public right-of-way and would not require property acquisition. Access to businesses could be disrupted for up to 1 year, compounding access problems associated with the Viaduct replacement and waterfront projects. Construction could temporarily disrupt views of the Elliott Bay waterfront.

Shared Storage Option
Impacts would be similar to the Neighborhood Storage Option, but construction-related land use and visual quality impacts would be concentrated at fewer, larger project sites in the Ship Canal and Lake Washington Neighborhoods of Fremont/Wallingford, North Union Bay, and Montlake. This option would eliminate 10 smaller storage projects in the Lake Washington Neighborhoods. The neighborhoods that have the highest potential to be affected are as follows: • Ballard and Fremont/Wallingford. Impacts of storage tanks would be the same as for the Neighborhood Storage Option, except the Fremont/Wallingford tank would require up to 3 acres of property acquisition in a primarily residential area and construction would last approximately 3 years. • North Union Bay. A shared storage tank with up to 3 acres of surface disturbance could require property and easement acquisition in a predominantly residential area that includes portions of the University of Washington. Construction duration of up to 4 years could intermittently disrupt access to residences, businesses, and the University. • Montlake. A shared storage tank covering up to 2 acres could require property and easement acquisition in a primarily residential neighborhood. Construction duration of up to 4.5 years could intermittently disrupt access to residences, businesses, and portions of the University of Washington campus. • Other neighborhoods would experience similar level of impacts as under the Neighborhood Storage Option except the East Waterway neighborhood, where a flow diversion would replace the need for a storage tank and cause fewer impacts.

Table 5-9. Summary of Potential Land Use and Visual Resource Impacts for LTCP Options
Shared West Ship Canal Tunnel Option
The Shared West Ship Canal Tunnel would reduce the number of City and King County independently constructed storage facilities compared to the Neighborhood Storage Option. This would reduce the number of areas affected by storage facility construction compared to the Neighborhood Storage Option, but would concentrate land use impacts in fewer areas of the city (Ballard and Fremont/Wallingford). The neighborhoods that would be most affected are as follows: • Ballard and Fremont/Wallingford. The storage tunnel would require a similar amount of property acquisition and easement acquisition as the Neighborhood Storage Option. Construction duration (3.5 years) would also be slightly shorter than for the storage tanks under the Neighborhood Storage Option, potentially resulting in fewer disturbances to property access. Nighttime construction would be required, causing light and glare impacts to adjacent neighborhoods. • Leschi. Impacts of constructing three pipes and a storage tank and associated pump stations in the Leschi neighborhood would cause the same impacts to traffic, property access, and views of Lake Washington as described above for the Neighborhood Storage Option. • Other neighborhoods would experience similar level of impacts as under the Neighborhood Storage Option.
Shared Ship Canal Tunnel Option
The Shared Ship Canal Tunnel Option would eliminate storage tank/pipe construction in several neighborhoods, but it would result in concentrated, potentially higher intensity impacts in the Ship Canal and certain Lake Washington Neighborhoods. Overall, the need for property acquisition and the amount of interference with access to residences and businesses would be reduced since most areas in the Lake Washington and Longfellow Creek/ Duwamish Neighborhoods would be controlled by flow diversions to the shared tunnel or King County facilities. Most of the construction associated with those projects would take place in paved rights-of-way and at existing facilities, reducing the need for property acquisition. The smaller flow diversion projects would also reduce construction duration and the potential for access impacts. The neighborhoods that would be most affected are as follows: • Ship Canal and Lake Washington Neighborhoods. Major construction impacts would occur at the portal locations including property acquisition of up to 4 acres in residential or industrial areas for tunnel portals, staging areas, and related facilities. Private property acquisition is likely. Intermittent access disruption would last for up to 7 years. Nighttime construction would be required, causing potential light and glare impacts to adjacent properties. • Other neighborhoods would experience similar or reduced level of impacts as compared to the Neighborhood Storage Option.

*The Neighborhood West Ship Canal Tunnel would have similar impacts in Ballard and Fremont/Wallingford as described for the Shared West Ship Canal Tunnel Option.

5.9.3 What are the potential land use and visual resource impacts of the Integrated Plan Alternative?

Under the Integrated Plan Alternative, completion of selected CSO control projects described under the LTCP Alternative would be deferred so that the City can focus on implementing the proposed stormwater projects. As a result, construction impacts associated with certain CSO control facilities in the Delridge, East Waterway, Duwamish, Portage Bay, and Montlake neighborhoods would occur later (after 2028) under the Integrated Plan Alternative. Consequently, these neighborhoods would experience fewer near-term land use and visual quality-related construction impacts.

In addition to construction of CSO control projects, additional construction would be needed to complete NDS Partnering projects and the South Park Water Quality Facility project. The street sweeping expansion program does not involve construction and no land use or visual quality impacts are anticipated.

NDS Partnering projects would be constructed in public road rights-of-way of the Piper's, Thornton, and Longfellow Creek areas and cause little or no land use or visual impact. It is not possible to identify all potential project locations at this time, so site-specific zoning classifications cannot be determined. Most projects are expected to occur within the Single Family (SF) zone but could occur in other zones. Prior to installation of rain gardens, the City would need to apply for and obtain applicable land use permits and approvals. Depending on the site, temporary easements could be required to accommodate access to a site or a location for project staging.

During scoping, several comments were received regarding the history of unsuccessful roadside rain gardens in the Ballard neighborhood, citing that the rain gardens did not function properly, altered the character of the neighborhood, and created a safety hazard. The City has incorporated the lessons learned from the previous project into the agency's rain garden programs. Rain gardens constructed under NDS Partnering would include detailed evaluation of subsurface conditions prior to implementation. Construction impacts to land use and visual resources are not anticipated.

The South Park Water Quality Facility would involve a small construction footprint, and suitable City-owned property is available in the drainage basin for this purpose. It is unlikely that property acquisition or easements would be required. Available City-owned property is located in an industrial-zoned area with surrounding industrial land use. Therefore, it is anticipated that a suitable site is available that would result in minimal land use and visual quality impacts during construction. If this project is carried forward under the Integrated Plan, the City would apply for land use permits as appropriate using the Master Use Permit process and would comply with the requirements of those permits. The project would be expected to require compliance with the Shoreline Master Program, environmentally critical areas reports, SEPA, and other land use and zoning regulations.

5.9.4 What are the potential impacts to land use and visual resources of the No Action Alternative?

Under the No Action Alternative, the CSO control projects included in the LTCP would not be built. However, the City would continue with two of its ongoing programs to reduce CSOs—sewer system improvements and natural drainage systems. Property acquisitions would not likely be required for sewer system improvements because work would occur at existing CSO or stormwater drainage locations. Construction activities are not expected to interfere with access to properties or businesses. See the previous section on the Integrated Plan Alternative for discussion of rain garden projects.

5.9.5 What measures are proposed to reduce or minimize impacts to land use and visual resources?

Construction impacts to land use and visual resources include dust, noise, and increased traffic. Measures to minimize these effects are described in Sections 5.3, 5.8, and 5.12. In addition, the City would undertake the following measures to mitigate construction-related impacts to land use and visual resources for all construction projects:

- Prioritize project locations on public property and in public rights-of-way.

- Comply with federal, state, and local regulations regarding property acquisition and relocation assistance.
- Follow conditions of the Master Use Permit as described in Section 4.8.
- Provide access to property and businesses during construction.

Additional mitigation measures for specific land use and visual resource impacts may be identified during future review of individual projects. The City would coordinate with property owners on mitigation efforts as appropriate. The City would also coordinate with property owners to identify any relocation or other mitigation options for properties that would be directly affected during the construction period.

Projects proposed under the LTCP options would require more extensive construction disturbance and, therefore, would potentially cause more land use and visual impacts. Neighborhoods that would be most affected by property acquisition include the Ship Canal and Lake Washington Neighborhoods where storage tanks and major tunnels would likely require more property acquisition and potentially relocations. The City would comply with all applicable requirements for property acquisition and relocation.

5.10 Recreation

This section describes the types of recreation impacts that could occur within the Plan area during implementation of the Plan alternatives.

Key Findings

Recreation

For all options under the *LTCP Alternative*, impacts to recreation could occur if a facility is sited within a park. Of the types of projects included in the LTCP options, storage tanks and tunnel portals could potentially be located on private or public property, including parks, although SPU would attempt to avoid park locations. If construction or staging areas are located adjacent or nearby to a park, recreational use of the park could be disrupted by restricted access, noise, dust, and truck trips during peak construction periods.

The potential for recreation impacts is highly variable and site dependent. The potential for impacts would be greatest under the Neighborhood Storage Option due to the higher number of tanks, but the larger tanks under the Shared Storage Option would have greater impacts if located in or adjacent to a park. Potential for impacts would be lower under the Shared West Ship Canal and Ship Canal Tunnel Options due to fewer tank sites.

Construction impacts to recreation specific to stormwater projects under the *Integrated Plan Alternative* are expected to be minimal.

5.10.1 What potential construction impacts are common to all of the alternatives?

Many of the construction-related recreation impacts would be common to all of the alternatives and options. Because specific sites have not been chosen, these are described as potential impacts. Additional site-specific impacts would be evaluated as appropriate during project-level evaluations. The potential impacts common to all alternatives are described below.

Construction within a Park

Impacts to recreation could occur if a facility is sited within a park. Of the types of projects included in the LTCP options, storage tanks and tunnel portals could potentially be located on private or public property, including parks, although the City would attempt to avoid park locations. If located in a park, construction could limit or preclude use of as much as two to three acres of the park for multiple years. Recreation would be impacted by high levels of noise, and truck trips to the park could make access or parking difficult for recreational users, particularly during peak construction periods. Portions of the park could be closed or inaccessible during construction. Any construction in a park would comply with the requirements of Initiative 42 (Ordinance No. 118477) related to siting public facilities in parks. If a CSO facility was built in or adjacent to a park with a National Park Service grant, the City would need to coordinate with Seattle Parks and Recreation to ensure that the project did not interfere with grant compliance.

Construction adjacent to a Park

Because specific sites have not been chosen, it is unclear which projects (if any) would be located adjacent or nearby to a park. If construction or staging areas are located adjacent to or nearby to a park, recreational use of the park could be disrupted by restricted access, noise, dust, and truck trips during peak construction periods.

Construction in a Right-of-Way

Construction of storage pipes and flow diversions would generally be located in road rights-of-way, and it could temporarily interfere with informal recreation opportunities such as biking and walking.

5.10.2 What are the potential recreation impacts of the LTCP options?

Each of the four LTCP options has different potential to result in recreation impacts. Table 5-10 summarizes the recreation impacts for projects that would occur for each option.

Table 5-10. Comparison of Potential Recreation Impacts among LTCP Options

Neighborhood Storage Option*

Because this option has the highest number of projects located throughout the city, it has a greater likelihood of having projects located adjacent to a park or recreational facility. There are approximately 150 parks within the potentially affected neighborhoods (see Section 4.9, Recreation). Storage pipes located in the right-of-way, often in or near residential areas, could affect access to parks and impact informal recreation opportunities such as walking and biking.

The neighborhoods that would be most affected are as follows:

- <u>Ship Canal Neighborhoods</u>. Storage tanks would be built in the Ballard and Fremont/Wallingford neighborhoods. Due to the availability of underdeveloped or undeveloped commercial and industrial properties in these neighborhoods, storage tanks are less likely to be built in a park. The Burke Gilman Trail runs through the Fremont/Wallingford neighborhood near the Ship Canal and CSO outfalls. It is possible that the storage tank or a new conveyance line could be built near the trail. Other parks in Ballard and Fremont/Wallingford near where storage tanks could be constructed are generally small neighborhood parks. The storage pipe built in the Magnolia neighborhood would be constructed in the right-of-way, but if built near Discovery Park or a small neighborhood park, noise from construction could intermittently disrupt recreation in the park.
- <u>Lake Washington Neighborhoods</u>. Storage pipes would be constructed in road rights-of-way in these neighborhoods. Lake Washington Neighborhoods have a high concentration of parks, including both small neighborhood parks and major parks such as the Washington Park Arboretum and numerous parks designed by the Olmsted Brothers. Storage pipes would not be built in these parks, but there is a high likelihood that they would be constructed in roadways adjacent to parks, resulting in high levels of noise, disruption of access, and potential placement of construction staging areas in parks (likely in parking lots).

  One of the major roads in the area is Lake Washington Boulevard, which was designed by the Olmsted Brothers and is a city park. It is likely that a storage pipe would be built in the right-of-way of Lake Washington Boulevard because few other options are available. Construction would take place in the paved area of the boulevard, but construction staging could potentially disturb vegetation designed by the Olmsted Brothers. Construction would disrupt use of the boulevard for pedestrians and bicyclists.

  The Leschi neighborhood would require three storage pipes and a tank. This neighborhood has a particularly high concentration of parks, particularly Olmsted parks, and fewer roads suitable for construction in the right-of-way. Therefore, it is likely that storage pipes could be built directly adjacent to parks in this neighborhood.
- <u>Longfellow Creek/Duwamish Neighborhoods</u>. Storage pipes and a storage tank would be constructed in these neighborhoods. These neighborhoods have a lower density of parks than other neighborhoods and many undeveloped or underdeveloped commercial and industrial sites available. Therefore, it is less likely that CSO control projects would be constructed in or directly adjacent to a park. Storage pipes in the Delridge neighborhoods could be constructed near enough to parks (such as the Longfellow Creek Green Space or smaller neighborhood parks) that noise from construction could intermittently disrupt recreation.
- <u>Elliott Bay/Lake Union Neighborhoods</u>. The Central Waterfront neighborhood includes many significant parks and recreational facilities, such as the Sculpture Park and the Aquarium, as well as smaller neighborhood parks such as the Belltown Cottage Park and Victor Steinbrueck Park. The storage pipe constructed in this neighborhood is unlikely to be located directly adjacent to a park, but it could be near enough to a park that construction noise and truck traffic could disrupt use of or access to the park.

Table 5-10. Comparison of Potential Recreation Impacts among LTCP Options
Shared Storage Option
The Shared Storage Option would have recreation impacts similar to the Neighborhood Storage Option. Due to their size and surface area required, shared storage tanks have a greater potential to impact recreation if located within or near parks. However, the use of shared storage tanks would reduce the number of storage tanks and pipes required in the Ship Canal and Lake Washington Neighborhoods. In other neighborhoods, storage pipes or tanks would be replaced by flow diversions, which would have less potential to impact parks but could still impact informal recreation such as walking and biking. The neighborhoods that would be most affected are as follows: • Ship Canal Neighborhoods. Impacts would be similar to the Neighborhood Storage Option. • Lake Washington Neighborhoods. Shared storage tanks would be built in North Union Bay and Montlake. The storage tank in North Union Bay could be located in proximity to the University of Washington Athletic Complex (including fields, a golf course, a ballpark, and an outdoor track) and the Union Bay Natural Area. Construction could limit use of or access to these areas for several years. Because the area is dominated by these recreational areas, impacts to recreation are likely. The storage tank in Montlake could impact recreation if located in or near East Montlake Park or West Montlake Park, or if construction traffic used Montlake Boulevard, an Olmsted Park. Storage pipes in the Leschi neighborhood would be replaced with flow transfer to the new shared storage tank. Flow transfer would likely still be built in the right-of-way next to parks, but there would be less construction disturbance. Compared to the Neighborhood Storage Option, impacts to the Lake Washington Neighborhoods would be lower because this option eliminates King County-only storage tanks in the North Union Bay and Montlake neighborhoods. • Longfellow Creek/Duwamish Neighborhoods. Impacts would be similar to the Neighborhood Storage Option. • Elliott Bay/Lake Union Neighborhoods. Impacts would be similar to the Neighborhood Storage Option.
Shared West Ship Canal Tunnel Option
Impacts to recreation from construction would be similar to the Neighborhood Storage Option, but impacts in the Ballard and Fremont/Wallingford neighborhoods would be concentrated at portal locations. If located in or adjacent to a park or recreational facility, portal construction could have a substantial impact on recreation. The neighborhoods that would be most affected are as follows: • Ballard and Fremont/Wallingford. A tunnel portal site would be built in each of these neighborhoods and could be located in or adjacent to existing or planned parks or greenways. A substantially higher number of truck trips would be required as compared to storage tanks, which would have a greater likelihood of disrupting access to nearby parks and informal recreation on city streets (such as biking and walking). Unlike the Neighborhood Storage Option, King County would not need to build its own storage tank in the neighborhood, which would decrease the overall number of construction sites. • Lake Washington Neighborhoods. Impacts would be similar to the Neighborhood Storage Option. • Longfellow Creek/Duwamish Neighborhoods. Impacts would be similar to the Neighborhood Storage Option. • Elliott Bay/Lake Union Neighborhoods. Impacts would be similar to the Neighborhood Storage Option.
Shared Ship Canal Tunnel Option
Under the Shared Ship Canal Tunnel Option, storage pipes and tanks throughout the Ship Canal and Lake Washington Neighborhoods would be replaced by a tunnel. Impacts would be similar to those described above for the Shared West Ship Canal Tunnel. The overall potential for this option to impact parks is lower than under other options because there are fewer project sites, particularly in Lake Washington Neighborhoods where storage pipes and tanks would likely be located adjacent to parks. The neighborhoods that would be most affected are as follows: • Ship Canal and Lake Washington Neighborhoods. If located in or adjacent to a park or recreational facility, noise impacts from tunnel portal construction would be substantial and truck trips could disrupt access to the park. If located in the park, multiple acres of the park could be closed to recreation for up to several years. A substantially higher number of truck trips would be required as compared to storage tanks, which would have a greater likelihood of disrupting access to nearby parks and informal recreation opportunities. The launch portal site would be located in

Table 5-10. Comparison of Potential Recreation Impacts among LTCP Options
the Ship Canal Neighborhoods and could be located in a recreational facility, such as an athletic field. The recovery portal site, which would have less construction activity than the launch portal site, would likely be located in the North Union Bay neighborhood. This neighborhood has many recreational facilities, including the University of Washington Athletic Complex (including Husky Stadium and its parking lots) and Montlake Park. If the tunnel portal site was located in or adjacent to these areas, access to and recreation at these facilities would be disrupted during the 6-year construction period. • Longfellow Creek/Duwamish Neighborhoods. Impacts would be similar to the Neighborhood Storage Option. • Elliott Bay/Lake Union Neighborhoods. Impacts would be similar to the Neighborhood Storage Option.

*The Neighborhood West Ship Canal Tunnel would have similar impacts in Ballard and Fremont/Wallingford as described for the Shared West Ship Canal Tunnel Option.

5.10.3 What are the potential recreation impacts of the Integrated Plan Alternative?

Construction of storage pipes, tanks, and tunnels under the Integrated Plan Alternative would have the same potential recreation impacts as under the LTCP Alternative, but construction would be delayed in some neighborhoods. Recreation impacts from construction of the elements specific to the Integrated Plan Alternative would be minor. Construction in the right-of-way for natural drainage system projects could temporarily interfere with informal recreation such as walking and biking due to restricted access. Construction would be of short duration and would not require noisy equipment. The South Park Water Quality Facility would be constructed in an industrial area and would not be located near parks or informal recreation.

5.10.4 What are the potential recreation impacts of the No Action Alternative?

Recreation impacts from construction of the No Action Alternative would be minor. Sewer system improvements would occur at existing CSO or stormwater drainage locations and are therefore not likely to be located in parks or designated recreational trails. Construction in the right-of-way for both sewer system improvements and for right-of-way rain garden projects could temporarily interfere with informal recreation due to restricted access. Construction would be of short duration and would not require noisy equipment.

5.10.5 What measures are proposed to reduce or minimize recreation impacts?

If a project component is located in a park, impacts to recreation would be unavoidable. The City would attempt to avoid siting projects in parks. See Section 3.2.2.2 for more information about how locations will be prioritized. Impacts to recreational facilities could be further minimized through coordination with Seattle Parks, including coordinating construction timing with special events at the park; construction staging methods and siting; scheduling to avoid overlap with the construction of other projects in the vicinity; and advance public notice and signage. Parks and recreational features would be restored to the extent possible.

Noise from construction would be mitigated using the methods discussed in Section 5.8. Increased truck traffic could make it more difficult to access parks, but access would be maintained and transportation impacts would be minimized as discussed in Section 5.12. Noise and access impacts to recreation for projects located adjacent to parks and to informal recreation areas would be mitigated using the same methods.

5.11 Historic, Cultural, and Archaeological Resources

This section describes the types of impacts that could occur to historic and cultural resources within the Plan area during implementation of Plan alternatives.

Key Findings

Historic, Cultural, and Archaeological Resources

Construction under the *LTCP Alternative* or *Integrated Plan Alternative* could have a potential adverse effect on historic, cultural, or archaeological resources in the Plan area. For aboveground resources, all Plan alternatives include similar, minimal potential for impacts.

The primary difference in impacts for the LTCP options relates to the amount of excavation in geological layers and their potential to encounter cultural resources. The Shared Storage Option – and to a lesser extent the Neighborhood Storage Option – would have greater amounts of excavation in geological layers with greater potential to encounter cultural resources than the tunnel options.

5.11.1 What potential construction impacts are common to all of the alternatives?

The majority of impacts to historic and cultural resources during construction would be common to all of the alternatives and options. These common impacts are described below.

Belowground Historic and Cultural Resources

Shoring, excavation, and dewatering for storage pipes, storage tanks, tunnel portals, and flow diversions have the potential to cause construction impacts to belowground cultural resources. In most neighborhoods, construction of pipes, tanks, and flow diversions is likely to require disturbance that would extend from ground surface, down through geological layers with potential to contain cultural resources, and all the way into layers that would be considered too old to contain cultural remains. Exceptions to this general pattern may exist in the Central Waterfront, Duwamish, and North Union Bay, where the thickness of historic fill may exceed the depth of construction excavation. Due to their smaller construction footprints, storage pipes would be expected to have less potential impact than storage tanks.

Based on the Washington State Department of Archaeology and Historic Preservation (DAHP) Statewide Predictive Model, within individual neighborhoods, areas in proximity to permanent sources of water (shorelines) would be more likely to contain archaeological sites than areas not in proximity to water (uplands).

Aboveground Historic and Cultural Resources

Depending on project site locations, construction of storage pipes, storage tanks, new conveyance for flow diversions, and tunnel portal sites has the potential for impacts to aboveground historic properties. Temporary construction impacts to aboveground resources typically include vibration, dust, noise, and can sometimes include impacts to the visual integrity of a historic property. All of the neighborhoods identified for these types of projects contain designated Seattle Landmarks. Similarly, there are properties listed on the National Register of Historic Places in all neighborhoods except for Delridge South. Depending on the sites selected for storage tanks or storage pipes, existing recorded or unrecorded historic-aged properties may be present.

Under all LTCP options, work is being proposed in neighborhoods that contain aboveground properties that are historic in age, but which have not yet been evaluated for their eligibility to the National Register or as a designated Seattle Landmark.

Because specific sites have not been chosen for the CSO control projects, this EIS does not evaluate historic and cultural resources impacts for specific projects. An evaluation of historic and cultural resources will be conducted as part of project-level SEPA analyses performed for each project, as appropriate.

5.11.2 What are the potential historic and cultural resources impacts of the LTCP options?

Table 5-11 summarizes the types of historic and cultural resource impacts that could occur under all four LTCP options. Each option would cause different levels of historic and cultural resources impacts to different neighborhoods. Impacts to belowground resources would be highest for options that propose the most ground disturbance, depending on selected project locations. For aboveground resources, the options with the highest potential impacts are those that propose the greatest amount of work in older, developed neighborhoods such as the Central Waterfront and Duwamish or neighborhoods with historic districts.

Table 5-11. Summary of Potential Historic and Cultural Resources Impacts for LTCP Options
Neighborhood Storage Option*
For aboveground historic and cultural resources, the neighborhoods that would be most affected are as follows: • Ballard, Fremont/Wallingford, and East Waterway. A storage tank would be built in each of these neighborhoods. Tanks would be located on private or City property and may require demolition of existing structures, including potentially historic structures, if present. • Leschi. Three pipes and a tank are proposed within this neighborhood, including along Lake Washington Boulevard East which was designed by the Olmsted Brothers. Depending on the proposed location and depth of the storage pipes, these have a greater potential to impact historic and cultural resources. • Central Waterfront. Established in 1851, this neighborhood contains the oldest aboveground historic resources. Construction of the proposed storage pipe through this area has a higher potential for impacting aboveground historic resources due to the greater number of historic properties in the neighborhood. For belowground historic and cultural resources, the neighborhoods that would be most affected are as follows: • Ballard and Fremont/Wallingford. The historic Ballard and Fremont/Wallingford neighborhoods have a high probability to contain historic-period belowground cultural resources that could be impacted by construction of large tanks. • Montlake. The Montlake neighborhood has recorded, belowground precontact and historic cultural resources, and it has a high probability to contain additional belowground resources. Construction of three storage pipes beneath the right-of-way has the potential to impact belowground resources. • Duwamish. The Duwamish neighborhood contains several important precontact archaeological sites. Depending on project location, installation of storage pipes has a potential to affect additional belowground cultural resources, if present. • Central Waterfront. Due to multiple, historic-period regrades, the potential for belowground precontact and historic cultural resources can vary significantly from block to block. Depending on project location, the potential for encountering precontact or historic cultural resources may range from very low to very high.

Table 5-11. Summary of Potential Historic and Cultural Resources Impacts for LTCP Options

Shared Storage Option

For aboveground historic and cultural resources, the neighborhoods that would be most affected are as follows:

- Ballard, Fremont/Wallingford, North Union Bay, Montlake, and East Waterway neighborhoods. A storage tank would be built in each of these neighborhoods. Tanks would be located on private or City property and may require demolition of existing structures, including historic structures, if present.
- Central Waterfront. Same as the Neighborhood Storage Option.

For belowground historic and cultural resources, the neighborhoods that would be most affected are as follows:

- North Union Bay. The North Union Bay neighborhood contains both precontact and historic belowground cultural resources. A storage tank built in this neighborhood has the potential to affect additional belowground resources, if present.
- Montlake and Leschi neighborhoods. A shared storage tank would be built in these neighborhoods, with a greater potential to affect any belowground cultural resources than the Neighborhood Storage Option. The Montlake neighborhood contains precontact and historic archaeological sites in proximity to the waterfront. Unknown belowground resources may also exist, and impacts resulting from tank construction would be permanent and irreversible if resources are encountered during construction.
- Other neighborhoods. Same as the Neighborhood Storage Option.

Shared West Ship Canal Tunnel Option

This option has the potential for temporary impacts to numerous historic properties along the proposed tunnel alignment (vibration, dust, noise, and visual integrity). Historic structures may be more susceptible to damage from vibration. However, no permanent impacts to aboveground resources within the proposed tunnel alignment are anticipated.

For aboveground historic and cultural resources, the neighborhoods that would be most affected are as follows:

- Ballard and Fremont/Wallingford. The deep storage tunnel has the greatest potential impact to aboveground historic and cultural resources in the Ballard and Fremont/Wallingford neighborhoods. The tunnel would pass through or next to designated Seattle Landmarks and National Register-listed properties.

  Historic properties that may be impacted by the proposed tunnel alignment include but are not limited to structures, parks, and districts listed on the National Register. National Register-listed properties within the proposed tunnel alignment include Gas Works Park, Chittenden Locks, and numerous buildings, bridges, and libraries. In addition, the tunnel may impact designated Seattle Landmarks and Seattle Historic Districts such as Gas Works Park, buildings, bridges, schools, and multiple residences.
- Leschi. Same as the Neighborhood Storage Option.
- Central Waterfront. Same as the Neighborhood Storage Option.

For belowground historic and cultural resources, the neighborhoods that would be most affected are as follows:

- Ballard and Fremont/Wallingford. The greatest potential to affect belowground precontact or historic cultural resources is associated with portal construction. The neighborhoods of Fremont/Wallingford and Ballard, where portals would be built, do not contain previously recorded archaeological sites. Compared with Neighborhood Storage and Shared Storage Options, the Shared West Ship Canal Tunnel Option would involve less disturbance of geologic layers that have the potential to contain cultural resources.

Shared Ship Canal Tunnel Option

This option has a similar potential for construction impacts on historic properties as the Shared West Ship Canal Tunnel Option.

For aboveground historic and cultural resources, the neighborhoods that would be most affected are as follows:

- Montlake, Portage Bay, Fremont/Wallingford, and Ballard. The storage tunnel has the greatest potential impact to aboveground historic and cultural resources in these neighborhoods. This tunnel would be longer than the West Ship Canal Tunnel and would pass through or next to designated Seattle Landmarks and National Register-listed properties. Historic properties that may be impacted by the proposed tunnel alignment include but are not limited to structures, parks, and districts listed on the National Register. In addition, the tunnel may impact designated Seattle Landmarks and Seattle Historic Districts such as Gas Works Park, Fremont Hotel, and Ballard Avenue Historic

Table 5-11. Summary of Potential Historic and Cultural Resources Impacts for LTCP Options
District. For belowground historic and cultural resources, the neighborhoods that would be most affected are as follows: • North Union Bay, Montlake, and Fremont/Wallingford. The storage tunnel proposed between these two neighborhoods would be constructed through glacial deposits too old to contain belowground cultural resources. The greatest potential to affect any belowground precontact or historic cultural resources is associated with portal construction. Compared with the Neighborhood Storage and Shared Storage Options, which call for storage tank construction, the Ship Canal Tunnel Option would involve less disturbance of geologic layers that have the potential to contain cultural resources. Compared with the West Ship Canal Tunnel, portal construction (depending on location) in the North Union Bay neighborhood has a greater risk to affect any existing belowground precontact or historic cultural resources.

*The Neighborhood West Ship Canal Tunnel would have similar impacts in Ballard and Fremont/Wallingford as described for the Shared West Ship Canal Tunnel Option.

5.11.3 What are the potential historic and cultural resources impacts of the Integrated Plan Alternative?

In addition to construction of CSO control projects under the selected LTCP option, additional construction would occur for NDS Partnering projects and the South Park Water Quality Facility project. The street sweeping expansion program does not involve construction; therefore, no historic and cultural resources impacts are anticipated.

NDS Partnering projects constructed in public road rights-of-way of the Piper's, Thornton, and Longfellow Creek neighborhoods have the potential to encounter buried cultural resources. NDS Partnering projects have the potential to impact the setting of adjacent historic properties by changing the amount and character of vegetation.

Construction of the South Park Water Quality Facility would involve approximately one acre of surface disturbance. The facility is expected to be located in an industrial area near the Duwamish River. Depending on specific site location, construction has the potential to permanently impact any buried cultural resources which may be in the area. Depending on specific site location, construction of aboveground buildings or structures also has the potential to impact existing historic properties adjacent to the project.

5.11.4 What are the potential historic and cultural resources impacts of the No Action Alternative?

Sewer system improvements have the potential for construction impacts to historic properties depending on the locations of the improvements. Temporary construction impacts to aboveground resources typically include vibration, dust, noise, and can sometimes affect the visual integrity of a historic property. Depending on specific project location, these projects have the potential to impact belowground cultural resources. However, compared with the LTCP CSO control projects, sewer system improvements and natural drainage systems would have very low potential to impact belowground resources because they would generally be constructed in previously disturbed areas.

5.11.5 What measures are proposed to reduce or minimize impacts to historic and cultural resources?

To minimize impacts to historic and cultural resources, the City would conduct project-level cultural resource surveys prior to construction. These surveys would identify any belowground and aboveground historic and cultural resources that may be impacted by the proposed project. The City would consult with stakeholders as required by the regulatory trigger (i.e., Section 106, Washington State Governor's Executive Order 05-05, or SEPA) to avoid, minimize, and mitigate potential impacts to identified resources.

If historic properties are identified during project-level cultural resource surveys, the City would follow the applicable regulatory process to evaluate those resources for their eligibility to relevant historic registers (i.e., National Register, Washington Heritage Register, or Seattle Landmarks) and consult with stakeholders regarding resource-specific mitigation measures.

For work within City of Seattle historic districts, review by the Seattle Landmarks Preservation Board or district-specific review boards would be required. Proposed changes to a designated Seattle Landmark, or proposed work adjacent to a designated Seattle Landmark, requires review by the Seattle Landmarks Preservation Board which manages proposed changes through the Certificate of Approval process.

Under Section 106 of the National Historic Preservation Act, proposed impacts to a National Register-listed property or district would require review by DAHP (acting as Washington's State Historic Preservation Office, or "SHPO") to determine if there would be any adverse effects on listed properties.

The City would follow best management practices to reduce potential impacts to historic properties from vibration, dust, noise, and visual alterations. Practices to minimize potential vibration and dust impacts include property-specific vibration monitoring; regular washing of construction equipment, vehicles, and tires before exiting the project locations; and controlling stormwater runoff from distributing sediments onto surrounding properties. For potential visual and audible impacts that would diminish the integrity of a property's significant historic features, mitigation measures may include screening off the project location or reducing construction activity during the property's peak usage time, such as open hours for a park or church.

5.12 Transportation

The description of potential transportation impacts provided in this Draft EIS is programmatic. The types of impacts that could be expected from implementation of the Plan alternatives are generally discussed, but site-specific impacts are not evaluated. Site-specific, project-level transportation analysis would be conducted prior to implementation of each project.

Key Findings

Transportation

Construction of CSO control projects under the *LTCP Alternative* or *Integrated Plan Alternative* would result in moderate to substantial, adverse transportation impacts for temporary periods ranging from one to seven years. Potential construction-related transportation impacts would be highly visible and are of concern to local residents, business owners, and commuters. Transportation impacts would include increases in traffic volumes due to construction-generated truck trips and commute trips of construction workers, and roadway lane and sidewalk closures where construction activities take place.

The primary differences in potential transportation impacts of the LTCP options are related to the length of construction period, the estimated number of truck trips, and the road network in the affected neighborhood. More dispersed impacts would occur under the Neighborhood Storage Option. Impacts would be higher but concentrated at fewer locations under the shared options.

For the tunnel options, if the tunnel portals are located near Lake Washington, Elliott Bay, or the waterway that connects them, it could be possible to transport excavated material by barge rather than by truck. This would reduce truck trips on the surrounding roadway system related to tunnel excavation.

5.12.1 What potential construction impacts are common to all of the alternatives?

The following sections describe the general types of transportation impacts that could occur with the range of CSO control projects proposed as part of all four LTCP options.

5.12.1.1 Construction Truck Trips

Construction activities that generate truck trips include mobilization of construction equipment and materials to the site, transport of excavated material away from the site, and demobilization of construction equipment away from the site when construction is complete. The expected number of truck trips generated by construction activities varies greatly among the options. For example, 300 total truck round trips may be generated for minor conveyance construction, while over 106,000 total truck round trips may be generated to construct the Shared Ship Canal Tunnel.

Construction truck routes typically follow the most direct paths to and from the regional highway system using arterial streets. Construction transportation is often limited during commuter peak periods (typically the most congested hours of the day) to reduce construction truck delays due to commuter congestion and in some cases to minimize their impact on roadway operations.

The duration over which construction-generated traffic would occur also would vary. Some storage projects may require one year or less to construct, while the Shared Ship Canal Tunnel may require up to seven years. Construction of sewer system improvements would result in minor transportation impacts, similar to those described with the No Action Alternative. Figure 5-11 shows total estimated truck trips by Plan neighborhood area under each LTCP option. The differences in the number of truck trips expected among the options are further described in the following sections.

LTCP Options

ESTIMATED TRUCK TRIPS[1] BY NEIGHBORHOOD

A - NEIGHBORHOOD STORAGE OPTION[2]

Neighborhood area	Approximate Number of Truck Trips
1 SHIP CANAL NEIGHBORHOODS	51,500
2 LAKE WASHINGTON NEIGHBORHOODS	4,500
3 ELLIOTT BAY/LAKE UNION NEIGHBORHOODS	900
4 LONGFELLOW CREEK/DUWAMISH NEIGHBORHOODS	6,200

B - SHARED WEST SHIP CANAL TUNNEL OPTION[3]

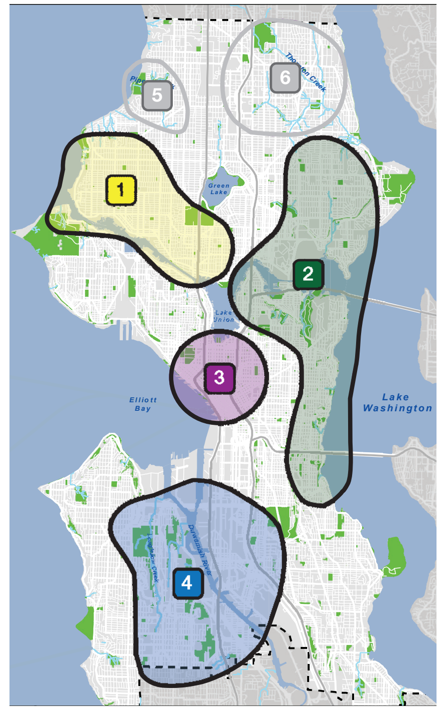
Neighborhood area	Approximate Number of Truck Trips
1 SHIP CANAL NEIGHBORHOODS	51,900
2 LAKE WASHINGTON NEIGHBORHOODS	4,300
3 ELLIOTT BAY/LAKE UNION NEIGHBORHOODS	900
4 LONGFELLOW CREEK/DUWAMISH NEIGHBORHOODS	3,700

C - SHARED SHIP CANAL TUNNEL OPTION[4]

Neighborhood area	Approximate Number of Truck Trips
1 WEST SHIP CANAL TUNNEL OPTION	100,000
2 LAKE WASHINGTON NEIGHBORHOODS	6,000
3 ELLIOTT BAY/LAKE UNION NEIGHBORHOODS	500
4 LONGFELLOW CREEK/DUWAMISH NEIGHBORHOODS	7,000

D - SHARED STORAGE OPTION[5]

Neighborhood area	Approximate Number of Truck Trips
1 SHIP CANAL NEIGHBORHOODS	24,000
2 LAKE WASHINGTON NEIGHBORHOODS	33,000
3 ELLIOTT BAY/LAKE UNION NEIGHBORHOODS	900
4 LONGFELLOW CREEK/DUWAMISH NEIGHBORHOODS	4,700



1 SHIP CANAL
2 LAKE WASHINGTON
3 ELLIOTT BAY/LAKE UNION
4 LONGFELLOW CREEK/DUWAMISH

LEGEND

Approximate Number of Truck Trips

1 City-only and shared facilities only; all details approximate.
2 9 King County-only CSO facilities would also be constructed.
3 8 King County-only CSO facilities would also be constructed.
4 6 King County-only CSO facilities would also be constructed.
5 6 King County-only CSO facilities would also be constructed.

SOURCE: SPU, 2013; CH2M Hill, 2013.

Figure 5-11. LTCP Options Estimated Truck Trips by Neighborhood Area.

Storage Pipes

Total construction truck trips are expected to range from 500 to 2,600 at each storage pipe construction location, depending on the diameter and length of the pipe. With storage pipe construction lasting generally between 1.5 to two years at each location, an average of approximately 1 to 6 truck round trips per day would occur at each location. However, during peak construction activities, up to 24 truck round trips per day could occur. This range of volumes is low compared to typical background traffic on city arterials. Average increases of 1 to 3 round trips per hour are not expected to adversely affect roadway operations and would not likely be noticeable to other drivers.

Storage Tanks

Total construction truck round trips are expected to range from 2,000 to 16,200 at each location, depending on the size of the tank. With expected construction duration of two to five years at each location, this averages to about 4 to 16 truck round trips per day per neighborhood location. However, during peak construction activities, 20 to 80 truck round trips per day could occur. The truck volumes generated by storage tank construction would be relatively low compared to typical background traffic on city arterials. Average increases of 1 or 2 round trips per hour are not expected to adversely affect roadway operations and would not likely be noticeable to other drivers. Increases of up to 10 round trips per hour during peak activity are also not expected to affect roadway operations, but they could be noticeable to other drivers.

Storage Tunnels

Total construction trips are expected to be over 60,000 truck round trips for the Shared West Ship Canal Tunnel Option and over 106,000 truck round trips for the Shared Ship Canal Tunnel Option. In addition to truck trips generated by excavation that would primarily be generated at the tunnel entrances, these options include pipeline, pump station, and micro-tunnel elements that would generate trips in several neighborhoods. With expected construction duration of about 3.5 years, truck trips generated by the Shared West Ship Canal Tunnel excavation are expected to average approximately 40 truck round trips per day, with about 60 round trips per day occurring during times of peak activity. With expected construction duration of about six to seven years, truck trips generated by the Shared Ship Canal Tunnel excavation are expected to average approximately 50 truck round trips per day, with about 100 round trips per day occurring during times of peak activity. (Truck trip impacts were calculated using a six-year construction period, to be conservative.) Increases of 5 to 13 round trips per hour are relatively low compared to typical background traffic on city arterials and are not expected to adversely affect roadway operations. However, at the upper end of the range, the truck trips could be noticeable to other drivers. Depending on the access location, the potential hourly volume of trucks could require supplemental traffic control (such as flaggers, signage, or temporary signals).

The pipeline, pump station, and micro-tunnel elements associated with the tunnel options are expected to generate truck trips in the neighborhoods where they would be constructed. Construction duration of these elements is expected to range from six months to two years. Pipeline construction is expected to generate an average of 6 to 10 round truck trips per day, with up to 18 round trips per day occurring during peak construction activity. Pump station construction is expected to generate an average of 1 to 5 round truck trips per day, with up to 10 round trips per day occurring during peak construction activity. Micro-tunnel construction is expected to generate an average of 3 to 7 round truck trips per day, with 18 to 60 round trips occurring during peak construction activity. The truck volumes generated by construction of these elements would be relatively low compared to typical background traffic on city arterials. Average increases of 1 or 2 round trips per hour are not expected to adversely affect roadway operations and would not likely be noticeable to other drivers. Increases of up to 8 round trips per hour during peak activity are also not expected to affect roadway operations, but they could be noticeable to other drivers.

Flow Transfers and Flow Diversions

Total construction truck trips are expected to range from 300 to 1,100 at each flow transfer or flow diversion construction location. With construction lasting one year or less at each location, this averages to about 3 to 4 truck round trips per day per neighborhood location. However, during peak construction activities, 12 to 16 truck round trips per day could occur. This range of volumes is low compared to typical background traffic on city arterials. Average increases of 1 to 2 round trips per hour are not expected to adversely affect roadway operations and would not likely be noticeable to other drivers.

5.12.1.2 Construction Employee Commute Trips

Construction activities generate commute trips for construction workers who travel to and from the sites. Because the neighborhood areas are located in urban settings where parking may be limited or priced, it is expected that construction employee vehicle trips would be limited only to the number that can park within the construction staging area, and that workers may either travel via transit or be shuttled from an offsite location such as a park-and-ride lot.

5.12.1.3 Road Closures and Associated Traffic, Transit, Non-Motorized Impacts, and Parking Impacts

Storage Pipes

Storage pipes would be located within roadway rights-of-way, requiring excavation beneath roadway lanes on existing city streets. Installation of pipes ranging from 4 to 5 feet in diameter may require closure of only one traffic lane, but installation of larger diameter pipes (10 to 12 feet) could require two lanes to be closed. In addition, construction could temporarily reduce on-street parking, require transit route detours, and require closure of sidewalks and bicycle lanes located within or adjacent to the project footprint. The potential for impact varies depending on the street type. For example, many local access streets are narrow (often 25 feet wide), so lane closures may also affect on-street parking in the vicinity of construction activities. In addition, local access streets typically have a higher density of driveways, so maintaining access to homes and businesses during construction would typically be more challenging on local access streets than on arterial streets. Pavement on local access streets is typically designed to carry lower traffic volumes and lighter vehicles, so it would be expected to deteriorate more quickly with construction truck traffic.

For arterials that have more than one lane in each direction (including both travel and parking lanes), it may be feasible to close one or more lanes and still maintain traffic flow on the roadway without requiring a detour. However, arterial streets also carry higher traffic volumes and provide the primary means for vehicle traffic traveling through a neighborhood. Transit routes and stops are typically located on arterial streets. Lane closures on high-volume arterials can result in congested conditions and traffic delays. Arterials also provide local access (via driveways) to homes and businesses located along them; lane closures and street excavation must be implemented in a way that maintains local access to adjacent properties. Pavement on arterial streets is typically designed to carry higher traffic volumes and heavier vehicles, so it would better accommodate construction truck traffic.

Neighborhoods with a limited number of route alternatives, such as those that do not have a grid network of arterials or local access streets, would likely be more severely impacted by lane or road closures. Lane closures or full closures of streets in these areas could result in adverse impacts to residents and businesses.

Depending on the characteristics of a road, construction within a traffic lane could require that the sidewalk and/or bicycle facilities adjacent to the segment under construction be narrowed or closed. If sidewalks are present on both sides of a street, pedestrians could be detoured to the sidewalk across the street. If not, it would be necessary to delineate a pedestrian pathway that separates them from construction activities. Special accommodations would be needed to retain pedestrian access to homes and businesses along the construction route if a sidewalk is closed. If a street has a separate bicycle lane or marked sharrows, it may experience a higher level of bicycle traffic. However, regardless of whether marked bicycle facilities exist, lane closures and detours would also need to be designed in a way to safely accommodate bicycle traffic.

If a lane closure occurs on a street with transit service, transit routes may need to be detoured. Transit stops may need to be temporarily closed or relocated. In addition, special accommodations would be needed if construction occurs within streets with transit infrastructure such as overhead trolley lines or raised transit stop islands.

It is likely that on-street parking would need to be prohibited along a roadway segment under construction. This would reduce the publicly available parking supply in the area during the construction period. The level of impact resulting from a reduction of on-street parking supply would vary depending on the neighborhood. For neighborhoods where on-street parking is the primary source of supply and parking utilization is high, the impact would be greater. In neighborhoods with excess available on-street parking supply, the impact would be minimal.

Storage Tanks

Storage tanks would be located on city or private property outside of the roadway right-of-way and generally would not require extensive excavation in city streets. It is possible that street lanes and sidewalks located adjacent to the tank sites would need to be closed or narrowed during construction of connections. This would result the same types of potential impacts as those described for the storage pipes, but to a less extensive degree.

Storage Tunnels

The storage tunnels would be excavated with a tunnel boring machine. Excavation would not be necessary in city streets except possibly at the tunnel entrance portals. It is possible that street lanes and sidewalks located adjacent to the tunnel endpoints would need to be closed or narrowed during construction. This would result in the same types of potential impacts as those described for the storage pipes, but to a less extensive degree.

The pipeline and micro-tunnel elements associated with the storage tunnel options would require in-street construction, similar to that described above for storage pipes. Pump stations would be located outside of roadway right-of-way, with potential impacts similar to those described for storage tanks.

Flow Transfers and Flow Diversions

Flow transfers and flow diversions would require minor construction. It is possible that minor in-street construction would occur, requiring street lanes and sidewalks to be closed or narrowed during construction. This would result in the same types of potential impacts as those described for the storage pipes, but with less extensive construction duration and intensity.

5.12.2 What are the potential transportation impacts of the LTCP options?

Table 5-12 summarizes the general types of transportation impacts that could occur with the type of CSO control projects proposed under all four LTCP options. Each of the four LTCP options would cause different levels of impacts to different neighborhoods. Figures 5-6 through 5-9 summarize the total construction truck round trips estimated to be generated by the LTCP options within the potentially affected neighborhoods.

Table 5-12. Summary of Potential Transportation Impacts for LTCP Options

Neighborhood Storage Option*

The Neighborhood Storage Option would have a high level of overall transportation impact. It would require extensive roadway lane and sidewalk closures throughout the city to accommodate storage pipe and tank construction from the City and King County independently constructed CSO storage facilities.

The neighborhoods that would be most affected are as follows:

- Ship Canal Neighborhoods. Construction of storage tanks in the Ballard and Fremont/Wallingford neighborhoods would result in an estimated 12,000 truck round trips (average 9 truck round trips per weekday over a 5-year duration) in Ballard, and an estimated 7,000 total truck round trips (average 13 truck round trips per weekday over a 3.5-year duration in Fremont/Wallingford). However, during periods of peak activity, up to 45 truck round trips per day could occur. The majority of the truck travel to and from these neighborhoods could be made using arterials. In addition, these neighborhoods have a grid of arterial and local access streets that could provide detour opportunities where lane closures are necessary. Trucks traveling to and from Ballard would have the farthest to travel of the three neighborhood areas to access the regional highway system, and their routes could potentially include arterials through the Fremont, Wallingford, or Green Lake neighborhoods. In Magnolia, installation of storage pipe within the right-of-way would require approximately 530 linear feet of roadway lane closure and potentially adjacent sidewalk closures, lasting about 1.5 years. The total 600 truck round trips generated would average to about 2 truck round trips per weekday, occurring at points along the length of the pipeline. However, during periods of peak activity, up to 8 truck round trips per day could occur. Topographical constraints limit access to and through the neighborhood, and there would be a limited number of route alternatives if detours due to lane closures were needed.
- Lake Washington Neighborhoods. Work to construct storage pipes in Leschi, Portage Bay and Montlake, and an additional storage tank in Leschi, would require work in road right-of-way and potential lane and sidewalk closures, lasting about 1.5 to 2 years. The length of storage pipe is anticipated to be up to 210 feet in each neighborhood. The total 900 to 2,000 truck round trips generated in each neighborhood would average 2 to 4 truck round trips per weekday, occurring at points along the length of the pipelines. However, during periods of peak activity, up to 8 truck round trips per day could occur in Portage Bay, 16 round trips in Montlake, and up to 20 round trips in Leschi. Topographical constraints limit access to and through these neighborhoods, and there would be a limited number of route alternatives if detours due to lane closures were needed. In the North Union Bay area, this option would require minor improvements to the existing sewer system, which would generate minimal transportation impacts.
- Longfellow Creek/Duwamish Neighborhoods. Work to construct storage pipes in North Delridge, South Delridge and Duwamish, and a storage tank in East Waterway would require work in road right-of-way and potential lane and sidewalk closures, lasting about 1.5 to 2 years. The total 500 to 2,600 truck round trips generated in each neighborhood would average 1 to 6 truck round trips per weekday, occurring at points along the length of the pipelines. However, during periods of peak activity, 4 to 8 truck round trips per day could occur in North Delridge and Duwamish, and up to 25 truck round trips per day could occur in South Delridge and East Waterway. The majority of the truck travel to and from these neighborhoods could be made using arterials. In addition, these neighborhoods have a grid of arterial and local access streets that could provide detour opportunities where lane closures are necessary.
- Central Waterfront. Installation of storage pipe within the right-of-way would require approximately 600 linear feet of roadway lane closure and potentially adjacent sidewalk closures, lasting about 2 years. The total 900 truck round trips generated would average to about 2 truck round trips per weekday, occurring at points along the length of the pipeline. However, during periods of peak activity, up to 8 truck round trips per day could occur. The majority of the truck travel to and from these neighborhoods could be made using arterials. In addition, this neighborhood has a grid of arterial streets that could provide detour opportunities where lane closures are necessary.

Table 5-12. Summary of Potential Transportation Impacts for LTCP Options

Shared Storage Option

The shared tanks constructed with the Shared Storage Option would eliminate or reduce the facilities needed in the Leschi and Montlake areas, compared to the Neighborhood Storage Option, but would increase transportation impacts in the Fremont/Wallingford and North Union Bay areas. In East Waterway, this option would require in-street construction, compared to construction of a storage tank with the Neighborhood Storage Option.

Total construction truck round trips are estimated to range from 11,000 to 16,200 at each neighborhood tank location, depending on the size of the tank. With expected construction duration of 3 to 4.5 years at each location, this averages to about 13 to 18 truck round trips per day per neighborhood location. However, during periods of peak construction activity, 65 to 80 truck round trips per day could be generated at the storage tank sites, which is higher than the expected peak activity at the tank sites with the Neighborhood Storage Option.

The neighborhoods that would be most affected are as follows:

- Fremont/ Wallingford. Storage tank construction would generate more truck trips than the Neighborhood Storage Option – 11,000 total truck round trips over 3 years averages to 14 round trips per day.
- North Union Bay. Construction of a shared storage tank would generate 16,200 truck trips over 4 years – an average of 16 truck trips per weekday generated at the tank site.
- Montlake. Construction of a shared storage tank would result in increased truck trips at the tank site (15,600 total truck round trips over 4.5 years, average 13 per day), compared to the storage pipes that would be constructed with the Neighborhood Storage Option. However, less in-street work and fewer lane closures would be needed. Due to limited arterials in this area combined with topographical constraints, this option would have less impact on Montlake than the Neighborhood Storage Option because it would not require major lane closures or detours.
- East Waterway. Minor in-street construction would potentially occur, requiring street lanes and sidewalks to be closed or narrowed during construction. About 1,100 total construction truck round trips are expected over a 1-year period, averaging about 4 truck round trips per day. However during periods of peak construction activity, up to 16 truck round trips per day could occur. This is lower than the 5 to 25 truck trips per day expected to result from storage tank construction under the Neighborhood Storage Option.
- Other neighborhoods. In Leschi, the shared storage tank would eliminate the need for storage pipe; therefore, transportation impacts would be reduced relative to the Neighborhood Storage Option. Transportation impacts in the Ballard, Magnolia, Portage Bay, North and South Delridge, Duwamish, and Central Waterfront areas would be similar to the Neighborhood Storage Option.

Shared West Ship Canal Tunnel Option

Elements of the Shared West Ship Canal Tunnel Option that would generate truck trips include tunnel excavation and construction of supporting pipeline, pump station and micro-tunnels. An estimated 60,000 truck round trips are anticipated for the Shared West Ship Canal Tunnel Option, generated primarily in Ballard. Overall, this option would result in substantially more truck trips over a longer period in Ballard compared to the Neighborhood Storage and Shared Storage Options.

The neighborhoods that would be most affected are as follows:

- Ballard. Truck trips resulting from tunnel excavation would primarily be generated at the launch portal location, which would likely be located in Ballard. With expected construction duration of 3.5 years, truck trips generated by the tunneling are expected to average 40 per day, with up to 60 round trips per day occurring during periods of peak construction activity. Supporting pipeline construction is expected to generate an average of 6 truck round trips per day, and up to 18 round trips per day during peak construction activity. Pump station construction is expected to generate an average of 1 truck round trip per day, and up to 2 truck round trips per day during peak construction activity. Micro-tunnel construction would generate an average of 5 truck round trips per day, and up to 54 round trips during peak construction activity, spread out among four locations in Ballard. The majority of the truck travel to and from Ballard could be made using arterials.
- Fremont/Wallingford and Magnolia. The majority of truck trips in the Ship Canal Neighborhoods are expected to be generated in Ballard. Transportation impacts in Fremont/Wallingford and Magnolia with this option would be lower than impacts with the Neighborhood Storage Option or Shared Storage Option.
- Other neighborhoods. The transportation impacts in all other neighborhoods would be the same as the Neighborhood Storage Option.

Table 5-12. Summary of Potential Transportation Impacts for LTCP Options
Shared Ship Canal Tunnel Option
The Shared Ship Canal Tunnel Option would replace the storage tanks and pipes in the Ship Canal and Lake Washington Neighborhoods (under the Neighborhood Storage Option) with a large tunnel across the length of the Ship Canal. Elements of the Shared Ship Canal Tunnel Option that would generate truck trips include tunnel excavation and construction of supporting pipeline, pump stations, and micro-tunnels in the Ship Canal and Lake Washington Neighborhoods. An estimated 106,000 truck round trips are anticipated for the Shared Ship Canal Tunnel Option. Overall, this option would result in substantially more truck trips over a longer period south of the Lake Washington Ship Canal, where the launch portal would likely be located, compared to the other options. The neighborhoods that would be most affected are as follows: • Ship Canal Neighborhoods. Truck trips resulting from tunnel excavation would primarily be generated at the launch portal location, which would likely be located on the south side of the Lake Washington Ship Canal. With estimated construction duration of 7 years, truck trips generated by the tunneling are expected to average up to 50 per day. Up to 100 round trips per day would occur during periods of peak construction activity. The majority of the truck travel to and from the area could be made using arterials. Supporting pipeline, pump station, and micro-tunnel construction would generate additional truck trips. Supporting pipeline construction is expected to generate an average of 10 truck round trips per day in Ballard and Fremont, and up to 18 round trips per day during peak construction activity. Pump station construction is expected to generate an average of 1 to 2 truck round trips per day, and up to 10 truck round trips per day during peak construction activity, at two locations in Ballard. Micro-tunnel construction would generate an average of 6 truck round trips per day, and up to 59 round trips during peak construction activity, spread out among 13 locations in Ballard. • Lake Washington Neighborhoods. Supporting pipeline construction is expected to generate an average of 10 truck round trips per day, and up to 18 round trips per day during peak construction activity, in North Union Bay, Montlake, and Leschi. Pump station construction is expected to generate an average of 1 to 5 truck trips per day, and up to 10 truck trips per day during peak construction activity, at one location in Montlake and one location in Leschi. Micro-tunnel construction would generate an average of 3 to 7 truck round trips per day, and 18 to 37 round trips during peak construction activity, spread out among two locations in Montlake, two locations in Portage Bay, and five locations in North Union Bay. • North Delridge. About 1,200 total construction truck round trips are expected to be generated over a 1-year period, averaging about 5 truck round trips per day. However, during periods of peak construction activity, up to 20 truck round trips per day could occur. This is higher than the 2 to 8 truck trips per day expected to result from storage pipe construction under the other options. • Duwamish. About 3,000 total construction truck round trips are expected to be generated over a 1-year period, averaging about 12 truck round trips per day. However, during periods of peak construction activity, up to 48 truck round trips per day could occur. This is higher than the 1 to 4 truck trips per day expected to result from storage pipe construction under the other options. • Other neighborhoods. Transportation impacts in the Magnolia neighborhood would be the same as for the Shared West Ship Canal Tunnel Option. In the South Delridge, East Waterway, and Central Waterfront areas, the transportation impact would be the same as for the Neighborhood Storage Option.

*The Neighborhood West Ship Canal Tunnel would have similar impacts in Ballard and Fremont/Wallingford as described for the Shared West Ship Canal Tunnel Option.

Notes:

Average and peak truck trip estimates are round trips – each round trip reflects one inbound and one outbound trip. While average trips per day are presented, it is likely that the number of daily truck trips would fluctuate according to the construction activities that occur from day to day, with the estimated peak numbers reflecting the highest volumes expected. Average and peak trips per day assume that construction would occur on weekdays (260 days per year).

5.12.3 What are the potential transportation impacts of the Integrated Plan Alternative?

Under the Integrated Plan Alternative, completion of selected CSO control projects under the LTCP would be deferred so that the City can focus on implementing stormwater projects. As a result, construction impacts associated with certain CSO control projects in Delridge, East Waterway, Duwamish, Portage Bay, and Montlake neighborhoods would occur later (after 2028) under the Integrated Plan Alternative. Consequently, those neighborhoods would experience fewer near-term construction-related transportation impacts.

NDS Partnering would occur in neighborhoods in the Piper's Creek, Thornton Creek, and Longfellow Creek areas. Neighborhoods would voluntarily sign up for the project, and areas would be identified for construction of bioretention facilities that may also include traffic calming and other local street improvements. Potential impacts related to construction would be short-term and localized, including a small number of construction vehicle trips, and lane or sidewalk narrowings or closures adjacent to construction activities.

The South Park Water Quality Facility is expected to be constructed on City-owned property, in an industrially zoned neighborhood with adequate access. Construction impacts would primarily consist of a small number of construction vehicle trips and are expected to be minimal.

Arterial street sweeping expansion does not involve construction and consists of expanding the extent of a program that is already in place. No construction impacts are expected.

5.12.4 What are the potential transportation impacts of the No Action Alternative?

Construction of sewer system improvements would generally occur within underground vaults/chambers at existing CSO or stormwater facilities, and to a lesser extent within street rights-of-way. Temporary lane closures could be required at these access locations, but they would expected to be localized and of short duration. These projects could also generate a small number of construction truck trips.

A small number of truck trips could be generated during installation of natural drainage systems completed as part of ongoing programs. Construction of rain gardens within the public right-of-way could require short-term lane closures. Each roadside rain garden would be expected to generate up to 10 truck trips over a construction period that could last up to five days. Short-term lane closures, if required, would be limited to a day or two.

A very small number of truck trips (less than 10) would be generated under the RainWise program. These projects are typically constructed at the parcel scale rather than at a block-level scale as with roadside rain gardens. No disturbance of roadways or sidewalks would occur with construction of RainWise projects and transportation impacts are expected to be negligible.

5.12.5 What measures are proposed to reduce or minimize transportation impacts?

As described earlier, site-specific transportation analysis would be conducted prior to implementation of projects. If potential operational or safety impacts are identified through project-level analysis, mitigation measures would be identified to minimize or avoid those impacts. Transportation-related mitigation measures would depend on the exact type and size of the proposed improvement but could include the following.

- Develop a Traffic Control Plan for any work within the public right-of-way that affects vehicular, transit, bicycle, or pedestrian traffic.

- Avoid creating additional delay at congested intersections either by choosing construction truck routes that avoid these locations, or constructing during nonpeak times of day.
- Maintain access for driveways and private roads.
- Provide adequate off-street parking areas at designated staging areas for construction-related vehicles.
- Provide onsite loading areas for removal and delivery of material.
- Provide a plan for construction workers to commute via alternative modes or ridesharing, to minimize added vehicle trips and parking demand at the site.
- Maintain pedestrian and bicycle access and circulation during project construction. If construction encroaches on a sidewalk, a safe detour should be provided for pedestrians at the nearest crosswalk. If construction encroaches on a bike lane, post warning signs that indicate bicycles and vehicles are sharing the roadway.
- Provide traffic controls such as flaggers and traffic control officers as appropriate.
- Maintain access to transit services and coordinate with transit agencies (King County Metro, Sound Transit, Community Transit) if transit stop closures or route detours are needed.
- Coordinate with the Seattle School District to ensure that access to school buses is maintained.
- Post standard construction warning signs in advance of the construction area and at any intersection that provides access to the construction area.
- Provide access for emergency vehicles at all times.
- Provide written notification to contractors regarding appropriate routes to and from construction sites, and weight and speed limits for local roads used to access construction sites.
- Coordinate with the local neighborhoods to ensure that access to residences and businesses is adequately maintained, and that any additional potential issues unique to the neighborhood are identified and addressed.
- Repair or restore the roadway right-of-way to its original condition or better upon completion of the work.
- Comply with Seattle Department of Transportation (SDOT) requirements to schedule work on arterial streets and sidewalks outside of peak traffic hours unless otherwise authorized by the City Traffic Engineer.
- Follow the Holiday Moratorium for construction, which indicates that no work shall be scheduled on streets or sidewalks within the Central Retail District and Pioneer Square from Thanksgiving Day through New Year's Day.

Transportation-related mitigation measures specific to the Shared West Ship Canal Tunnel and Shared Ship Canal Tunnel Options could include the following:

Barge Transport of Excavated Materials for Shared West Ship Canal Tunnel Option and Shared Ship Canal Tunnel Option. If the tunnel portals are located near Lake Washington, Elliott Bay, or the waterway that connects them, it could be possible to transport excavated material by barge rather than by truck. This could eliminate an estimated 16,000 truck round trips (average 40 and peak 60 truck round trips per day, for a 1,200-weekday duration) for the Shared West Ship Canal Tunnel Option, and an estimated 32,000 truck round trips (average 50 and peak 100 truck round trips per day, for a 1,810-weekday duration) for the Shared Ship Canal Tunnel Option. When the eliminated truck trips are divided by day and by hour, barging would cause a moderate reduction in impacts on roadway traffic operations. The number of trucks removed from roadways would be high enough to be noticeable to drivers, as well as to residents and businesses located along truck haul routes. Using barging as mitigation would require additional evaluations at the project level to determine feasibility of constructing ancillary facilities, including a conveyor system and a dock to support the barge, and to assess agency permit/approval feasibility. Based on preliminary Plan-level information, barge transport would involve an estimated 3 barge trips per week during active tunneling. The barges would act as normal marine traffic through the Ship Canal, Ballard Locks, and Puget Sound.

5.13 Utilities

This section describes the types of impacts that could occur to utilities (largely wastewater and water utilities) within the Plan area during construction of projects included under the Plan alternatives. Potential impacts to other utilities including water, electrical, natural gas, and communications are highly project-specific and would be evaluated at the future project implementation stage.

Key Findings

Utilities

Construction of CSO control facilities under the *LTCP Alternative* would occur in areas highly constrained by existing underground and overhead utilities, requiring extensive coordination with existing utilities to avoid conflicts. The primary difference in impacts among the options relates to the number of new storage facilities constructed and the amount of new conveyance (pipelines) required to transport flows to the new storage facilities. Several of the options include flow diversions to King County facilities. Coordination with King County would be needed to ensure minimal impacts to King County facilities during construction. It would also be important to coordinate with SPU to ensure that construction impacts to major water mains are avoided.

Under the *Integrated Plan Alternative*, localized belowground utilities could be affected by conveyance line construction for the South Park Water Quality Facility. There may be minor utility conflicts associated with NDS Partnering projects.

5.13.1 What potential construction impacts are common to all of the alternatives?

Construction of storage tanks, pipes, tunnels, pump stations, and appurtenant facilities will require extensive coordination with existing utilities. The LTCP is proposed to be constructed in an area that is heavily developed, with a full range of underlying utilities, including electrical power, cable, natural gas, storm and sanitary sewer, water, and others. During project design, City engineers will identify all existing utilities and attempt to avoid impacts to utilities to the extent possible. However it is not likely that the projects will be able to be constructed without encountering utility conflicts. The City will work with affected utilities to coordinate construction. Construction of combined sewer system improvements would involve building new portions of the system (e.g., new sewer pipes to convey flows to CSO storage facilities). This construction would not interrupt sewer service to existing customers.

In general, the potential to affect existing utility corridors is lower for construction of tunnels because they are constructed deeper underground, below most utilities. Local connections to the tunnel and pump stations would have the potential to encounter utilities at shallow depths. Conveyance connections to the tunnels and portal construction have the potential for surface disturbance and accompanying impacts to utilities.

Because the City's wastewater collection system sends wastewater flows to King County for treatment, it will be important for any construction-related flow modifications to be coordinated closely with King County. Ongoing discussions with King County will continue, and agreements will be negotiated prior to implementing the LTCP, as described in Section 5.13.5.

5.13.2 What are the potential utilities impacts of the LTCP options?

All of the LTCP options have the potential to result in utilities conflicts during construction, as described in Table 5-13.

Table 5-13. Summary of Potential Utilities Impacts for LTCP Options
Neighborhood Storage Option*
This option has the greatest number of City and King County independently constructed CSO storage facilities. Construction of tanks and pipes distributed throughout the Plan area would have substantial potential for impacts to utilities due to the magnitude of excavation, dewatering, and special construction requirements, such as installation of shoring (sheet piles). Storage tank and storage pipe construction would result in an approximate 7.5 acres of surface disturbance. The neighborhoods that would be most affected are as follows: • Ship Canal Neighborhoods. Large storage tanks and accompanying pipeline conveyance would be built in both the Ballard and Fremont/Wallingford neighborhoods, resulting in approximately 2 acres of surface disturbance at each site. The construction would occur in highly urbanized areas, resulting in potential for utility conflicts. Extensive coordination with existing utility providers would be required. • Lake Washington Neighborhoods. Three pipes, one storage tank, and associated pump stations would be constructed in Leschi. This neighborhood includes steep slope areas, which will limit construction options. Building in existing roadways and rights-of-way will have high potential for utility conflicts. • Longfellow Creek/Duwamish Neighborhoods. Three pipes and associated pump stations would be constructed in North and South Delridge neighborhoods, with accompanying utility conflicts. • East Waterway. One tank would be constructed in East Waterway, resulting in approximately 1 acre of surface disturbance.
Shared Storage Option
While construction of storage tanks and storage pipes under this option would result in approximately 12 acres of surface disturbance (the highest of all the LTCP options), overall impacts would be reduced compared to the Neighborhood Storage Option because the shared tanks would eliminate the need for several City and King County independently constructed CSO storage facilities. As noted for the Neighborhood Storage Option, all potentially affected neighborhoods are highly developed, and utility conflicts will be difficult to avoid. The neighborhoods that would be most affected are as follows: • Ship Canal Neighborhoods. Impacts of shared storage tanks would be similar to but greater than the Neighborhood Storage Option because the Fremont/Wallingford tank would be larger. • Montlake. A shared storage tank with up to 2 acres of surface disturbance would be constructed. These neighborhoods contain steep slopes, which will constrain the location of tanks and pipes and could create potential for utility conflicts. • Other neighborhoods would experience similar level of impacts as under the Neighborhood Storage Option except the East Waterway neighborhood, where a flow transfer with limited conveyance construction would replace the storage tank and cause potentially fewer utility impacts.
Shared West Ship Canal Tunnel Option
The Shared West Ship Canal Tunnel Option would result in total surface disturbance of 7 acres. Overall potential impacts to utilities would be reduced compared to the Neighborhood Storage Option as this option eliminates City and King County independently constructed CSO storage facilities that would otherwise be constructed in the same neighborhoods. The neighborhoods that would be most affected are as follows: • Ballard and Fremont/Wallingford**.** The storage tunnel would cause less surface disturbance than storage tanks, with disturbance limited to 4 acres split between the entry and exit portals. Potential impacts to utilities would be concentrated at the portals. • Leschi. Impacts of constructing three pipes, one tank, and associated pump stations in the confined neighborhood would have generally the same potential impacts to utilities as the Neighborhood Storage Option. • Other neighborhoods would have similar impacts as the Neighborhood Storage Option except in Magnolia and East Waterway. In Magnolia, a flow diversion to King County facilities would replace the storage pipe but would result in similar potential impacts to utilities. The East Waterway area would have the same flow diversion as under the Shared Storage Option.

Table 5-13. Summary of Potential Utilities Impacts for LTCP Options
Shared Ship Canal Tunnel Option
Compared to all other LTCP options, the Shared Ship Canal Tunnel Option would have the fewest City and King County independently constructed CSO storage facilities, and therefore the lowest level of surface disturbance and accompanying impacts to utilities. The neighborhoods that would be most affected are as follows: • Ship Canal and Lake Washington Neighborhoods. Major construction impacts and potential utility conflicts would occur at the portal locations (up to 4 acres of disturbance). • Other neighborhoods would have similar impacts or reduced impacts as compared to the Neighborhood Storage Option.

*The Neighborhood West Ship Canal Tunnel would have similar impacts in Ballard and Fremont/Wallingford as described for the Shared West Ship Canal Tunnel Option.

5.13.3 What are the potential utilities impacts of the Integrated Plan Alternative?

Impacts to public utilities under the Integrated Plan Alternative would be associated with localized belowground utilities potentially affected by conveyance line construction for the South Park Water Quality Facility. There may be minor utility conflicts associated with NDS Partnering projects.

5.13.4 What are the potential utilities impacts of the No Action Alternative?

Under the No Action Alternative, construction-related impacts to public utilities would occur under ongoing programs. However, impacts would be lower than those expected to occur under the LTCP or Integrated Plan Alternatives.

5.13.5 What measures are proposed to reduce or minimize impacts to utilities?

For both the LTCP Alternative and the Integrated Plan Alternative, the City would take measures to help reduce or eliminate potential impacts to utilities. The measures would include, but are not limited to, those listed below:

- Coordinate with other utilities and transportation departments to plan for shared construction and to avoid consecutive construction projects (CSO control projects, road construction, other underground utilities).
- Provide advance notice and coordinate with affected utilities to minimize disruption of services.
- Adhere to the City's design criteria for the clearance of water mains and other utilities as outlined in Section 1-07.17 of the City of Seattle's Standard Specifications for Road, Bridge and Municipal Construction.
- For all LTCP options, the City would work together with King County to analyze and mitigate downstream operational and capital impacts to the King County System. If downstream impacts cannot be successfully mitigated, then there is the potential that the County will be required to build new or larger downstream capital facilities to accommodate the LTCP options. Even with adequate mitigation though, there would likely be an increase in the County's operations & maintenance (O&M) costs to account for the additional flows from the City's system.

5.14 Socioeconomics and Environmental Justice

This section describes the types of socioeconomic impacts that could occur within the Plan area during implementation of the alternatives. Potential effects on historically underserved communities and low-income populations (environmental justice populations) are also discussed.

Much of the basis for the evaluation of impacts in this section comes from analyses for other sections of this EIS (particularly Section 5.12, Transportation; Section 5.9, Land Use and Visual Quality; and Section 5.8, Noise and Vibration). The intent of this section is to synthesize the results of those analyses to provide a qualitative assessment of the potential socioeconomic and environmental justice impacts that could occur under the alternatives.

Key Findings

Socioeconomics and Environmental Justice

Construction under the *LTCP Alternative* could cause a hardship for some residents due to disruptions to access and public transportation in project areas. There could be short-term impacts on existing economic conditions due to construction disturbance and temporary changes in the use of the land during construction. Construction associated with stormwater projects of the *Integrated Plan Alternative* would cause minor and temporary impacts to local communities and could alter access to community resources. Although construction effects may be substantial, none of the Plan alternatives would cause disproportionately high and adverse effects on minority and low-income populations.

5.14.1 What potential construction impacts are common to all of the alternatives?

Construction of CSO storage facilities such as storage tanks and tunnels can have a short-term impact on socioeconomic conditions and environmental justice populations. These impacts would generally be common to all of the alternatives and options and are discussed below.

Neighborhood Disruption

Although the intensity of construction activity would vary depending on the project and the phase of construction, construction activities would be noticeable in adjacent neighborhoods for periods lasting from months to several years. These construction activities include increases in noise, ground-borne vibration, and dust, and the presence of construction workers and temporary use of properties for project construction. Neighborhoods adjacent and nearby to construction could experience impacts from detour routes, haul truck traffic, and relocated bus stops. Modified access from partial closures/detours of streets, sidewalks, bicycle paths/routes, and trails, and increased noise and construction activity in these areas, could discourage neighborhood activity and use of community resources. Although access would be modified during construction, it would not be eliminated.

These effects could reduce residents' perceived quality of life and limit connections to community resources, patronage at neighborhood businesses, or use of recreational amenities, especially those with access from affected roadways. While these impacts would not be permanent, a multi-year project could result in shifts of neighborhood patterns, such as access to businesses, parks, and other community resources and activities.

The availability of sites ranging from 0.5 acre to 2 acres that are suitable for large storage tanks is limited. This could result in the location of facilities in proximity to residential areas, or within community resources, such as parks. Economic and business impacts could result if economically important industrial or commercial lands are purchased or leased for this purpose.

Storage pipes would likely be located in paved or developed rights-of-way and could result in neighborhood disruption and business impacts from temporary changes in access. In general, noise impacts would be less than for storage pipes or tanks, as tunneling construction would occur underground, and the tunnel portals would likely be located in industrial or commercial areas that have high levels of existing noise.

Business Impacts / Economic Activity

The types of projects included under the LTCP options would have short-term impacts on existing economic conditions due to construction disturbance and temporary changes in the use of the land during construction. In some cases, these changes would be permanent, while in other cases, economic activity would largely be restored following construction. These impacts could include loss of direct access to existing uses or the need for substantial detours to reach properties. Business operators would be concerned about the potential for lost patronage during construction, which could occur in some locations. There would be a higher potential for long-term effects on businesses that experience impacts from multi-year construction projects than from shorter duration projects. There would also be moderate, short-term economic benefits to local businesses from construction contracts and spending by construction workers.

Some storage projects may take place near shorelines in industrial and commercial areas. Adverse economic impacts can occur if economically important land is purchased or leased for construction of tunnels or tanks, taking the land out of income-generating industrial or commercial uses during construction. While some, or all, of this land may be reclaimed or repurposed for industrial or commercial use after construction, reduced local economic activity could result during the construction period. If acquisition of private property or displacement of residents or businesses is necessary, the City would attempt to find willing property sellers and would follow federal, state, and local requirements for property acquisition, compensation, and relocation (Seattle Municipal Code Title 20). Because specific sites have not been chosen for the CSO control projects, this EIS does not evaluate impacts for specific locations.

Construction jobs and indirect jobs generated by construction of projects under the LTCP options would vary depending on the project and over the course of the LTCP implementation period. Construction would not be expected to result in a substantial change in the overall local labor force and employment characteristics for the City, but it would provide some benefit to the local economy and neighborhood businesses.

5.14.2 What are the potential socioeconomic impacts of the LTCP options?

Table 5-14 summarizes the types of socioeconomic and environmental justice impacts that could occur under the four options of the LTCP. Each of the four LTCP options would cause different levels of impacts to different neighborhoods. Impacts would be highest for those alternatives and storage options that have long construction periods, affect residential areas or community resources, or could require large areas of property acquisition or use of industrial or commercial lands. In general, impacts are similar to those described in Section 5.9, Land Use and Visual Quality, because socioeconomic impacts are strongly related to land use impacts.

Table 5-14. Summary of Potential Socioeconomic Impacts for LTCP Options
Neighborhood Storage Option*
This storage option has the greatest number of City and King County independently constructed CSO storage facilities, and therefore, the greatest number of areas that would experience construction disturbance and modified access to community resources and businesses during the construction period. The neighborhoods that would be most affected include the Ballard, Fremont/Wallingford, Leschi, and Longfellow Creek/Duwamish neighborhoods, relating to impacts outlined in Sections 5.9 and 5.12.
Shared Storage Option
Shared storage tanks would reduce the total number of new storage tanks required in the city (by both the City and King County) and would reduce the number of storage pipes that would be constructed as compared to the Neighborhood Storage Option. This would reduce the number of areas where property acquisition is required, as well as the number of areas that would experience construction disturbance and modified access to community resources and businesses. The neighborhoods that have the highest potential to be affected include Ballard, Fremont/Wallingford, North Union Bay, and Montlake, relating to construction-related impacts outlined in Section 5.9, Land Use, and Section 5.12, Transportation.
Shared West Ship Canal Tunnel Option
The Shared West Ship Canal Tunnel would eliminate the need for the City (and King County) independently constructed storage facilities in the Ship Canal and Lake Washington Neighborhoods. Therefore, fewer areas would experience construction disturbance and modified access to community resources or businesses. However, this option would concentrate impacts in the Ship Canal Neighborhoods. In Ballard and Fremont/Wallingford, the storage tunnel would potentially result in less overall business or economic disruption because less property or easement acquisition would be needed to accommodate the tunnel portals. However, portal locations could require property acquisition of industrial or commercial lands along the Ship Canal in the vicinity of Ballard and Fremont/Wallingford neighborhoods during the 3.5-year construction duration. Economic and business impacts could result if economically important industrial or commercial lands are directly or indirectly affected. Truck trips for hauling tunnel spoils would be substantial in the vicinity of the Ballard and Fremont/Wallingford neighborhoods, and could reduce residents' quality of life and limit connections to community resources, patronage at neighborhood businesses, or use of recreational amenities, especially those with access from affected roadways. If barges are used to haul tunnel spoils (to mitigate transportation impacts), there would be a potential for disruption to fishing areas in the Ship Canal. The Muckleshoot Indian Tribe's usual and accustomed fishing areas within the Plan area include all of Lake Washington and the Ship Canal, where barges would be loaded and transported. Usual and accustomed fishing areas are crucially important to the livelihood, lifestyle, and identity of Muckleshoot Indian Tribe members. Barging tunnel spoils could prevent or limit access to usual and accustomed fishing areas under one or both of the following conditions: (1) existing areas used by the Muckleshoot Indian Tribe for fishing would be partially obstructed; and (2) barge movements in the Ship Canal would interfere with tribal fishing. In-water construction (to construct or retrofit a pier to support the barge operation) could harm fish and adversely affect treaty fisheries resources by limiting the availability of fish for subsistence, ceremonial, and commercial purposes. If barging is advanced as a mitigation measure, the City would work with the Muckleshoot Indian Tribe to resolve fully and fairly issues associated with the impacts on treaty rights. Given the low numbers of estimated barge trips required to haul the tunnel spoils, adverse impacts from barge movements are not anticipated.

Table 5-14. Summary of Potential Socioeconomic Impacts for LTCP Options
Shared Ship Canal Tunnel Option
The Shared Ship Canal Tunnel Option would affect the fewest neighborhoods throughout the city of all of the options, but it would also concentrate impacts in the Ship Canal and Lake Washington Neighborhoods. Overall, the potential to impact businesses and local economic activity would be reduced city-wide. Impacts would be similar to the West Ship Canal Tunnel but would occur over a longer duration (up to 7 years). Economic and business impacts could result if economically important industrial or commercial lands are directly or indirectly affected. Truck trips for hauling tunnel spoils would be substantial in the vicinity of the south side of the Ship Canal and could reduce residents' quality of life and limit connections to community resources, patronage at neighborhood businesses, or use of recreational amenities, especially those with access from affected roadways. Potential impacts from barging are the same as discussed for the Shared West Ship Canal Tunnel Option, but they would occur over a longer construction timeframe.

*The Neighborhood West Ship Canal Tunnel would have similar impacts in Ballard and Fremont/Wallingford as described for the Shared West Ship Canal Tunnel Option.

5.14.3 What are the potential environmental justice impacts of the LTCP options?

Construction impacts on environmental justice populations would generally be the same as those previously described in the discussion of socioeconomics. In particular, environmental justice populations would experience increased traffic congestion, reduced mobility, reduced transit service, air emissions, and increased noise. Temporary congestion during construction may also have an impact on organizations that serve environmental justice populations. These construction impacts would affect all populations including historically underserved and low-income residents of neighborhoods in the Plan area.

As discussed in Section 4.13, demographic analysis shows that neighborhoods in the Plan area have generally the same or lower proportions of low-income and minority populations compared to the rest of the city. Based on a review of the population and income characteristics of the Plan neighborhood areas, the Longfellow Creek/Duwamish Neighborhoods have the highest presence of minority populations. In terms of income, the per capita income of the study area is lower than that of the city as a whole, and the proportion of population below poverty thresholds in the Plan area is slightly higher in comparison to the whole city.

While the Longfellow Creek/Duwamish Neighborhoods have a greater presence of minority and low-income populations in comparison to other neighborhoods in the Plan area, none of the options include projects that would have greater construction disturbance in this area than in the other Plan neighborhoods. In fact, the largest, most disruptive projects included in the options would be located in the Ship Canal and Lake Washington Neighborhoods where the populations are predominantly not historically underserved or low-income. Even though the amount of construction disturbance would be less in the Longfellow Creek/Duwamish Neighborhoods than other neighborhoods, environmental justice populations in this area could be more sensitive to construction impacts as they are generally more reliant on public transit, which could be affected by traffic congestion and road closures/detours.

Given the distribution of the CSO control projects throughout the city, and the fact that the largest, longest duration construction projects under any of the LTCP options would not be located in neighborhoods with a greater presence of minority and low-income populations, construction-related effects on neighborhoods would not fall disproportionately on environmental justice populations.

5.14.4 What are the potential socioeconomic and environmental justice impacts of the Integrated Plan Alternative?

Construction of storage pipes, tanks, and tunnels under the Integrated Plan Alternative would have the same potential socioeconomic impacts as under the LTCP Alternative, but certain CSO control projects would be delayed in Delridge, East Waterway, Duwamish, Portage Bay, and Montlake neighborhoods. Consequently, these neighborhoods would experience fewer near-term construction-related socioeconomic impacts.

Installation of natural drainage systems through NDS Partnering would cause minor and temporary impacts. Specific installations may require temporary closures of sidewalks and street lanes, and brief detours of traffic and pedestrians around the work area. Construction could result in temporary community impacts from relocated bus stops, and modified access to community resources from partial closures of streets, sidewalks, or bicycle paths/routes. Such detours would comply with relevant policies administered by the Seattle Department of Transportation as part of its Street Use permitting process, as applicable. Project construction associated with the South Park Water Quality Facility could alter access to community resources and result in short-term noise and other impacts in affected neighborhoods. However, the potential for impacts is minimal as the project is anticipated to be located in an industrial area.

5.14.5 What are the potential socioeconomic and environmental justice impacts of the No Action Alternative?

Project construction under ongoing programs to implement sewer system improvements and natural drainage systems could alter access to community resources and result in short-term noise and other impacts in affected neighborhoods. However, these impacts would be temporary and would not affect the integrity of the neighborhoods. The No Action Alternative would require fewer disruptions in industrial and commercial areas, and fewer property acquisitions and displacements than would the LTCP or Integrated Plan Alternatives.

Sewer system improvements would occur at existing CSO or stormwater drainage locations. Construction activities would be minor and generally less than four months in duration, with only minor neighborhood disruption and economic impacts. In some neighborhoods, the City is able to substantially reduce CSO volumes using sewer system improvements, reducing the need to construct storage projects as part of the LTCP. This is particularly true in the Longfellow Creek/Duwamish Neighborhoods where sewer system improvements would substantially reduce the size of needed storage projects and related construction activity under the LTCP.

Installation of natural drainage systems through the City’s Right-of-Way program would cause minor and temporary impacts similar to those described above for NDS Partnering under the Integrated Plan Alternative. Specific installations may require temporary closures of sidewalks and street lanes, and brief detours of traffic and pedestrians around the work area. Construction of roadside rain gardens could result in temporary community impacts from relocated bus stops, and modified access to community resources from partial closures of streets, sidewalks, or bicycle paths/routes. Such detours would comply with relevant policies administered by the Seattle Department of Transportation as part of its Street Use permitting process, as applicable.

5.14.6 What measures are proposed to reduce or minimize socioeconomic and environmental justice impacts?

Measures to minimize noise and ground-borne vibration, dust, and truck trips are described in Sections 5.3, 5.8, and 5.12.

In addition, the City would undertake the following measures to mitigate socioeconomic impacts for all four proposed options:

- Prioritize project locations on public property and in public rights-of-way.
- Comply with federal, state, and local regulations regarding property acquisition and relocation assistance.
- Provide advance notification to nearby residents of construction activities including any sidewalk and street lane closures.
- Prepare a traffic control plan including measures to address residential access, emergency vehicle access, road closures and detours, and temporary bus route changes.

Additional measures to minimize impacts to environmental justice populations and organizations and businesses that serve them would include communicating information and obtaining feedback about construction activities, impacts, and mitigation at low-income housing sites and through social service providers. The project would also focus outreach to populations with limited English proficiency and to other populations susceptible to construction-related impacts.

Additional mitigation measures for specific socioeconomic and environmental justice impacts may be identified during future review of individual projects. The City would coordinate with property owners on mitigation efforts as appropriate. The City would also coordinate with property owners to identify any relocation or other mitigation options for properties that would be directly affected during the construction period.

CHAPTER 6

OPERATION IMPACTS AND MITIGATION

6.1 Introduction

6.1.1 What is included in this chapter?

This chapter describes the potential effects of the Plan after construction has been completed and the Plan projects are in operation. Both the LTCP Alternative and the Integrated Plan Alternative would implement one of the four LTCP options, although some of these CSO control projects would be deferred under the Integrated Plan Alternative. Because CSO control facilities under the LTCP options would largely be underground, few operational effects to the environment would result from Plan implementation.

The same elements of the environment discussed in Chapters 4 and 5 are discussed in this chapter, following the same general organization. The potential direct and indirect effects of project operation were analyzed for the Plan alternatives and the No Action Alternative. Because the Plan would be implemented as a coordinated package phased over time, the effects of the combination of all elements functioning together as an overall plan are presented. Long-term cumulative impacts are presented in Chapter 7.

Under the No Action Alternative, the Plan would not be implemented. The main long-term implications of not implementing the Plan relate to surface water quality and include indirect effects on biological resources, environmental health, and recreation. The only other operational effects would be those caused by the operation and future maintenance and repairs of existing CSO facilities, planned CSO control projects, ongoing programs (roadside rain gardens, RainWise), and existing and planned stormwater facilities.

6.2 Earth and Groundwater

This section describes the types of impacts that could occur to the geological setting, soils, and groundwater within the Plan area resulting from operation of the Plan alternatives.

Key Findings

Earth and Groundwater

Overall, the operational effects from the *LTCP Alternative* and the *Integrated Plan Alternative* are expected to be minor. With the implementation of site-appropriate design, potential adverse impacts would be avoided and minimized.

6.2.1 What are the potential operational effects of the LTCP Alternative on earth and groundwater?

Generally, none of the projects proposed for any of the LTCP Alternative options would cause erosion impacts because there would be no exposed soils following construction and site restoration. Because underground storage facilities (pipes, tanks, tunnels) would not be constructed on steep slopes or landslide-prone areas, and would not require new slopes or major earth fills, operational impacts would generally be limited to geologic hazards that already exist. For example, there would be a risk of seismic events during the period of operation, and this risk could result in other related geologic hazards, such as liquefaction and seismic-induced slope failures.

6.2.1.1 Seismic Hazards

The CSO control projects, including storage tanks and tunnels, would be designed for the seismic hazards that are known to exist. As part of project-specific site analysis and facility design, technical engineering analysis would be conducted to confirm that the facility meets appropriate seismic design criteria, including the design of shoring, storage structures, and related facilities. Storage tanks, pipes, and tunnels included in the LTCP options would be designed in accordance with seismic design standards, which are intended to minimize the long-term risks to the system.

6.2.1.2 Changes to Groundwater Flow

Groundwater flow paths could be altered by tanks, pipes, and tunnels, or ground improvements included in project designs. The potential impact to groundwater flow is considered low for all types of projects included under the LTCP options. However, the potential effects of barriers to groundwater flow, such as sheet pile walls or subsurface tunnels, would be considered during siting and final design to confirm that effects to any nearby soils or structures supported on or within the soils would be negligible.

6.2.1.3 Comparison of Earth and Groundwater Impacts among the LTCP Options

The degree of the impacts described above would depend on the specific site conditions and project-specific design. The most important geologic hazard for operations would result from seismic ground shaking, which would affect all facilities, although the hazard could be slightly higher in the Longfellow Creek / Duwamish Neighborhoods because of their proximity to the Seattle Fault Zone where the risks from fault movement and ground shaking are higher. In other areas, the primary seismic hazard would be associated with ground shaking and secondary effects of ground shaking, such as liquefaction. With the implementation of appropriate design, potential adverse impacts would be avoided and minimized.

All of the CSO facilities included in the options would be designed to meet all applicable standards to minimize seismic risk. While impacts are generally similar among the LTCP options, the following differences exist.

Neighborhood Storage Option

This option would have the most tanks and pipes located throughout the Plan area potentially at risk during a seismic event. However, storage facilities would be designed in accordance with seismic design standards, which are intended to minimize the long-term risks to the system. Tanks and pipes located in the Longfellow Creek / Duwamish Neighborhoods (in proximity to the Seattle Fault Zone) could potentially be at a greater risk during a seismic event than other areas, and they would be at a potentially higher risk for liquefaction in saturated soils than the other options. In most other Plan neighborhoods, the general project areas offer overall stable geology and soil conditions during operation.

The Neighborhood West Ship Canal Tunnel would have similar impacts in Ballard and Fremont/Wallingford as described below for the Shared West Ship Canal Tunnel Option.

Shared Storage Option

This option would have similar potential for impacts as the Neighborhood Storage Option, although fewer storage tanks and pipes in the Ship Canal and Lake Washington Neighborhoods would be at potential risk.

Shared West Ship Canal Tunnel Option

This option replaces storage tanks in Ballard and Fremont/Wallingford with a tunnel. Impacts would be similar to the Neighborhood Storage Option but there would be fewer storage tanks and pipes potentially at risk during a seismic event. Tunnels are generally designed to avoid other underground developments and take advantage of stable glacial till layers. Operational effects are anticipated to be minor. In East Waterway and Magnolia, flow diversions would replace storage tanks/pipes, which present lower potential risk during seismic events.

Shared Ship Canal Tunnel Option

This option would have similar potential for impacts as the Shared West Ship Canal Tunnel Option. Additional flow diversions in Duwamish and Delridge (and flow transfers to the Shared Ship Canal Tunnel from Leschi, Montlake, and Portage Bay) would further reduce the number of storage facilities at potential risk.

6.2.2 What are the potential operational effects of the Integrated Plan Alternative on earth and groundwater?

In addition to the operational impacts of the selected LTCP option, the operational impacts of the stormwater projects specific to the Integrated Plan Alternative are anticipated to be minor. Depending on location selected, the South Park Water Quality Facility could be at risk for liquefaction in saturated soils; however, the facility would meet seismic design standards. NDS Partnering projects could cause erosion if not properly maintained. Street sweeping would not be expected to have operational effects on earth or groundwater.

6.2.3 What are the potential operational effects of the No Action Alternative on earth and groundwater?

Under the No Action Alternative, the existing earth and groundwater environment in the Plan area would essentially remain unchanged. Projects completed as part of the ongoing RainWise and roadside rain garden programs could cause erosion if they are not properly maintained. City projects included in the 2010 Plan Amendment will meet seismic design standards.

6.2.4 What measures are proposed to reduce or minimize potential impacts to earth?

The City would undertake the following measures to mitigate operational impacts to earth for all proposed projects under the Plan:

- All sites would be maintained to prevent erosion.
- Projects would be sited and designed to minimize seismic risk and potential for earth subsidence.

As part of ongoing programs, the City undertakes the following measures to minimize impacts of natural drainage systems:

- The City maintains all roadside rain gardens to prevent erosion.

- The City provides education and incentives for homeowners to maintain rain gardens on their properties.

6.3 Air Quality and Odors

This section describes the air quality impacts and odors that could result from operating the facilities constructed for the Plan alternatives.

6.3.1 What are the potential operational effects of the LTCP Alternative on air quality and odor?

6.3.1.1 Emissions

Operational emissions would be limited to vehicle and equipment emissions associated with periodic maintenance activities and infrequent use of emergency generators. These emissions would be minimal and would not produce localized air quality impacts. Diesel engine emissions would be emitted through exhaust stacks at the site of the ancillary equipment facility during maintenance and operation of standby generators. All emergency generators would be required to incorporate Best Available Control Technology to minimize emissions of pollutants. Since the generators would operate only during power outages and testing, emissions would be infrequent and of short duration.

Key Findings

Air Quality

The net operational effects of the *LTCP Alternative* on air quality and odors would be minor in the Plan area. The Neighborhood Storage Option would have the highest number of potential odor-producing tanks and pipes located throughout the Plan area. All facilities would be designed and maintained to minimize emissions of odorous compounds.

In addition to the operational impacts of the selected LTCP option, the air quality impacts of the stormwater projects specific to the *Integrated Plan Alternative* are anticipated to be minor.

6.3.1.2 Odors

Several of the CSO control facilities have the potential to generate odors during operation because they detain or hold a mixture of wastewater and stormwater during and following storms. These flows include potentially odor-generating compounds that can be released to the air under some conditions. These facilities include pump stations, diversion weir structures (due to turbulence), storage facilities (due to the increased detention time), and any permanent access or ventilation facilities (including tunnel portals). The potential for odors would depend on the wastewater characteristics (dissolved sulfide, dissolved oxygen, pH, temperature, etc.), wastewater hydraulics, and facility operation (cleaning, etc.).

The level of odor would likely be less than with a facility handling only sewage because stormwater inputs to the combined sewer system dilute the concentration of odor-causing compounds. Also, most combined sewage flows are generated during the rainy season when both the ambient air and water temperatures are relatively cool, which reduces the potential for odor-generating compounds such as hydrogen sulfide. In addition, CSO storage facilities would have automated cleaning systems and would be maintained at slightly negative pressure to minimize odors. Finally, all CSO control facilities installed for the Plan would include the appropriate level of state-of-the-art technology for odor control (Figure 6-1) and would be maintained to minimize emissions of odorous compounds to the atmosphere.

Figure 6-1. Typical odor control equipment for a CSO storage facility

Odor control systems would be operated at access shaft points for storage facilities and at the pump stations. Odor release at storage tunnels is primarily limited to the launch and recovery portals. During normal operation of the tunnel, the ventilation system at the pump station would pull outside air into the tunnel. This results in continuous movement of all air within the tunnel to the pump station for odor treatment and exhaust. When the tunnel fills with combined sewage during a storm event, the air (and odor) from the tunnel will be displaced. Although air may be vented from the tunnel at the tunnel shafts when the tunnel fills, odor problems are not expected. All air from the tunnel would be vented to an odor control system, where it would be treated prior to release to the atmosphere. The largest potential source of odor would be at the effluent pump stations. However, these structures would also have the highest level of mechanical odor control equipment.

Emissions would be minimal from operation of all CSO control facilities included in the LTCP options. All CSO facilities installed for the Plan would include state-of-the-art technology for odor control and would be maintained to minimize emissions of odorous compounds to the atmosphere. Odors would not likely be noticeable outside of the proposed facility under normal operating conditions.

6.3.1.3 Comparison of air quality and odor impacts among the LTCP options

All of the CSO control facilities included in the options have potential for odor impacts, but they would be designed to minimize odors by incorporating odor control and automated flushing systems. CSO control projects that store flows (e.g., tanks and tunnels) have a higher potential for odor impacts than flow transfers. Also, larger storage facilities have the potential to produce larger volumes of odorous emissions. However, concentrations of odorous compounds would be the same regardless of size, and control facilities would be sized accordingly to treat the higher volumes of air. While impacts are generally similar among the LTCP options, the following differences exist, based upon the location of facilities and potential receptors.

Neighborhood Storage Option

This option would have the greatest number of potential odor-producing tanks and pipes located throughout the Plan area, including several that could be located in or near residential areas of the Ship Canal, Lake Washington, Longfellow Creek /Duwamish, and Central Waterfront Neighborhoods. Odors are more likely to be noticed in residential or commercial areas. This option includes an estimated 13 pump stations, which could result in occasional odors.

The Neighborhood West Ship Canal Tunnel would have similar impacts in Ballard and Fremont/Wallingford as described below for the Shared West Ship Canal Tunnel Option.

Shared Storage Option

This option includes several storage tanks that could be located in or near residential areas of the Ship Canal, Lake Washington, Longfellow Creek / Duwamish, and Central Waterfront Neighborhoods. This option would have similar potential for impacts as the Neighborhood Storage Option, with fewer potential odor-producing storage tanks and pipes in the Ship Canal Neighborhoods. This option replaces a storage tank with a flow diversion in the East Waterway neighborhood, which has less potential to produce odors. Of all the options, this option potentially has the greatest number of pump stations (15), which could result in occasional odors.

Shared West Ship Canal Tunnel Option

The large tunnel would reduce the number of potential odor-producing storage facilities in the Ballard and Fremont/Wallingford neighborhoods. The large tunnel would have the greatest potential for odors at the downstream tunnel portal (likely located along the Ship Canal in the vicinity of Ballard) but these would be minimized by an odor control facility. In neighborhoods where flow diversions would replace storage tanks/pipes (East Waterway and Magnolia), there would be less potential for odor impacts. This option includes an estimated 10 pump stations, which could result in occasional odors.

Shared Ship Canal Tunnel Option

This option would have similar potential for impacts to the Shared West Ship Canal Tunnel Option, except that storage facilities with odor-producing potential would largely be eliminated in the Lake Washington Neighborhoods of Montlake, Portage Bay, and Leschi. The large tunnel would have the greatest potential for odors at the downstream tunnel portal (likely located along the south side of the Ship Canal) but these would be minimized by an odor control facility. Additional flow diversions in Duwamish and Delridge would further reduce the number of potentially odor-producing storage facilities in those neighborhoods. This option includes an estimated 10 pump stations, which could result in occasional odors.

6.3.2 What are the potential operational effects of the Integrated Plan Alternative on air quality and odors?

In addition to the operational impacts of the selected LTCP option, the air quality impacts of the stormwater projects specific to the Integrated Plan Alternative are anticipated to be minor. Similar to CSO storage facilities, the South Park Water Quality Facility has the potential to generate odors. However, this impact is expected to be minimal because stormwater has fewer odor-generating compounds than wastewater or combined sewer overflows. Street sweeping has the potential to temporarily increase localized dust and emissions, but this would be minimal and street sweeping occurs at night on most arterials. There are no operational air-related impacts associated with NDS Partnering.

6.3.3 What are the potential operational effects of the No Action Alternative on air quality and odors?

No air quality impacts or increased odors are anticipated from the ongoing sewer system improvements and natural drainage systems. Air quality impacts and odors associated with the projects in the 2010 Plan Amendment would be similar to those described above. The projects either have completed, or will undergo, separate SEPA analysis as appropriate and are not included in this EIS.

If projects included in the No Action Alternative are not adequate to reduce CSO events, odors associated with the CSO releases would continue and could increase if the number of CSO events increases.

6.3.4 What measures are proposed to reduce or minimize potential impacts to air quality and odors?

The City would undertake the following measures to mitigate air quality and odor impacts for the operation of all proposed projects. Mitigation measures would be the same for all the Plan alternatives.

- All storage facilities would be designed with state-of-the-art odor control systems.
- The City would operate storage facilities to minimize the potential for odors by limiting the length of time combined sewage is stored in the facilities, maintaining air space at slightly negative pressures, and scheduling maintenance of odor control systems during cold temperatures and periods of low flow.

6.4 Surface Water

This section describes the types of impacts that could occur to surface water within the Plan area from operation of the Plan alternatives.

Implementation of either the LTCP or the Integrated Plan Alternative would result in substantially reduced pollutant loadings to receiving water bodies. The LTCP is being implemented to improve receiving water quality, meet CSO standards administered by EPA and Ecology, and comply with the Consent Decree. The alternatives have been developed to be consistent with those requirements; however, the timing of water quality benefits and the reduction in pollutants vary depending on which alternative is implemented, as described below.

6.4.1 What are the surface water impacts of the LTCP Alternative?

Operational impacts to surface water quality would be the same for all of the LTCP options, because all options would meet the Consent Decree requirement for control of CSOs, in compliance with the Clean Water Act, EPA's CSO Control Policy, and the objectives of the Washington Water Pollution Control Act. All options are required to meet the regulatory requirements of the City's National Pollutant Discharge Elimination System permit,

Key Findings

Surface Water

The *LTCP Alternative* would result in substantial reduction of pollutant loading from existing uncontrolled CSO outfalls compared with the No Action Alternative. The LTCP Alternative would comply with Clean Water Act requirements and the Consent Decree. The Ship Canal/Lake Union, Lake Washington, Duwamish River, Longfellow Creek, Elliott Bay, and Puget Sound would receive reduced discharges from CSOs. The *Integrated Plan Alternative* would result in greater pollutant loading reductions than the LTCP Alternative.

The *No Action Alternative* would not comply with the Consent Decree and would not achieve the City's Plan for Protecting Seattle's Waterways.

which limits overflows from controlled outfalls. Therefore, long-term operational impacts to surface water are discussed for the LTCP Alternative as a whole.

The City of Seattle has been working to control CSOs since the 1960s. The LTCP is the final component to complete CSO control efforts and comply with federal and state requirements. The 2013 Consent Decree, an agreement between the City of Seattle, Washington Department of Ecology, EPA, and U.S. Department of Justice, specifies the actions that the City must take to address CSOs that violate the Clean Water Act. Regulations require that CSO outfalls must meet a performance standard to achieve the "greatest reasonable reduction" to be considered "controlled" in accordance with WAC 173-245-020(22), which outlines the requirements for CSO control facilities. According to these regulations, a CSO is considered "controlled" when no more than one untreated discharge occurs per year, determined annually and based on a 20-year moving average period.

As noted in Chapter 1, the Consent Decree has established a deadline of December 2025 to complete construction of all CSO control measures. One year following completion of construction of each CSO control measure, the City is required to document that the CSO outfall has been controlled, through post-construction monitoring. Additional detail on the Consent Decree requirements is included in the Summary section of *Volume 2, LTCP*.

In 2012, there were 355 overflow events and 154 million gallons of untreated CSOs discharged from the City's 87 managed outfalls, 35 of which are uncontrolled. Eight of these CSOs will be controlled through the implementation of the 2010-2015 CSO Plan, described in more detail in Chapter 1 of *Volume 2, LTCP*. Early Action CSO Programs and Measures will result in an additional five outfalls being controlled by 2019, including two in the North Henderson basin and three in the South Henderson basin. The remaining 22 uncontrolled outfalls will be controlled through implementation of the approved LTCP. Figure 2-3 illustrates the outfalls to be controlled.

Under the LTCP, uncontrolled outfalls discharging into Lake Washington, the Ship Canal, Union Bay, Portage Bay, Longfellow Creek, the Duwamish River, and Elliott Bay would be controlled to one untreated discharge per year on a 20-year rolling average in order to comply with EPA and Ecology requirements. The LTCP would reduce the frequency of CSO discharge events by more than 50 percent and the average annual CSO discharge volume by more than 55 percent.

Controlling these outfalls to meet EPA and Ecology requirements would result in substantial reductions of fecal coliform bacteria, toxics, metals, and nutrients entering local receiving water bodies from CSOs.

The LTCP would reduce fecal coliform discharges from CSO outfalls by nearly 70 percent, with reductions of bacterial and other pathogen loading between 65 and 75 percent in Lake Washington and the Ship Canal/Lake Union receiving waters, where high levels of water contact recreation occur. While CSO discharges can include viruses and other pathogens as well as toxic organic constituents, not all of these constituents are measured. Fecal coliform bacteria is an indicator for pathogenic constituents.

Suspended solids from CSOs deposited near CSO outfalls would be substantially reduced, thereby reducing the potential for wildlife and humans to come into contact with potentially contaminated sediments. Total suspended solids discharged from CSO outfalls would be reduced by nearly 65 percent, with reductions of 75 percent in the Ship Canal/Lake Union receiving waters.

Total copper, a constituent that is toxic to salmonids and other aquatic organisms, would be reduced by nearly 65 percent from CSO outfalls when compared to the No Action Alternative. Reductions of nearly 75 percent would occur in the Ship Canal/Lake Union, and nearly 67 percent in Lake Washington. Total phosphorus, an important constituent in algae production, would be reduced by 65 percent over the No Action Alternative, with highest reductions from outfalls in the Ship Canal/Lake Union and Lake Washington basins. Fecal coliform bacteria discharged from CSO outfalls would be reduced by roughly 69 percent. Reductions of other toxic contaminants, nutrients, and metals would also be substantial.

There are no adverse operational impacts on surface waters associated with the LTCP Alternative.

6.4.2 What are the potential operational effects of the Integrated Plan Alternative on surface water?

The Consent Decree allows the City to propose an Integrated Plan as an alternative to the LTCP. This would allow deferral of some LTCP projects if evaluations indicate that stormwater projects could achieve significantly better water quality benefits than would be achieved by implementing LTCP CSO control projects only. The stormwater projects would need to be implemented by December 31, 2025, while the deferred LTCP projects would be completed between 2028 and 2030, as approved by Ecology. Implementing the Integrated Plan Alternative would not replace or eliminate any CSO control projects in the LTCP Alternative, but it would allow the City to devote more resources in the near term to addressing stormwater pollutant loads, resulting in greater water quality benefits.

The Consent Decree listed a number of specific constituents that the Integrated Plan must address. These are constituents that represent both environmental and human health concerns and are contained in both stormwater and CSOs. These include fecal coliform bacteria, total suspended solids, biochemical oxygen demand (BOD), ammonia, phosphorus, oil and grease, and pH. The Consent Decree also includes several general categories of constituents (e.g., metals, pesticides, and semi-volatile organic compounds).

Because of the limited timeframe for developing the Integrated Plan, it was not possible to collect new water quality data. Therefore the City compiled and reviewed existing stormwater, CSO, and receiving water data to develop a list of “Representative Constituents of Concern” (RCOCs). In some cases, the City used surrogates to represent categories of constituents, such as dissolved copper and dissolved zinc for metals, and PCBs and polybrominated diphenyl ethers (PBDEs) for toxic organic compounds. Additional detail on the development of RCOCs can be found in Chapter 6 of *Volume 3, Integrated Plan, as well as the methods used* to estimate the pollutant load reductions for the LTCP projects to be deferred, and for the stormwater projects considered for inclusion in the Integrated Plan.

In development of the Integrated Plan, the City also ranked local receiving water bodies based on requirements outlined in the Consent Decree, as described in Chapter 1 of *Volume 3, Integrated Plan.*

The City identified potential stormwater projects for implementation, and potential LTCP CSO control projects for deferral, based on the water body and drainage basin rankings and EPA guidance. An initial list of more than 14 projects or programs was narrowed to 10 stormwater projects that were evaluated in detail. The stormwater projects/programs were selected based on their ability to provide benefits in key drainage basins and receiving water bodies, as described in Chapter 5 of *Volume 3, Integrated Plan.* In contrast, the LTCP projects identified for deferral were relatively small. The intent was to identify stormwater projects that could provide significant water quality benefits compared to the CSO control projects proposed for deferral.

The Integrated Plan team then evaluated data relating to potential impacts on pollutant loading and exposures for RCOCs for human and ecological receptors, and then estimated pollutant load and exposure reductions for the stormwater projects relative to the CSO control projects. The team used a Multi-Objective Decision Analysis (MODA) to score the candidate stormwater projects and compare the benefits of each project with its costs. They selected a combination of projects that would provide significantly more water quality benefits than the LTCP CSO control projects.

As summarized in Chapter 1 of this document, the Integrated Plan evaluation identified three stormwater projects that would result in deferral of six CSO control projects included in the LTCP. The stormwater projects would be implemented by 2025, and completion of the deferred CSO control projects would be delayed until 2030. The three stormwater projects are described in more detail in Chapter 3, Plan Alternatives, and in Chapter 8 of *Volume 3, Integrated Plan.* The Integrated Plan projects include the following:

- Natural Drainage System (NDS) Partnering
- South Park Water Quality Facility
- Expanded Street Sweeping (Arterials)

Six LTCP CSO control projects were identified for deferral in the Delridge, East Waterway, Duwamish, Portage Bay, and Montlake basins. Table IPS-1 in *Volume 3, Integrated Plan* summarizes the Integrated Plan projects and the LTCP projects identified for deferral. Under the Integrated Plan, approximately 1,600 MG/year of stormwater would be treated or removed from the Longfellow, Piper's, and Thornton Creek basins, through the implementation of NDS Partnering, the South Park Water Quality Facility, and the expansion of street sweeping on arterials (based on the volume of stormwater on streets to be swept). The LTCP projects proposed to be deferred would treat or remove approximately 1.4 MG/year in the Delridge, East Waterway, Duwamish, Portage Bay, and Montlake basins. Additional discussion of these findings is included in Chapter 8 of *Volume 3, Integrated Plan.*

Based on detailed evaluations conducted by the City's Integrated Plan team, the Integrated Plan would result in a greater reduction of pollutant loading than would occur for the LTCP Alternative. Implementation of the Integrated Plan projects would result in substantially greater reductions of total suspended solids, oil and grease, total and dissolved copper and zinc, phosphorus, PCBs, and PBDEs, among other constituents.

The Integrated Plan stormwater projects provide greater reductions for all RCOCs except for ammonia-N. The primary reason for the substantial increase in pollutant load reduction for the Integrated Plan projects is that the stormwater projects treat or remove much larger volumes of water than the comparable CSO control projects within their respective basins. In addition, the Integrated Plan stormwater projects treat larger volumes of water than the comparable CSO control projects during February through September, when human exposure with receiving waters is more likely.

CSO pollutant loads deferred from 2025 until after 2028 for the Integrated Plan would amount to between 2 and 7 percent of the existing uncontrolled CSO loads, and between 7 and 16 percent of the projected CSO loads in 2025 to all water bodies. These ranges of deferred CSO pollutant loads depend on the specific constituent, with the greatest reductions associated with total suspended solids, metals, oil and grease, and other constituents associated with street runoff. After the deferred LTCP CSO control projects are completed, their water quality benefits will add to the water quality benefits of the stormwater projects, resulting in further water quality improvements.

Figure 3-8 shows the location of the stormwater projects/programs that would be implemented and the LTCP CSO control projects that would be deferred under the Integrated Plan Alternative. The City selected the South Park Water Quality Facility, the arterial street sweeping expansion program, and the NDS Partnering project for the Integrated Plan because they provide the most pollutant reduction and other benefits as determined during the MODA evaluation. The six LTCP CSO control projects were identified for deferral because they are located in CSO basins determined by the LTCP team to be lower priority based on EPA guidelines and consideration of potential partnering opportunities with King County. The deferred LTCP CSO control projects would provide considerably smaller reductions in pollutant loads and exposures than the Integrated Plan stormwater projects.

The deferral of CSO pollutant load reductions for the Integrated Plan would primarily delay reductions to the Duwamish Waterway and the Ship Canal/Lake Union. The deferred CSO pollutant loads would amount to approximately 30 percent of existing uncontrolled CSO loads to the Duwamish Waterway, and less than 1 percent of existing uncontrolled CSO loads to the Ship Canal and Lake Union. However, stormwater pollutant load reductions by 2025 for the Integrated Plan would far exceed the deferred CSO pollutant loadings to each of these water bodies.

6.4.3 What are the potential operational effects of the No Action Alternative on surface water?

Under the No Action Alternative, pollutant loadings to receiving water bodies would not be reduced beyond levels provided from construction of projects included in the 2010 CSO Control Plan and currently planned NDS and RainWise projects. This alternative does not comply with the Consent Decree, and it would result in significant fines for the City. This alternative is not consistent with the City's Plan to Protect Seattle's Waterways.

CSO pollutant loadings would continue, with potential impacts highest for the Ship Canal and Lake Union because they currently receive the highest CSO pollutant loads of all water bodies in Seattle. Potential impacts would also be high for Longfellow Creek because it currently receives moderate CSO pollutant loads and is a relatively small receiving water body. Impacts would be moderate for Lake Washington and Duwamish Waterway, and lowest for Puget Sound and Elliott Bay, based on their relatively low existing CSO pollutant loads.

6.4.4 What measures are proposed to reduce or minimize impacts to surface water?

The LTCP and the Integrated Plan are intended to reduce impacts to surface water bodies in Seattle's waterways, and as such, they will lessen water quality impacts that are currently occurring. Implementation of either of these alternatives would result in anticipated benefits to receiving water bodies. Post-construction monitoring required in the Consent Decree will ensure that facilities are operating as intended, and it will include adjustments to improve facility performance if necessary.

6.5 Biological Resources

This section describes the types of impacts that could occur to biological resources within the Plan area resulting from operation of the Plan alternatives. In general, implementation of either alternative would reduce the volume of untreated sewage and stormwater runoff being discharged to surface waters, thereby reducing the potential for related adverse effects on biological resources and aquatic life in particular. Implementation of either the LTCP or Integrated Plan Alternative would comply with the Consent Decree, as well as other federal and state requirements.

Key Findings

Biological Resources

The *LTCP Alternative* would have negligible to minor operational effects in the Plan area. There would be long-term beneficial effects on fish and aquatic life from reducing CSOs. The *Integrated Plan Alternative* would provide additional water quality reductions, providing greater potential benefits to biota in the affected receiving water bodies.

The *No Action Alternative* would result in no additional improvements to CSO reductions in the Plan area, which could have long-term adverse effects on fish and aquatic life including listed species.

6.5.1 What are the potential operational effects of the LTCP Alternative on biological resources?

The LTCP Alternative would not cause ongoing impacts to terrestrial wildlife and would benefit aquatic species and habitats. Direct impacts to terrestrial habitats associated with constructing facilities and permanent aboveground access areas are discussed as construction impacts in Chapter 5 (see Section 5.5). Some of the projects, such as storage tanks, may include habitat enhancements, such as replanting with native plants. This would create new areas of habitat for species tolerant of urban conditions.

Pump stations and other surface facilities could generate noise depending on the specific design. Occasional noise associated with maintenance vehicles would also occur. Noise levels from operation of the facilities are not expected to result in impacts to wildlife because species in urban areas are more or less tolerant of some level of human activity.

All options would reduce the number of CSO events and lead to improved water quality, as described in Section 6.4, Surface Water. Consequently, all options would result in long-term, beneficial impacts for fish and other aquatic species. The total volume of the City's current CSO discharge would be decreased by nearly 60 percent with the implementation of all CSO control projects included in the LTCP options. No in-water construction would occur for any of the options, and therefore no permanent impacts to aquatic habitats would occur.

There are no adverse operational impacts on biological resources associated with the LTCP Alternative.

6.5.2 What are the potential operational effects of the Integrated Plan Alternative on biological resources?

In addition to the beneficial impacts described above for the LTCP Alternative, the Integrated Plan Alternative would result in additional pollutant reductions, particularly in the Duwamish Waterway. Reductions in metals loading, particularly copper, would benefit aquatic resources in these waterways. Thornton Creek, Piper's Creek, and Longfellow Creek would experience reduced pollutant loadings from NDS Partnering projects. Multiple drainages throughout the Plan area would benefit from the expanded street sweeping program as summarized in Section 6.4.

6.5.3 What are the potential operational effects of the No Action Alternative on biological resources?

None of the projects proposed under the No Action Alternative are expected to cause impacts to biological resources. Rain gardens could provide small areas of habitat in neighborhoods. However, the No Action Alterative would not result in any of the long-term, beneficial impacts as described for the LTCP and Integrated Plan Alternatives because no additional CSO or stormwater control projects would be implemented beyond those projects and programs currently funded or slated for implementation. Water quality in water bodies throughout the Plan area would continue to be negatively impacted by CSO and stormwater releases. Fish and other aquatic species, including threatened or endangered salmonids and marine mammals, and their habitats would continue to be exposed to CSO discharges at the current levels.

Impacts would be greater during the wet weather season (approximately October through May) when CSOs and stormwater discharges are more likely. CSO and stormwater discharges in Elliott Bay would continue to cause potentially adverse effects to listed species present during the wet weather season, including Pacific salmon, steelhead, bull trout, rockfish, killer whale, Steller sea lion, and humpback whale. Adult Chinook, steelhead, coho, and sockeye salmon are present in the Duwamish, Ship Canal, Lake Union, Union Bay, and Lake Washington during this time, and sockeye salmon are present in Thornton, Piper’s, and Longfellow Creeks. Thornton and Longfellow Creeks also support adult Chinook salmon, and Piper’s Creek contains adult chum during the winter months. Juvenile salmonids, which are dependent on shoreline and nearshore habitats near outfalls, are present during the winter months in many of the same water bodies, particularly the Duwamish and Lake Washington, and would be exposed to CSO releases. Thornton, Piper’s, and Longfellow Creeks support juvenile steelhead and coho salmon, and Piper’s Creek also contains cutthroat and chum.

6.5.4 What measures are proposed to reduce or minimize impacts to biological resources?

Because none of the Plan alternatives are expected to cause adverse impacts to biological resources, no mitigation measures are proposed. Mitigation measures for reducing noise associated with facility operations are discussed in Section 6.8, Noise and Vibration.

6.6 Energy and Climate Change

This section describes the types of impacts that could occur to energy use and the risks associated with climate change within the Plan area resulting from operation of the Plan alternatives.

6.6.1 What are the potential operational effects of the LTCP Alternative on energy and climate change?

6.6.1.1 Energy Use

Storage facilities that are drained and flushed by gravity are anticipated to have the lowest energy requirements. Conversely, underground tanks or tunnels that rely on pump stations for dewatering, and mechanical flushing systems to scour accumulated sediments, are anticipated to have higher operation and maintenance needs. Electric pumps and ventilation equipment would be required at facilities such as pump stations, storage tanks, flow transfers, and tunnel facilities. The pumps and equipment would be operated by electricity. Although operating the CSO facilities can be energy intensive, most of the equipment operates infrequently, only during storm events. Therefore, the CSO facilities are expected to have a minor impact on energy use or demand in the Plan area.

6.6.1.2 Greenhouse Gas Emissions

Operation of the CSO facilities would generate greenhouse gases. Although most electricity used in the city is generated by hydropower, which does not produce greenhouse gases, small amounts of electricity are generated by natural gas and coal which do produce greenhouse gases.

6.6.1.3 Risks from Climate Change

As described in Chapter 4, the major risks associated with climate change in Seattle are increased precipitation and sea level rise. Climate change and some aspects of climate variability are expected to increase rainfall in the winter. Increased rainfall likely means an increase in stormwater runoff from impervious surfaces in the basin. Increased precipitation could increase the number of CSO events if new facilities are not designed to include climate change projections. However, CSO storage tanks have been designed to address the changes expected from climate change and climate variability. The City has incorporated climate change modeling in its development of Plan alternatives and would incorporate additional modeling in the design of individual CSO facilities as projects move forward. The control volumes required for compliance with the once-per-year overflow requirement for the LTCP have been determined based on a 6 percent increase in precipitation and associated stormwater over the current levels. Six percent is within the range of precipitation increase predicted by climate change modeling for the future planning period. Refer to *Volume 2, LTCP* for further information on climate change modeling.

Sea level rise is not anticipated to impact the proposed projects in the Ship Canal and Lake Washington Neighborhoods because the U.S. Army Corps of Engineers maintains Lake Washington at levels that are lower than the elevation of the project sites. The City would avoid locating CSO facilities in other areas of the city that are vulnerable based on sea level rise projections.

> **Key Findings**
>
> ***Energy and Climate Change***
>
> Both the *LTCP Alternative* and *Integrated Plan Alternative* would have minor operational effects on energy use. The greenhouse gas emissions produced by operating and maintaining CSO facilities are not expected to cause appreciable climate change impacts. SPU has incorporated climate change modeling in its development of Plan alternatives and would incorporate additional modeling in the design of individual CSO facilities to minimize risks from anticipated changes in precipitation and sea level rise.

6.6.1.4 Comparison of Energy and Climate Change Impacts among the LTCP Options

All of the LTCP options include proposed facilities that would require electrical power and increase energy use in the city. As described above, the increased use is expected to be minor. Climate change and climate variability have the potential to impact the proposed project due to increases in sea level and rainfall. All of the LTCP options would be designed to handle increased precipitation predicted by climate change modeling, and the projects would not be located in areas vulnerable to projected sea level changes. Therefore, all of the projects are expected to minimize risk from climate change. Differences among the LTCP options are described below.

Neighborhood Storage Option

CSO control facilities (tanks, pipes, sewer system improvements) would have minor operational effects on energy use as a result of pumping and electrical equipment requirements. The Neighborhood West Ship Canal Tunnel would have slightly higher energy requirements as described below for the Shared West Ship Canal Tunnel Option. Overall, energy use would be higher under the Neighborhood Storage Option compared to the other options because this option has the highest number of City and King County independently constructed CSO facilities.

Shared Storage Option

The larger shared storage tanks under the Shared Storage Option have slightly higher energy requirements than smaller tanks under the Neighborhood Storage Option. However, overall energy use would be expected to be lower because the shared tanks eliminate 10 City and 3 King County independently constructed CSO facilities.

Shared West Ship Canal Tunnel Option

The Shared West Ship Canal Tunnel Option would potentially have a slightly higher electrical requirement than tanks under both the Neighborhood Storage and Shared Storage Options because of the electricity needed to pump the deeply stored water. However, overall energy use would be expected to be lower than the Neighborhood Storage Option because 4 City and 1 King County independently constructed CSO facilities would be eliminated.

Shared Ship Canal Tunnel Option

The Shared Ship Canal Tunnel Option would have slightly higher energy use than the Shared West Ship Canal Tunnel because of the electrical energy requirements of the larger tunnel. However, overall energy use would be the most reduced under this option compared to the Neighborhood Storage Option because it eliminates 15 City and 3 King County independently constructed CSO facilities, the most of all the options.

6.6.2 What are the potential operational effects of the Integrated Plan Alternative on energy and climate change?

In addition to the CSO control facilities under the LTCP, the South Park Water Quality Facility would use energy on an intermittent basis. In general, impacts from the Integrated Plan Alternative would be very similar to the LTCP Alternative.

6.6.3 What are the potential operational effects of the No Action Alternative on energy and climate change?

Energy requirements from operation of projects implemented under ongoing programs are minimal.

Natural drainage systems do not require energy and would be located away from areas prone to sea level rise. Sewer system improvements and the planned storage projects included in the 2010 Plan Amendment would require electrical power, but the small increase in electrical demand is not expected have a major effect on electrical use in the city.

Any existing CSO facilities located in areas prone to sea level rise could be flooded, reducing their ability to effectively handle CSO events.

6.6.4 What measures are proposed to reduce or minimize energy and climate change impacts?

The City would undertake the following measures to reduce the impacts of CSO facilities on energy and to protect the facilities from the risks of climate change:

- Comply with state and City requirements related to energy efficiency of the new CSO facilities.
- Include evaluations of greenhouse gas emissions as required by the City in project-level SEPA analyses.
- Incorporate climate change modeling into design of CSO facilities.
- Utilize the adaptation planning pathways incorporated in the City's *Sea Level Rise Planning Guidance for Capital Projects* (City of Seattle, 2011d) to design and locate CSO facilities.

6.7 Environmental Health and Public Safety

This section describes the types of impacts that could occur to environmental health and public safety within the Plan area from operation of the Plan alternatives.

Key Findings

Environmental Health and Public Safety

Overall, the *LTCP Alternative* is expected to reduce environmental health risks associated with CSOs by reducing untreated discharges. Pathogens and toxic organic and inorganic constituents would be reduced to a greater level under the *Integrated Plan Alternative* than the LTCP Alternative. Once the deferred CSO control projects are implemented, they will add to the long-term loading reduction achieved by the Integrated Plan stormwater projects.

Under the *No Action Alternative*, water quality in surface waters throughout the Plan area would continue to be negatively impacted by CSO releases from uncontrolled outfalls and by stormwater discharges. The No Action Alternative is not compliant with the Consent Decree and is not consistent with the City's Plan for Protecting Seattle's Waterways.

6.7.1 What are the potential operational effects of the LTCP Alternative on environmental health?

Operation of the CSO facilities is expected to reduce the risk to human health by reducing CSO events that release untreated wastewater to surface water bodies. Reduced CSO discharges would reduce potential contamination that could reach Plan area beaches, thereby lowering the potential for human contact with contaminated waters. Water quality improvements from reduced CSO events may also help reduce contamination of fish and shellfish that are caught in the area and consumed.

As described in Chapter 5, contaminated materials could be encountered during construction, and some facilities, such as storage tanks and tunnels, could be constructed on contaminated sites. In both cases, the contaminated materials would be removed, resulting in improved conditions and reducing the potential for long-term environmental health impacts.

All options would reduce the number of CSO events and lead to improved water quality, as described above. None of the LTCP Alternative options are expected to cause adverse impacts to environmental health.

6.7.2 What are the potential operational effects of the Integrated Plan Alternative on environmental health and public safety?

As described in Section 6.4.2, a number of contaminants conveyed in CSOs and stormwater pose potential environmental health concerns. While both the LTCP Alternative and the Integrated Plan Alternative would substantially reduce pollutant loading, the Integrated Plan provides a higher level of pollutant reduction.

Pollutant load and human exposure evaluations conducted as part of the Integrated Plan indicated fecal coliform bacteria (an indicator for pathogens) would be reduced to a greater level under the Integrated Plan Alternative than the LTCP Alternative. As described above in Section 6.4, this is largely due to the greater volume reduced by the Integrated Plan Alternative, and because reductions from Integrated Plan projects would be greater during the months when potential for human contact is highest, between February and September. Refer to Chapters 6 and 8 of *Volume 3, Integrated Plan* for a more detailed discussion of the evaluation methodology and results for human exposure. In general, reduction in environmental health risks would be greatest under the Integrated Plan Alternative.

Under the Integrated Plan Alternative, both the stormwater projects and the deferred LTCP projects would reduce pollutant loads to water bodies. However, the stormwater projects would benefit water bodies throughout the city, while deferred LTCP projects would largely benefit the Duwamish Waterway and the Ship Canal. The Integrated Plan Alternative would result in substantially larger reductions in pollutant loads than the LTCP projects alone. These large reductions should bring accompanying reductions in environmental health risks.

NDS Partnering would construct bioretention facilities (i.e., engineered rain gardens) in the storm sewer system basis that drain to Piper's, Thornton, and Longfellow Creeks. Concerns have been raised by citizens regarding the potential safety risks and mosquito breeding potential associated with ponded water within bioretention facilities. However, proper siting and design of these facilities will minimize health and safety risks.

The South Park Water Quality Facility would treat runoff from approximately 250 acres in the 7th Avenue S drainage system, prior to discharge to the Lower Duwamish Waterway. The primary objectives are to reduce flows and loads of total PCBs, metals, bacteria, and other pollutants, which would be anticipated to reduce environmental health risks in these water bodies.

Expanded street sweeping would focus on the storm sewer system basins. Increased sweeping of arterials would remove potential stormwater pollutants from a drainage area of approximately 1,736 acres. The primary objective of expanded street sweeping would be to reduce loads of total PCBs, metals, bacteria, and other particulate-bound pollutants and prevent these pollutants from entering receiving waters, where environmental and public health risks could occur. Expanded street sweeping, in particular, is shown to provide substantial fecal coliform load reduction, resulting in lower levels of pathogens in receiving waters.

The stormwater projects provide larger load reductions for the key drivers for human exposure (PCBs and fecal coliform) than the LTCP projects that would be deferred. The primary reason is that the stormwater projects would treat larger volumes than the LTCP projects. Because the stormwater discharges are much more frequent than CSO discharges, they are more likely to present an exposure and environmental health risk.

Refer to *Volume 3, Integrated Plan*, for more information on pollutant reductions anticipated under the Integrated Plan Alternative.

6.7.3 What are the potential operational effects of the No Action Alternative on environmental health and public safety?

The No Action Alternative would not implement any additional CSO or stormwater control projects beyond those projects and programs currently funded or slated for implementation. Water quality in surface waters throughout the Plan area would continue to be negatively impacted by CSO releases from uncontrolled outfalls and by stormwater discharges. Contaminated discharges could continue to affect swimming beaches and fishing areas, causing potential environmental health impacts. People could be exposed to pathogens or other pollutants through direct contact with contaminated water or sediments (e.g., swimming or wading), ingestion of pathogen-containing water, or eating contaminated fish or shellfish. The No Action Alternative does not comply with the Consent Decree and is not consistent with the City's Plan for Protecting Seattle's Waterways.

The risk of CSOs having a harmful effect on humans from pathogens or other contaminant exposure ultimately depends on the extent of human activity in water bodies near CSOs during and immediately after a discharge event. Because CSO events largely occur during heavy rainfall in the cooler months, the potential number of individuals swimming or wading is likely fairly low, but activities on and near the water occur year-round. These risks could continue or potentially worsen under the No Action Alternative.

Natural drainage systems that are not maintained or properly sited could create breeding areas for mosquitoes. Mosquitoes breed in standing water and require at least a week to complete their life cycles. Generally rain gardens are designed to drain quickly, usually within several hours or a day. Thus, rain gardens that are properly sited and have quickly draining soils are unlikely to provide good breeding conditions for mosquitoes (Rector et al., 2012). Rain gardens require maintenance to keep vegetation healthy and to prevent standing water.

6.7.4 What measures are proposed to reduce or minimize impacts to environmental health and public safety?

The proposed projects and programs associated with the LTCP and Integrated Plan Alternatives would help to reduce environmental health risks and do not require further mitigation. As part of ongoing programs, the City undertakes the following measures to minimize impacts of natural drainage systems:

- The City maintains roadside rain gardens to prevent standing water and reduce the potential for mosquito breeding.
- The City provides education and incentives to encourage property owners to maintain rain gardens.

6.8 Noise and Vibration

This section describes the types of noise and vibration impacts that could occur from operation of the Plan alternatives.

6.8.1 What are the potential operational effects of the LTCP Alternative on noise?

Some facilities associated with storage tanks, pipes, and tunnels could generate noise during operation, including the following:

- Odor control facilities. Where passive odor control systems (without ventilation fans) are used, no noise control is required. Otherwise, odor control facilities, and any ventilation facilities, would be provided with noise reduction and attenuation measures as required to conform to permissible noise levels.
- Fans. Fans associated with heating, ventilating, and air conditioning would be contained within a facility vault. Fans would generate a steady, continuous sound and would operate 24 hours a day, 7 days a week.

Key Findings

Noise and Vibration

The net operational effects of the *LTCP Alternative* would be minor in the Plan area. Noise would be generated under all options by pump stations and odor control facilities. All facilities would be designed and maintained to reduce noise to permissible levels. Because the Neighborhood Storage and Shared Storage Options have the most project sites needing pump stations and other facilities, potential noise impacts are greatest for these options. Overall potential for noise impacts would be reduced under the Shared Storage and shared tunnel options because of fewer City and King County-only CSO facilities. No additional noise impacts are expected from the *Integrated Plan Alternative.*

- Tipping buckets, which flush a storage tank with clean water after a CSO event. Noise from tipping buckets is only generated after CSO events and would largely be contained within the tank itself.
- Pump stations. Pumps generate sound on an intermittent basis and most of the noise would be contained within the facility vault.
- Maintenance activities. Maintenance of the facilities would be infrequent and occur only during daytime hours, resulting in a minor source of noise.

Most noise-generating equipment associated with storage tanks and tunnels would be located below ground. All facilities would be designed to comply with the City's maximum allowable noise limits and, in all but the quietest of locations, to not exceed existing background noise levels at facility sites.

There would be no long-term sources of vibration at storage tank, pipe, or tunnel sites.

6.8.1.1 Comparison of Noise Impacts among the LTCP Options

Specific evaluation of noise levels and impacts is addressed at the project level when facility sites are known and site-specific background noise levels can be investigated. However, a general comparison of the potential noise impacts among the LTCP options is provided. Noise would occur from: (1) operation of pump stations and mechanical and electrical facilities, and (2) maintenance activities associated with projects included under the LTCP. Noise-related impacts would be minor under all options.

Because the Neighborhood Storage and Shared Storage Options would potentially have the most pump stations and other facilities, they would have a higher potential for noise impacts. Some pump stations and mechanical facilities could be located in residential areas, particularly in the Lake Washington, Longfellow Creek / Duwamish, and Ship Canal Neighborhoods.

The Shared West Ship Canal and Shared Ship Canal Tunnel Options would potentially have fewer pump stations and mechanical facilities than the other options, so operational noise impacts would potentially be the least under these options.

6.8.2 What are the potential operational effects of the Integrated Plan Alternative on noise?

Storage pipes, tanks, and tunnels constructed under the Integrated Plan Alternative would have the same operational noise impacts as under the LTCP Alternative, but construction of these facilities would be delayed in some neighborhoods. Operation of the projects specific to the Integrated Plan Alternative would have minimal noise impacts. Natural drainage systems would not generate noise. Street sweeping would only occur on arterial streets and would not generate noise in excess of typical vehicle noise. The South Park Water Quality Facility could generate some operational noise from ventilation fans and maintenance activities. However, the facility would be located in an industrial area and operational noise would not impact residences or other sensitive receptors.

6.8.3 What are the potential operational effects of the No Action Alternative on noise?

Operation of sewer system improvements and natural drainage systems would not generate noise.

6.8.4 What measures are proposed to reduce or minimize noise impacts?

A noise analysis for each project would be performed during final design. Once project sites are selected and receiving properties are identified, noise regulations (see Table 4-8) can be used to determine the level at which project-generated noise would be considered significant. Project- and location-specific mitigation measures would be determined at that time. Potential mitigation measures could include the following:

- Pump station and odor control facility designs would include attenuation measures for fan noise and pump and motor noise as needed to comply with noise levels specified by the City of Seattle and to address location-specific factors as determined during project design.
- Facility vault access hatches would be designed to be relatively thick and to have seals at the perimeters to contain noise within the vault.
- Noise-producing ventilation air intakes and exhausts would be placed in a direction facing away from sensitive receptors whenever possible.

6.9 Land Use and Visual Quality

This section describes the types of impacts that could occur to land use and visual quality within the Plan area from operation of the Plan alternatives.

Key Findings

Land Use and Visual Quality

Potential land use impacts associated with CSO control projects under the *LTCP Alternative* include conversion of land in residential, commercial, or industrial areas to public utility uses. These impacts differ between the options because of different property requirements of tanks vs. tunnels. The completed facilities would largely be constructed below ground; aboveground facilities would have minimal visual impacts with the use of site appropriate design and screening. Stormwater projects constructed under the *Integrated Plan Alternative* are not expected to cause major long term impacts to land use.

6.9.1 What are the potential operational effects of the LTCP Alternative on land use and visual quality?

6.9.1.1 Consistency with Seattle Comprehensive Plan Policies

The Plan is consistent with the overall goals and policies of the Comprehensive Plan, and individual goals and polices related to utilities and environment that call for improving water quality and minimizing CSO events. Consistency with individual Comprehensive Plan goals and policies related to land use, transportation, and other resources would depend on the details of the future projects.

6.9.1.2 Land Conversion or Easement Restrictions

Potential land use impacts associated with the proposed CSO facilities include conversion of land in residential, commercial, or industrial areas to public utility uses. Residents of residential areas in which CSO facilities are located could perceive the facilities as being inconsistent with local land use policies. As described in Section 4.8.1.2, locating such facilities in residential zones requires a Council Conditional Use Permit which requires public notification and input.

Storage pipes included in the LTCP Alternative would be located within the public right-of-way and would not cause land use changes. Storage pipes and other CSO control projects constructed within existing rights-of-way or City property would generally be most compatible with existing zoning and planning policies. Storage tanks and tunnels would require permanent access hatches or shafts for maintenance, but those access sites would require less property for permanent easements than the areas used for construction. To the extent possible, the City would attempt to avoid locating storage facilities such as storage tanks and tunnel portals in parks, and no facilities would be built on beaches. However, limitations in available sites for facilities may necessitate locating storage facilities in or adjacent to a park in some cases, potentially affecting current and future recreational uses. See Section 6.10, Recreation.

The presence of underground storage tanks would restrict certain future uses at the site of the facility. Typical uses for the tops of storage tanks include athletic fields and parking facilities. The City would retain more area in ownership or by permanent easement for a storage tank than for a tunnel.

In contrast to storage tanks, the City would be able to sell or lease approximately 75 percent of the tunnel launch portal lands required for construction back to private ownership where it could be developed for zoned uses (e.g., industrial, commercial). Approximately 0.5 acre would be retained by the City to house the pump station, odor control, and permanent shaft (approximately 30-foot-diameter caisson) for access and maintenance. All of the area used for the smaller, recovery end of the tunnel would be retained by the City. Additionally, tunnel shafts would be required to accept flows from each contributing City and King County CSO basin (depending on the LTCP option).

6.9.1.3 Redevelopment Potential

Construction of tunnel portals could occur in contaminated soils, given the probable location of the tunnel portal along the Lake Washington Ship Canal within historically industrial areas. Remediation of these sites would be required prior to tunnel construction. Once the tunnel has been constructed, much of the tunnel launch portal land could be sold back to private ownership. Remediation would make these areas more attractive for private developers.

6.9.1.4 Visual Impacts

The completed facilities would largely be constructed below ground (Figure 6-2). Aboveground facilities would have minimal visual impacts with the use of appropriate design and screening. Visible facilities would include pump stations and other facilities (if located above ground) to support storage tanks, pipes, and tunnels. Typically the size of these facilities ranges from a small shed to as large as a small residential house; they are designed to blend in with the neighborhood. Some storage facilities would 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.

Figure 6-2. Typical Underground Storage Tank (Genesee CSO Storage Tank Rendering)

6.9.1.5 Comparison of Land Use and Visual Quality Impacts among the LTCP Options

As described above, storage tanks, and to a lesser extent storage tunnels, could potentially cause minor long-term land use impacts depending on the sites selected. Visual impacts for all options would be minor because aboveground facilities would be relatively small and designed to blend with the surrounding neighborhood. While impacts would generally be similar among the LTCP options, the following differences exist.

Neighborhood Storage Option

This option would have the most storage tanks located throughout the Plan area with the potential to cause permanent land use changes. Private property or permanent easements could be acquired for any of the LTCP options, but they would likely be greatest under the Neighborhood Storage and Shared Storage Options. Current land uses would be permanently changed to become storage facilities, but the tanks and associated equipment would largely be underground. The presence of underground storage tanks would restrict certain future uses at the site of the facility. While there is the potential to redevelop the surface area into certain beneficial uses, the previous land use at the site could be permanently altered. Typical uses for the tops of storage tanks include passive recreation, athletic fields, and parking facilities. The City would retain more area in ownership or by permanent easement for a storage tank than for a tunnel.

Ballard would have the largest storage tank (occupying an estimated 60,000 square feet). The completed facilities would be designed to visually blend with the surroundings, but it is likely that they will have a different appearance than preconstruction conditions. Storage pipes would be constructed in street rights-of-way and would have less potential for land use changes.

Storage pipes located in the Lake Washington Neighborhoods, Longfellow Creek /Duwamish Neighborhoods, and in Magnolia would be constructed in street rights-of-way and would not have a long-term impact on local residential and commercial land uses. Tanks located in the Ship Canal Neighborhoods and the East Waterway area could result in long-term, localized land use impacts given the number of tanks that would potentially need to be sited on industrial lands. The City has heard public concerns about converting the city’s limited industrial lands to other uses.

The Neighborhood West Ship Canal Tunnel would have similar impacts in Ballard and Fremont/Wallingford as described below for the Shared West Ship Canal Tunnel Option.

Shared Storage Option

The impacts would be similar to the Neighborhood Storage Option. While fewer sites in the Ship Canal Neighborhoods would be used for storage tanks, and no tank would be sited in the East Waterway area, potential land use impacts from siting larger shared tanks could occur in the Lake Washington Neighborhoods. These tanks would occupy an estimated 35,000 square feet (North Union Bay) and 40,000 square feet (Montlake). There is a greater potential for conversion of residential lands for storage tanks in the Lake Washington Neighborhoods under this option, with perceived inconsistency with adjacent residential land use. As noted above, the City would retain more area in ownership or by permanent easement for a storage tank than for a tunnel, and the presence of an underground tank restricts certain future uses of the site.

Shared West Ship Canal Tunnel Option

This option would have less potential for long-term land use impacts than both the Neighborhood Storage and Shared Storage Options since the tunnel would replace the need to site several storage tanks in the Ship Canal Neighborhoods (Ballard and Fremont/ Wallingford), and less property would need to be retained by the City following construction. In contrast to storage tanks, the City would be able to sell or lease approximately 75 percent of the tunnel launch portal lands in Ballard required for construction back to private ownership where it could be developed for zoned uses (e.g., industrial, commercial). Approximately 0.5 acre of the launch portal would be retained by the City to house the pump station, odor control, and permanent shaft for access and maintenance. All of the area used for the smaller, recovery end of the tunnel in Fremont/Wallingford would be retained by the City. Some additional areas would be retained for permanent shafts as required to accept flows from each contributing City and King County CSO area.

Shared Ship Canal Tunnel Option

Similar to the Shared West Ship Canal Tunnel Option, less property would need to be retained following construction of the tunnel compared to the Neighborhood and Shared Storage Options. The City would be able to sell or lease approximately 75 percent of the tunnel launch portal lands on the south side of the Ship Canal required for construction back to private ownership where it could be developed for zoned uses (e.g., industrial, commercial). Approximately 0.5 acre would be retained by the City to house the pump station, odor control, and permanent shaft for access and maintenance. All of the area used for the smaller, recovery end of the tunnel in North Union Bay would be retained by the City. Compared to the Shared West Ship Canal Tunnel Option, the Ship Canal Tunnel would result in less potential for land use impacts in Ballard and more potential for land use impacts on the south side of the Ship Canal and in North Union Bay.

6.9.2 What are the potential operational effects of the Integrated Plan Alternative on land use and visual quality?

Stormwater projects constructed under the Integrated Plan are not expected to cause major long-term impacts to land use or visual quality. The South Park Water Quality Facility is expected to have a footprint of less than 1 acre and there is likely available City property within the basin that is suitable for the facility. The facility would likely be sited in an industrial-zoned area, surrounded by industrial land uses. The visual impact of the facility is expected to be minimal, because the aboveground structure would be less than two stories high, resembling a pump station building.

Long-term land use impacts from NDS Partnering projects would be minimal because the projects would be implemented in neighborhoods on a voluntary basis, and they would be installed to blend with neighborhood character. Projects such as rain gardens constructed within public rights-of-way would add vegetated elements and streetscaping to existing neighborhoods. The projects would result in narrower roads that can provide a traffic calming effect, which could be a beneficial impact in some neighborhoods. Some neighborhoods would experience increased community interaction, as residents collaborate to develop landscaping plans and implement stewardship programs. Because ongoing maintenance would be an important component in the long-term effectiveness of these facilities, the City would implement a maintenance and monitoring program. The City's early experiences with rain gardens would be used to implement projects that function according to design, are safe, and are sustainable. The facilities would be sited in areas with appropriate soils, and they would only be implemented in areas where the neighborhood has volunteered to be a part of the program.

Land use impacts associated with expanded street sweeping are not expected to occur. Residential parking would not be affected by the expanded program, and because only minimal parking occurs on arterials at night, indirect land use impacts are not expected.

6.9.3 What are the potential operational effects of the No Action Alternative on land use and visual quality?

Operation of sewer system improvements and NDS projects implemented under ongoing programs is not expected to result in land use or visual quality impacts. The planned CSO control projects included in the 2010 Plan Amendment would have minor land use impacts. Visual quality impacts would be limited to the aboveground support facilities needed for the CSO control projects and are also expected to be minor.

6.9.4 What measures are proposed to reduce or minimize impacts to land use and visual quality?

The City would undertake the following measures to mitigate land use and visual quality impacts for all proposed projects:

- Minimize the size of permanent aboveground facilities and design them to blend with the surroundings.
- Locate and aim any artificial lighting away from adjacent roadways, residential areas, and water bodies. Use the minimum wattage necessary to provide the necessary illumination.
- Sell or lease portal land in excess of what is needed back to private ownership.

Additional site-specific measures would be identified during project design.

6.10 Recreation

This section describes the types of impacts that could occur to recreational activities, parks, and beaches within the Plan area resulting from operation of the Plan alternatives.

6.10.1 What are the potential operational impacts of the LTCP Alternative on recreation, parks, and beaches?

The operation of CSO facilities such as sewer system improvements, storage pipes, and flow transfers would cause few impacts to recreation, parks, and beaches because the facilities would be located in public rights-of-way. To the extent possible, the City would attempt to avoid locating CSO facilities such as storage tanks and tunnel portals in parks, and no facilities would be built on beaches.

However, because of limitations in available sites for facilities, it may be necessary to locate storage tanks or tunnel portals in or adjacent to a park or athletic field, or in parking areas or other associated park land. Locating CSO facilities in parks could constrain the use of that portion of a park for certain future park uses. Any underlying utility facility could preclude future development on the site for some uses. Close coordination with Seattle Parks and Recreation would occur to avoid and minimize impacts. Siting a CSO facility in a park would require compliance with Initiative 42 (Ordinance No. 118477) which requires a public hearing and an ordinance finding that any change of a park use to another usage is necessary (see Section 4.9.1.4).

In contrast to storage tanks, which require only small access hatches as permanent surface features, the City would need to retain a portion of the surface area above the tunnel shafts (approximately 30–foot-diameter caisson) for permanent access and maintenance. This permanent area could occupy as much as 0.5 acre.

Key Findings

Recreation

Overall, the operational effects from the *LTCP Alternative* on recreational activities are expected to be minor. Reductions in pollutant loading would benefit long-term water quality and help maintain beneficial uses at area beaches. Water contact recreation would be enhanced by improved water quality in Lake Washington, Portage Bay, and Lake Union, in particular. If located in a park, storage facilities would constrain certain future uses of that area for park purposes. However, recreational amenities could be provided on top of storage tanks following construction. The *Integrated Plan Alternative* would not result in additional impacts to recreation. The *No Action Alternative* would result in no additional improvements to water quality in the Plan area water bodies, with ongoing adverse effects on swimming beaches.

If the City locates a storage tank in a park, the area over the tank would be restored and opportunities would be explored to provide park amenities on the surface. Associated CSO facilities could take up a small area of the park and would be designed to blend in with the park surroundings. The CSO facility would be designed and constructed to ensure that recreational activities (such as walking, biking, sports, etc.) at parks would not be impacted by the operation of CSO facilities, and that planned or programmed future recreational uses would be maintained to the extent possible. If the City locates a storage tank or tunnel portal on athletic fields, the fields would be restored following construction and no long-term changes in use of the fields would occur. If a CSO facility is built in or adjacent to a park with a National Park Service grant, close coordination with Seattle Parks and Recreation would occur to ensure that the project does not interfere with grant compliance.

In general, the LTCP Alternative would reduce pollutant loading to the area's water bodies, with potential long-term benefits to water-based recreation. In particular, parks within the Ship Canal and Lake Union would experience the highest level of pollutant reduction, followed by Lake Washington, Longfellow Creek, and Puget Sound.

6.10.1.1 Comparison of Recreation Impacts among the LTCP Options

Differences among the options within each neighborhood are as follows.

Neighborhood Storage Option

This option would have the most tanks located throughout the Plan area, thereby resulting in the greatest potential to result in long term effects to an existing park or recreational facility. Parks in the Ship Canal Neighborhoods would have the greatest potential to be affected, given the number of tanks located in those neighborhoods. Once construction is complete, recreational activities at parks would be returned to preconstruction uses to the greatest extent possible. Potential future changes in park use could be constrained if permanent CSO facilities are located within the park area.

Parks in the Ship Canal Neighborhoods that could be near CSO facilities include the Burke Gilman Trail in the Fremont/Wallingford neighborhood, Discovery Park, and small neighborhood parks. Lake Washington Neighborhoods have a high concentration of parks, including both small neighborhood parks and major parks such as the Washington Park Arboretum, Madison Park, and numerous parks designed by the Olmsted Brothers. One of the major roads in the area is Lake Washington Boulevard, which was designed by the Olmsted Brothers and is a city park. It is likely that a storage pipe would be built in the right-of-way of Lake Washington Boulevard under this option because few other areas are available. The Leschi neighborhood has a particularly high concentration of parks and few roads suitable for construction in the right-of-way, so it is likely that storage pipes would be built directly adjacent to parks in this neighborhood. CSO facilities in the Longfellow Creek/Duwamish Neighborhoods are less likely to be constructed near parks, though smaller neighborhood parks and the Longfellow Creek Green Space are located in the Delridge neighborhood. CSO facilities in the Central Waterfront neighborhood are unlikely to be directly adjacent to a park, but the neighborhood does include many significant recreational facilities such as the Sculpture Park, the Aquarium, and small neighborhood parks.

The Neighborhood West Ship Canal Tunnel would have similar impacts in Ballard and Fremont/Wallingford as described below for the Shared West Ship Canal Tunnel Option.

Shared Storage Option

This option would have similar potential impacts as the Neighborhood Storage Option. While fewer sites in the Ship Canal Neighborhoods would be used for storage tanks, potential park and recreation impacts from siting larger shared tanks could occur in Fremont/Wallingford (Burke Gilman Trail and Fremont Canal Park) and in the Lake Washington Neighborhoods. The Montlake neighborhood is more likely to be affected under this option because of the relatively larger amount of parkland, including Montlake Boulevard (an Olmsted Park). The storage tank in North Union Bay would be located in proximity to the University of Washington Athletic Complex (including fields, a golf course, a ballpark, and an outdoor track) and the Union Bay Natural Area. Potentially impacted parks in other neighborhoods would be the same as under the Neighborhood Storage Option.

Shared West Ship Canal Tunnel Option

The tunnel would replace the need to site several storage tanks in the Ship Canal Neighborhoods (Ballard and Fremont/Wallingford), reducing the potential for long-term impacts to parks and recreational facilities. However, the tunnel portal site could be located in or adjacent to existing or planned parks and greenways. Potentially impacted parks in other neighborhoods would be the same as under the Neighborhood Storage Option.

Shared Ship Canal Tunnel Option

Tunnel portals would be located along the south side of the Ship Canal and North Union Bay where there are many park and recreation areas, including sports fields owned and operated by Seattle Pacific University and the University of Washington, as well as the Burke Gilman Trail and numerous neighborhood parks. Fields and parking lots associated with the University of Washington Athletic Complex could be impacted. However, no storage tanks would be built in the Ship Canal or Lake Washington Neighborhoods, reducing the potential to affect parks and recreational opportunities in these neighborhoods. Potentially impacted parks in the Longfellow Creek/Duwamish and Elliott Bay/Lake Union Neighborhoods would be the same as under the Neighborhood Storage Option.

6.10.2 What are the potential operational effects of the Integrated Plan Alternative on recreation, parks, and beaches?

Storage pipes, tanks, and tunnels constructed under the Integrated Plan Alternative would have the same recreational impacts as under the LTCP Alternative. The elements specific to the Integrated Plan Alternative are not expected to result in recreation impacts. Natural drainage systems would be constructed largely in residential areas and the completed projects would not impact passive recreation such as walking and biking. Expanded street sweeping would use main arterial roads and would occur at night, so it would be unlikely to impact recreational use of streets. The South Park Water Quality Facility would be located in an industrial area and would not be near any recreational uses.

In general, the Integrated Plan Alternative would results in greater reduction of pollutant loading to the area’s water bodies than the LTCP Alternative, although both alternatives would provide overall benefits to water-based recreation. Water-based recreation in the Duwamish River would receive the highest level of initial benefit because of proposed projects within that basin.

6.10.3 What are the potential operational effects of the No Action Alternative on recreation?

Sewer system improvements would cause no direct impacts to recreation, parks, and beaches. Natural drainage solution projects such as rain gardens could be constructed adjacent to or in parks. These facilities are not expected to affect recreation or use of the parks. Rain garden plantings would blend with park landscaping. The CSO control projects included in 2010 Plan Amendment could be located in or near parks and beaches. Those projects either have been completed or will undergo separate SEPA analysis, as appropriate.

The No Action Alternative would result in no additional improvements to water quality in the Plan area. Indirect effects on water-based recreational activities at swimming beaches and in Plan area water bodies associated with continued CSO discharges would continue and potentially worsen.

6.10.4 What potential measures are proposed to reduce or minimize impacts to recreation?

The City would undertake the following measures to mitigate park and recreational impacts for all proposed projects:

- Comply with the conditions of Initiative 42 (Ordinance No. 118477) related to siting public facilities in parks.

- Coordinate closely with Seattle Parks and Recreation Department to minimize potential operational impacts for current and future recreational activities.

Additional site-specific measures, including mitigation for project-related impacts, would be identified during project design.

6.11 Historic, Cultural, and Archaeological

Operation of projects implemented under the Plan alternatives is anticipated to have no effect on historic, cultural, and archaeological resources within the Plan area.

6.12 Transportation

This section describes the types of impacts that could occur to transportation within the Plan area from operation of the Plan alternatives.

Key Findings

Transportation

Overall, the operational effects from vehicle trips generated by facility maintenance under all Plan alternatives are expected to be minor.

6.12.1 What are the potential operational effects of the LTCP Alternative on transportation?

When constructed, the CSO 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 most common visits to storage facilities by City maintenance staff would occur quarterly and after a CSO event, typically requiring only one vehicle. In the first year or so of use, City staff may elect to visit the site periodically during or after a CSO event, which would also typically require only one vehicle. The frequency and number of vehicles represent a very small portion of the overall traffic in the project vicinity. Occasional maintenance may be required at these locations, which could generate a small number of localized vehicle trips. This is expected to occur infrequently and would not affect roadway operations. Therefore, no long-term impacts on transportation are expected to result from the LTCP Alternative.

6.12.2 What are the potential operational effects of the Integrated Plan Alternative on transportation?

Operation of the additional projects implemented under the Integrated Plan Alternative would have minimal transportation impacts. Projects implemented under NDS Partnering may generate occasional maintenance trips that would have negligible effects on traffic operations. The South Park Water Quality Facility could also generate occasional vehicle trips with minimal effect on roadway operations. Expanded street sweeping would consist of expanding the extent of a program that is already in place. Street sweeping would only occur on arterial streets at night when traffic is low and would not affect roadway operations.

6.12.3 What are the potential operational effects of the No Action Alternative on transportation?

Completed projects under the No Action Alternative are not expected to cause transportation impacts.

Occasional maintenance may be required at locations of sewer system improvements, natural drainage projects, and CSO control projects completed under the 2010 Plan Amendment, which could generate a small number of localized vehicle trips. These trips would be expected to occur infrequently and would not affect roadway operations.

6.12.4 What measures are proposed to reduce or minimize impacts to transportation?

Because there would be no impacts to transportation, no mitigation measures are proposed.

6.13 Utilities

This section describes the types of impacts that could occur to utilities (largely wastewater utilities) within the Plan area from operation of the Plan alternatives. Potential impacts to other utilities including water, electrical, natural gas, and communications are highly project-specific and will be evaluated at the future project implementation stage.

6.13.1 What are the potential operational effects of the LTCP Alternative on utilities?

Implementation of the LTCP will require close coordination with numerous utilities, in particular, wastewater and stormwater utilities within the service area. Because the City's collection system network sends wastewater to King County for treatment, coordination with King County will be particularly important. King County's West Point Treatment Plant would receive additional sewage flows as a result of Plan implementation. The high variability in flow rates within the sewer system associated with heavy storms could be challenging to manage at the King County West Point Treatment Plant.

Based on City modeling, these additional flows will have little effect on the peak loading to King County's West Point Treatment Plant and may potentially reduce peak loading. However, annual average flows will increase, resulting in greater operational and maintenance costs. Seattle and King County will address the incremental cost of these flows in their sewage disposal agreement. The potential implications to King County's combined sewer system vary depending upon the option implemented, as described below. In general the operational implications associated with shared options will require greater coordination with King County than the Neighborhood Storage Option.

Key Findings

Utilities

Implementation of the *LTCP Alternative* would require close coordination with numerous utilities within the service area. King County's West Point Treatment Plant would receive additional sewage flows, but these additional flows would have little effect on the peak loading to West Point. However, annual average flows would increase, resulting in greater operational and maintenance costs to King County. The potential implications to King County's combined sewer system vary depending upon the option implemented. For all LTCP options, the City would work together with King County to analyze and mitigate downstream operational and capital impacts to the King County System.

Impacts to public utilities would be largely related to selection of an LTCP option. No additional impacts are expected to occur related to the implementation of *Integrated Plan* stormwater projects.

Neighborhood Storage Option

This option would generally have minimal operational impacts to utilities within the service area once construction is complete. Sewer system improvements in North Union Bay and a flow diversion in Portage Bay, as well as flow diversions in the South Delridge and East Waterway neighborhoods, would modify the flow volumes diverted to the King County system. This could result in operational impacts if not adequately coordinated with the County. However, all flow diversions would be undertaken in accordance with signed agreements with King County to ensure that impacts do not occur or are mitigated.

This option would result in the largest number of independent storage and conveyance (pipeline and pump station) facilities constructed and operated by both the City and the County, resulting in accompanying operation and maintenance requirements for each facility. Implementing the Neighborhood West Ship Canal Tunnel option would reduce the total number of facilities constructed, which could reduce the operational impacts associated with the individual storage facilities, but would result in operational considerations for the tunnel.

Shared Storage Option

The Shared Storage Option would result in three shared storage projects, including a shared tunnel in the Fremont/Wallingford neighborhood, a storage tank in the North Union Bay neighborhood, and a storage tank and flow diversion structures in the Montlake/Leschi neighborhoods. Shared projects would require close coordination regarding operation and maintenance considerations, cost sharing, and other factors. Close coordination of these projects between utilities can avoid any decrease in the operational efficiency of shared facilities. Long-term agreements will be made prior to the decision to implement the shared projects; therefore, significant long-term impacts are not anticipated. Implementation of this option would eliminate the need for several City and King County independent storage facilities, which would reduce the overall operational and maintenance requirements.

Shared West Ship Canal Tunnel Option

The Shared West Ship Canal Tunnel Option would require substantial coordination with King County during project planning, design, and construction. The Shared West Ship Canal Tunnel Option may reduce the operational complexity of controlling neighborhood storage tanks or even shared storage tanks, as it provides one large storage facility for all flows to be managed through a single point of discharge to the West Point Treatment Plant. Substantial coordination with King County would be needed during the planning, design, construction, and operation of the shared tunnel to capture all potential benefits.

Shared Ship Canal Tunnel Option

The Shared Ship Canal Tunnel Option would require substantial coordination with King County during project planning, design, and construction. As with the Shared West Ship Canal Tunnel Option, this option may reduce the operational complexity of controlling neighborhood storage tanks or even shared storage tanks, as it provides one large storage facility for all flows to be managed through a single point of discharge to the West Point Treatment Plant. Additional City and King County flows would be handled by the larger, Shared Ship Canal Tunnel, further reducing operational complexity. Substantial coordination with King County would be needed during the planning, design, construction, and operation of the shared tunnel to capture all potential benefits.

6.13.2 What are the potential operational effects of the Integrated Plan Alternative on utilities?

Operation of the additional projects implemented under the Integrated Plan Alternative would not have any anticipated adverse impacts on utilities.

6.13.3 What are the potential operational effects of the No Action Alternative on utilities?

Operation of projects completed as part of ongoing programs under the No Action Alternative is not expected to cause utility impacts. Under the No Action Alternative, no additional CSO control measures would be completed. Therefore, no additional storage would be constructed within the City's combined sewer system, resulting in continued and likely more frequent and/or higher volume overflows occurring into the future. Implementation of the No Action Alternative would not comply with the Consent Decree, and it could potentially result in significant fines for the City, with potential impacts to City ratepayers.

6.13.4 What measures are proposed to reduce or minimize impacts to utilities?

For all LTCP options, the City would work together with King County to analyze and mitigate downstream operational and capital impacts to the King County System. If downstream impacts cannot be successfully mitigated, then there is the potential that the County will be required to build new or larger downstream capital facilities to accommodate the LTCP options. Even with adequate mitigation though, there would likely be an increase in the County's operations & maintenance (O&M) costs to account for the additional flows from the City's system.

6.14 Socioeconomics and Environmental Justice

This section describes the types of socioeconomic and environmental justice impacts that could occur within the Plan area from operation of the Plan alternatives.

Key Findings

Socioeconomics and Environmental Justice

The operational effects of both the *LTCP Alternative* and *Integrated Plan Alternative* would be minor to moderately beneficial, and there would be no adverse operational effects that would be predominantly borne by minority or low-income populations and underserved communities. The *No Action Alternative* could result in minimal to substantial adverse impacts on environmental justice populations in the Plan area.

6.14.1 What are the potential operational effects of the LTCP Alternative on socioeconomic conditions and environmental justice populations?

6.14.1.1 Neighborhood Cohesion

The greatest impact of storage facilities on socioeconomic conditions, including neighborhood cohesion, would occur during construction. Once the facilities are completed, the disruptions would be minor and infrequent. Sewer system improvements and storage pipes, tanks, and tunnels would be located underground and would not cause impacts. Some associated facilities would generate noise, but noise levels are not expected to exceed the City's maximum noise levels. Some facilities also have the potential to produce odor, but that potential is minimal because the facilities would include state-of-the-art odor reduction equipment. None of the completed facilities would have long-term effects on community facilities (churches, schools, community centers, or libraries). There would be no changes to travel routes and durations, transit service, pedestrian access, or the character of land uses in neighborhoods. Therefore, none of the options would have long-term operational effects on neighborhood cohesion.

6.14.1.2 Environmental Justice

Because the LTCP options would result in very limited and minor operational effects, there would be no adverse operational effects that would be predominantly borne by minority or low-income populations. These minor impacts would affect all populations including historically underserved and low-income residents of neighborhoods in the Plan area. While the Longfellow Creek/Duwamish Neighborhoods have a greater presence of minority and low-income populations in comparison to other neighborhoods in the Plan area, none of the options include projects that would have greater operational disturbance in this area than in the other Plan neighborhoods. Given the distribution of the LTCP projects throughout the city, these minor operational effects on neighborhoods would not fall disproportionately on environmental justice populations. Implementation of the LTCP Alternative would not result in any identifiable effects that would be specific to any minority, low-income, or underserved community.

Under the LCTP Alternative, CSO discharges would be reduced, which would indirectly result in a long-term, beneficial impact on human health and safety. There would be beneficial effects on those who fish along the piers or waterfront as a result of improved water quality. These effects would be the same regardless of option. The improved water quality that would be achieved could increase the number of salmon and other fish species over time and could indirectly benefit Native American fishing in the area.

6.14.1.3 Comparison of Socioeconomic and Environmental Justice Impacts among the LTCP Options

Generally, none of the projects proposed for any of the LTCP Alternative options would have environmental justice impacts. While socioeconomic impacts would be minor and are generally similar among the LTCP options, the following differences exist.

Neighborhood Storage Option

The availability of sites ranging from 0.5 acre to 2 acres that are suitable for storage tanks is limited in the Plan neighborhoods. Economic and business impacts could result if economically important industrial or commercial lands are purchased or leased for this purpose.

The Neighborhood West Ship Canal Tunnel would have similar impacts in the Ship Canal Neighborhoods as described below for the Shared West Ship Canal Tunnel Option.

Shared Storage Option

Shared storage tanks (and a flow transfer in the East Waterway area) would reduce the total number of new storage tanks required in the city (by both the City and King County). This would reduce the amount of property acquisition or permanent easements required.

Shared West Ship Canal Tunnel Option

Under the Shared West Ship Canal Tunnel Option, beneficial effects on local economic activity in the Ship Canal Neighborhoods could occur over time once construction is completed and previous vacant industrial or commercial lands (if used for tunnel portals) become more attractive for investment. Lands reclaimed or repurposed for industrial or commercial use after construction of tunnels could stimulate economic activity, provide opportunities for new or expanded business and employment, and generate more tax revenues.

Shared Ship Canal Tunnel Option

Impacts would generally be the same as the West Ship Canal Tunnel Option and could potentially be beneficial.

6.14.2 What are the potential operational effects of the Integrated Plan Alternative on socioeconomic conditions and environmental justice populations?

The effects of the additional Integrated Plan stormwater projects would be minor to moderately beneficial. There would be no adverse operational effects that would be predominantly borne by minority or low-income populations and underserved communities. Under the Integrated Plan Alternative, both the stormwater projects and the deferred LTCP projects would reduce pollutant loads to water bodies. However, the deferred LTCP projects would benefit the Duwamish Waterway and the Ship Canal while the stormwater projects would benefit water bodies throughout the city. The Integrated Plan Alternative would result in substantially larger reductions in pollutant loads than the LTCP projects alone. This should bring large reductions in environmental health risks, which are often predominantly borne by minority or low-income populations.

6.14.3 What are the potential operational effects of the No Action Alternative on socioeconomic conditions and environmental justice populations?

Under the No Action Alternative, CSO discharges would not be reduced beyond what is planned as part of the 2010 Plan Amendment. No further improvements in current environmental health risks associated with pollution of the Plan area water bodies would occur. These current health risks are predominantly borne by low-income, tribal, and subsistence fishing communities, and immigrant families for whom fishing the Duwamish River, the Lake Washington system, and Puget Sound is rooted in cultural traditions.

Sewer system improvements and natural drainage systems included in the No Action Alternative are not expected to cause socioeconomic or environmental justice impacts.

6.14.4 What measures are proposed to reduce or minimize socioeconomic and environmental justice impacts?

The City actively solicited public participation as part of the planning process for the Plan and gave equal consideration to all input from persons regardless of age, race, income status, or other socioeconomic or demographic factors. The City will continue public participation efforts as projects are advanced consistent with the City's social and racial justice initiative.

CHAPTER 6

OPERATION IMPACTS AND MITIGATION

6.1 Introduction

6.1.1 What is included in this chapter?

This chapter describes the potential effects of the Plan after construction has been completed and the Plan projects are in operation. Both the LTCP Alternative and the Integrated Plan Alternative would implement one of the four LTCP options, although some of these CSO control projects would be deferred under the Integrated Plan Alternative. Because CSO control facilities under the LTCP options would largely be underground, few operational effects to the environment would result from Plan implementation.

The same elements of the environment discussed in Chapters 4 and 5 are discussed in this chapter, following the same general organization. The potential direct and indirect effects of project operation were analyzed for the Plan alternatives and the No Action Alternative. Because the Plan would be implemented as a coordinated package phased over time, the effects of the combination of all elements functioning together as an overall plan are presented. Long-term cumulative impacts are presented in Chapter 7.

Under the No Action Alternative, the Plan would not be implemented. The main long-term implications of not implementing the Plan relate to surface water quality and include indirect effects on biological resources, environmental health, and recreation. The only other operational effects would be those caused by the operation and future maintenance and repairs of existing CSO facilities, planned CSO control projects, ongoing programs (roadside rain gardens, RainWise), and existing and planned stormwater facilities.

6.2 Earth and Groundwater

This section describes the types of impacts that could occur to the geological setting, soils, and groundwater within the Plan area resulting from operation of the Plan alternatives.

> **Key Findings**
>
> ***Earth and Groundwater***
>
> Overall, the operational effects from the *LTCP Alternative* and the *Integrated Plan Alternative* are expected to be minor. With the implementation of site-appropriate design, potential adverse impacts would be avoided and minimized.

6.2.1 What are the potential operational effects of the LTCP Alternative on earth and groundwater?

Generally, none of the projects proposed for any of the LTCP Alternative options would cause erosion impacts because there would be no exposed soils following construction and site restoration. Because underground storage facilities (pipes, tanks, tunnels) would not be constructed on steep slopes or landslide-prone areas, and would not require new slopes or major earth fills, operational impacts would generally be limited to geologic hazards that already exist. For example, there would be a risk of seismic events during the period of operation, and this risk could result in other related geologic hazards, such as liquefaction and seismic-induced slope failures.

6.2.1.1 Seismic Hazards

The CSO control projects, including storage tanks and tunnels, would be designed for the seismic hazards that are known to exist. As part of project-specific site analysis and facility design, technical engineering analysis would be conducted to confirm that the facility meets appropriate seismic design criteria, including the design of shoring, storage structures, and related facilities. Storage tanks, pipes, and tunnels included in the LTCP options would be designed in accordance with seismic design standards, which are intended to minimize the long-term risks to the system.

6.2.1.2 Changes to Groundwater Flow

Groundwater flow paths could be altered by tanks, pipes, and tunnels, or ground improvements included in project designs. The potential impact to groundwater flow is considered low for all types of projects included under the LTCP options. However, the potential effects of barriers to groundwater flow, such as sheet pile walls or subsurface tunnels, would be considered during siting and final design to confirm that effects to any nearby soils or structures supported on or within the soils would be negligible.

6.2.1.3 Comparison of Earth and Groundwater Impacts among the LTCP Options

The degree of the impacts described above would depend on the specific site conditions and project-specific design. The most important geologic hazard for operations would result from seismic ground shaking, which would affect all facilities, although the hazard could be slightly higher in the Longfellow Creek / Duwamish Neighborhoods because of their proximity to the Seattle Fault Zone where the risks from fault movement and ground shaking are higher. In other areas, the primary seismic hazard would be associated with ground shaking and secondary effects of ground shaking, such as liquefaction. With the implementation of appropriate design, potential adverse impacts would be avoided and minimized.

All of the CSO facilities included in the options would be designed to meet all applicable standards to minimize seismic risk. While impacts are generally similar among the LTCP options, the following differences exist.

Neighborhood Storage Option

This option would have the most tanks and pipes located throughout the Plan area potentially at risk during a seismic event. However, storage facilities would be designed in accordance with seismic design standards, which are intended to minimize the long-term risks to the system. Tanks and pipes located in the Longfellow Creek / Duwamish Neighborhoods (in proximity to the Seattle Fault Zone) could potentially be at a greater risk during a seismic event than other areas, and they would be at a potentially higher risk for liquefaction in saturated soils than the other options. In most other Plan neighborhoods, the general project areas offer overall stable geology and soil conditions during operation.

The Neighborhood West Ship Canal Tunnel would have similar impacts in Ballard and Fremont/Wallingford as described below for the Shared West Ship Canal Tunnel Option.

Shared Storage Option

This option would have similar potential for impacts as the Neighborhood Storage Option, although fewer storage tanks and pipes in the Ship Canal and Lake Washington Neighborhoods would be at potential risk.

Shared West Ship Canal Tunnel Option

This option replaces storage tanks in Ballard and Fremont/Wallingford with a tunnel. Impacts would be similar to the Neighborhood Storage Option but there would be fewer storage tanks and pipes potentially at risk during a seismic event. Tunnels are generally designed to avoid other underground developments and take advantage of stable glacial till layers. Operational effects are anticipated to be minor. In East Waterway and Magnolia, flow diversions would replace storage tanks/pipes, which present lower potential risk during seismic events.

Shared Ship Canal Tunnel Option

This option would have similar potential for impacts as the Shared West Ship Canal Tunnel Option. Additional flow diversions in Duwamish and Delridge (and flow transfers to the Shared Ship Canal Tunnel from Leschi, Montlake, and Portage Bay) would further reduce the number of storage facilities at potential risk.

6.2.2 What are the potential operational effects of the Integrated Plan Alternative on earth and groundwater?

In addition to the operational impacts of the selected LTCP option, the operational impacts of the stormwater projects specific to the Integrated Plan Alternative are anticipated to be minor. Depending on location selected, the South Park Water Quality Facility could be at risk for liquefaction in saturated soils; however, the facility would meet seismic design standards. NDS Partnering projects could cause erosion if not properly maintained. Street sweeping would not be expected to have operational effects on earth or groundwater.

6.2.3 What are the potential operational effects of the No Action Alternative on earth and groundwater?

Under the No Action Alternative, the existing earth and groundwater environment in the Plan area would essentially remain unchanged. Projects completed as part of the ongoing RainWise and roadside rain garden programs could cause erosion if they are not properly maintained. City projects included in the 2010 Plan Amendment will meet seismic design standards.

6.2.4 What measures are proposed to reduce or minimize potential impacts to earth?

The City would undertake the following measures to mitigate operational impacts to earth for all proposed projects under the Plan:

- All sites would be maintained to prevent erosion.
- Projects would be sited and designed to minimize seismic risk and potential for earth subsidence.

As part of ongoing programs, the City undertakes the following measures to minimize impacts of natural drainage systems:

- The City maintains all roadside rain gardens to prevent erosion.

- The City provides education and incentives for homeowners to maintain rain gardens on their properties.

6.3 Air Quality and Odors

This section describes the air quality impacts and odors that could result from operating the facilities constructed for the Plan alternatives.

6.3.1 What are the potential operational effects of the LTCP Alternative on air quality and odor?

Key Findings

Air Quality

The net operational effects of the *LTCP Alternative* on air quality and odors would be minor in the Plan area. The Neighborhood Storage Option would have the highest number of potential odor-producing tanks and pipes located throughout the Plan area. All facilities would be designed and maintained to minimize emissions of odorous compounds.

In addition to the operational impacts of the selected LTCP option, the air quality impacts of the stormwater projects specific to the *Integrated Plan Alternative* are anticipated to be minor.

6.3.1.1 Emissions

Operational emissions would be limited to vehicle and equipment emissions associated with periodic maintenance activities and infrequent use of emergency generators. These emissions would be minimal and would not produce localized air quality impacts. Diesel engine emissions would be emitted through exhaust stacks at the site of the ancillary equipment facility during maintenance and operation of standby generators. All emergency generators would be required to incorporate Best Available Control Technology to minimize emissions of pollutants. Since the generators would operate only during power outages and testing, emissions would be infrequent and of short duration.

6.3.1.2 Odors

Several of the CSO control facilities have the potential to generate odors during operation because they detain or hold a mixture of wastewater and stormwater during and following storms. These flows include potentially odor-generating compounds that can be released to the air under some conditions. These facilities include pump stations, diversion weir structures (due to turbulence), storage facilities (due to the increased detention time), and any permanent access or ventilation facilities (including tunnel portals). The potential for odors would depend on the wastewater characteristics (dissolved sulfide, dissolved oxygen, pH, temperature, etc.), wastewater hydraulics, and facility operation (cleaning, etc.).

The level of odor would likely be less than with a facility handling only sewage because stormwater inputs to the combined sewer system dilute the concentration of odor-causing compounds. Also, most combined sewage flows are generated during the rainy season when both the ambient air and water temperatures are relatively cool, which reduces the potential for odor-generating compounds such as hydrogen sulfide. In addition, CSO storage facilities would have automated cleaning systems and would be maintained at slightly negative pressure to minimize odors. Finally, all CSO control facilities installed for the Plan would include the appropriate level of state-of-the-art technology for odor control (Figure 6-1) and would be maintained to minimize emissions of odorous compounds to the atmosphere.

Figure 6-1. Typical odor control equipment for a CSO storage facility

Odor control systems would be operated at access shaft points for storage facilities and at the pump stations. Odor release at storage tunnels is primarily limited to the launch and recovery portals. During normal operation of the tunnel, the ventilation system at the pump station would pull outside air into the tunnel. This results in continuous movement of all air within the tunnel to the pump station for odor treatment and exhaust. When the tunnel fills with combined sewage during a storm event, the air (and odor) from the tunnel will be displaced. Although air may be vented from the tunnel at the tunnel shafts when the tunnel fills, odor problems are not expected. All air from the tunnel would be vented to an odor control system, where it would be treated prior to release to the atmosphere. The largest potential source of odor would be at the effluent pump stations. However, these structures would also have the highest level of mechanical odor control equipment.

Emissions would be minimal from operation of all CSO control facilities included in the LTCP options. All CSO facilities installed for the Plan would include state-of-the-art technology for odor control and would be maintained to minimize emissions of odorous compounds to the atmosphere. Odors would not likely be noticeable outside of the proposed facility under normal operating conditions.

6.3.1.3 Comparison of air quality and odor impacts among the LTCP options

All of the CSO control facilities included in the options have potential for odor impacts, but they would be designed to minimize odors by incorporating odor control and automated flushing systems. CSO control projects that store flows (e.g., tanks and tunnels) have a higher potential for odor impacts than flow transfers. Also, larger storage facilities have the potential to produce larger volumes of odorous emissions. However, concentrations of odorous compounds would be the same regardless of size, and control facilities would be sized accordingly to treat the higher volumes of air. While impacts are generally similar among the LTCP options, the following differences exist, based upon the location of facilities and potential receptors.

Neighborhood Storage Option

This option would have the greatest number of potential odor-producing tanks and pipes located throughout the Plan area, including several that could be located in or near residential areas of the Ship Canal, Lake Washington, Longfellow Creek /Duwamish, and Central Waterfront Neighborhoods. Odors are more likely to be noticed in residential or commercial areas. This option includes an estimated 13 pump stations, which could result in occasional odors.

The Neighborhood West Ship Canal Tunnel would have similar impacts in Ballard and Fremont/Wallingford as described below for the Shared West Ship Canal Tunnel Option.

Shared Storage Option

This option includes several storage tanks that could be located in or near residential areas of the Ship Canal, Lake Washington, Longfellow Creek / Duwamish, and Central Waterfront Neighborhoods. This option would have similar potential for impacts as the Neighborhood Storage Option, with fewer potential odor-producing storage tanks and pipes in the Ship Canal Neighborhoods. This option replaces a storage tank with a flow diversion in the East Waterway neighborhood, which has less potential to produce odors. Of all the options, this option potentially has the greatest number of pump stations (15), which could result in occasional odors.

Shared West Ship Canal Tunnel Option

The large tunnel would reduce the number of potential odor-producing storage facilities in the Ballard and Fremont/Wallingford neighborhoods. The large tunnel would have the greatest potential for odors at the downstream tunnel portal (likely located along the Ship Canal in the vicinity of Ballard) but these would be minimized by an odor control facility. In neighborhoods where flow diversions would replace storage tanks/pipes (East Waterway and Magnolia), there would be less potential for odor impacts. This option includes an estimated 10 pump stations, which could result in occasional odors.

Shared Ship Canal Tunnel Option

This option would have similar potential for impacts to the Shared West Ship Canal Tunnel Option, except that storage facilities with odor-producing potential would largely be eliminated in the Lake Washington Neighborhoods of Montlake, Portage Bay, and Leschi. The large tunnel would have the greatest potential for odors at the downstream tunnel portal (likely located along the south side of the Ship Canal) but these would be minimized by an odor control facility. Additional flow diversions in Duwamish and Delridge would further reduce the number of potentially odor-producing storage facilities in those neighborhoods. This option includes an estimated 10 pump stations, which could result in occasional odors.

6.3.2 What are the potential operational effects of the Integrated Plan Alternative on air quality and odors?

In addition to the operational impacts of the selected LTCP option, the air quality impacts of the stormwater projects specific to the Integrated Plan Alternative are anticipated to be minor. Similar to CSO storage facilities, the South Park Water Quality Facility has the potential to generate odors. However, this impact is expected to be minimal because stormwater has fewer odor-generating compounds than wastewater or combined sewer overflows. Street sweeping has the potential to temporarily increase localized dust and emissions, but this would be minimal and street sweeping occurs at night on most arterials. There are no operational air-related impacts associated with NDS Partnering.

6.3.3 What are the potential operational effects of the No Action Alternative on air quality and odors?

No air quality impacts or increased odors are anticipated from the ongoing sewer system improvements and natural drainage systems. Air quality impacts and odors associated with the projects in the 2010 Plan Amendment would be similar to those described above. The projects either have completed, or will undergo, separate SEPA analysis as appropriate and are not included in this EIS.

If projects included in the No Action Alternative are not adequate to reduce CSO events, odors associated with the CSO releases would continue and could increase if the number of CSO events increases.

6.3.4 What measures are proposed to reduce or minimize potential impacts to air quality and odors?

The City would undertake the following measures to mitigate air quality and odor impacts for the operation of all proposed projects. Mitigation measures would be the same for all the Plan alternatives.

- All storage facilities would be designed with state-of-the-art odor control systems.
- The City would operate storage facilities to minimize the potential for odors by limiting the length of time combined sewage is stored in the facilities, maintaining air space at slightly negative pressures, and scheduling maintenance of odor control systems during cold temperatures and periods of low flow.

6.4 Surface Water

This section describes the types of impacts that could occur to surface water within the Plan area from operation of the Plan alternatives.

Implementation of either the LTCP or the Integrated Plan Alternative would result in substantially reduced pollutant loadings to receiving water bodies. The LTCP is being implemented to improve receiving water quality, meet CSO standards administered by EPA and Ecology, and comply with the Consent Decree. The alternatives have been developed to be consistent with those requirements; however, the timing of water quality benefits and the reduction in pollutants vary depending on which alternative is implemented, as described below.

Key Findings

Surface Water

The *LTCP Alternative* would result in substantial reduction of pollutant loading from existing uncontrolled CSO outfalls compared with the No Action Alternative. The LTCP Alternative would comply with Clean Water Act requirements and the Consent Decree. The Ship Canal/Lake Union, Lake Washington, Duwamish River, Longfellow Creek, Elliott Bay, and Puget Sound would receive reduced discharges from CSOs. The *Integrated Plan Alternative* would result in greater pollutant loading reductions than the LTCP Alternative.

The *No Action Alternative* would not comply with the Consent Decree and would not achieve the City's Plan for Protecting Seattle's Waterways.

6.4.1 What are the surface water impacts of the LTCP Alternative?

Operational impacts to surface water quality would be the same for all of the LTCP options, because all options would meet the Consent Decree requirement for control of CSOs, in compliance with the Clean Water Act, EPA's CSO Control Policy, and the objectives of the Washington Water Pollution Control Act. All options are required to meet the regulatory requirements of the City's National Pollutant Discharge Elimination System permit, which limits overflows from controlled outfalls. Therefore, long-term operational impacts to surface water are discussed for the LTCP Alternative as a whole.

The City of Seattle has been working to control CSOs since the 1960s. The LTCP is the final component to complete CSO control efforts and comply with federal and state requirements. The 2013 Consent Decree, an agreement between the City of Seattle, Washington Department of Ecology, EPA, and U.S. Department of Justice, specifies the actions that the City must take to address CSOs that violate the Clean Water Act. Regulations require that CSO outfalls must meet a performance standard to achieve the “greatest reasonable reduction” to be considered “controlled” in accordance with WAC 173-245-020(22), which outlines the requirements for CSO control facilities. According to these regulations, a CSO is considered “controlled” when no more than one untreated discharge occurs per year, determined annually and based on a 20-year moving average period.

As noted in Chapter 1, the Consent Decree has established a deadline of December 2025 to complete construction of all CSO control measures. One year following completion of construction of each CSO control measure, the City is required to document that the CSO outfall has been controlled, through post-construction monitoring. Additional detail on the Consent Decree requirements is included in the Summary section of *Volume 2, LTCP*.

In 2012, there were 355 overflow events and 154 million gallons of untreated CSOs discharged from the City’s 87 managed outfalls, 35 of which are uncontrolled. Eight of these CSOs will be controlled through the implementation of the 2010-2015 CSO Plan, described in more detail in Chapter 1 of *Volume 2, LTCP*. Early Action CSO Programs and Measures will result in an additional five outfalls being controlled by 2019, including two in the North Henderson basin and three in the South Henderson basin. The remaining 22 uncontrolled outfalls will be controlled through implementation of the approved LTCP. Figure 2-3 illustrates the outfalls to be controlled.

Under the LTCP, uncontrolled outfalls discharging into Lake Washington, the Ship Canal, Union Bay, Portage Bay, Longfellow Creek, the Duwamish River, and Elliott Bay would be controlled to one untreated discharge per year on a 20-year rolling average in order to comply with EPA and Ecology requirements. The LTCP would reduce the frequency of CSO discharge events by more than 50 percent and the average annual CSO discharge volume by more than 55 percent.

Controlling these outfalls to meet EPA and Ecology requirements would result in substantial reductions of fecal coliform bacteria, toxics, metals, and nutrients entering local receiving water bodies from CSOs.

The LTCP would reduce fecal coliform discharges from CSO outfalls by nearly 70 percent, with reductions of bacterial and other pathogen loading between 65 and 75 percent in Lake Washington and the Ship Canal/Lake Union receiving waters, where high levels of water contact recreation occur. While CSO discharges can include viruses and other pathogens as well as toxic organic constituents, not all of these constituents are measured. Fecal coliform bacteria is an indicator for pathogenic constituents.

Suspended solids from CSOs deposited near CSO outfalls would be substantially reduced, thereby reducing the potential for wildlife and humans to come into contact with potentially contaminated sediments. Total suspended solids discharged from CSO outfalls would be reduced by nearly 65 percent, with reductions of 75 percent in the Ship Canal/Lake Union receiving waters.

Total copper, a constituent that is toxic to salmonids and other aquatic organisms, would be reduced by nearly 65 percent from CSO outfalls when compared to the No Action Alternative. Reductions of nearly 75 percent would occur in the Ship Canal/Lake Union, and nearly 67 percent in Lake Washington. Total phosphorus, an important constituent in algae production, would be reduced by 65 percent over the No Action Alternative, with highest reductions from outfalls in the Ship Canal/Lake Union and Lake Washington basins. Fecal coliform bacteria discharged from CSO outfalls would be reduced by roughly 69 percent. Reductions of other toxic contaminants, nutrients, and metals would also be substantial.

There are no adverse operational impacts on surface waters associated with the LTCP Alternative.

6.4.2 What are the potential operational effects of the Integrated Plan Alternative on surface water?

The Consent Decree allows the City to propose an Integrated Plan as an alternative to the LTCP. This would allow deferral of some LTCP projects if evaluations indicate that stormwater projects could achieve significantly better water quality benefits than would be achieved by implementing LTCP CSO control projects only. The stormwater projects would need to be implemented by December 31, 2025, while the deferred LTCP projects would be completed between 2028 and 2030, as approved by Ecology. Implementing the Integrated Plan Alternative would not replace or eliminate any CSO control projects in the LTCP Alternative, but it would allow the City to devote more resources in the near term to addressing stormwater pollutant loads, resulting in greater water quality benefits.

The Consent Decree listed a number of specific constituents that the Integrated Plan must address. These are constituents that represent both environmental and human health concerns and are contained in both stormwater and CSOs. These include fecal coliform bacteria, total suspended solids, biochemical oxygen demand (BOD), ammonia, phosphorus, oil and grease, and pH. The Consent Decree also includes several general categories of constituents (e.g., metals, pesticides, and semi-volatile organic compounds).

Because of the limited timeframe for developing the Integrated Plan, it was not possible to collect new water quality data. Therefore the City compiled and reviewed existing stormwater, CSO, and receiving water data to develop a list of "Representative Constituents of Concern" (RCOCs). In some cases, the City used surrogates to represent categories of constituents, such as dissolved copper and dissolved zinc for metals, and PCBs and polybrominated diphenyl ethers (PBDEs) for toxic organic compounds. Additional detail on the development of RCOCs can be found in Chapter 6 of *Volume 3, Integrated Plan, as well as the methods used* to estimate the pollutant load reductions for the LTCP projects to be deferred, and for the stormwater projects considered for inclusion in the Integrated Plan.

In development of the Integrated Plan, the City also ranked local receiving water bodies based on requirements outlined in the Consent Decree, as described in Chapter 1 of *Volume 3, Integrated Plan.*

The City identified potential stormwater projects for implementation, and potential LTCP CSO control projects for deferral, based on the water body and drainage basin rankings and EPA guidance. An initial list of more than 14 projects or programs was narrowed to 10 stormwater projects that were evaluated in detail. The stormwater projects/programs were selected based on their ability to provide benefits in key drainage basins and receiving water bodies, as described in Chapter 5 of *Volume 3, Integrated Plan.* In contrast, the LTCP projects identified for deferral were relatively small. The intent was to identify stormwater projects that could provide significant water quality benefits compared to the CSO control projects proposed for deferral.

The Integrated Plan team then evaluated data relating to potential impacts on pollutant loading and exposures for RCOCs for human and ecological receptors, and then estimated pollutant load and exposure reductions for the stormwater projects relative to the CSO control projects. The team used a Multi-Objective Decision Analysis (MODA) to score the candidate stormwater projects and compare the benefits of each project with its costs. They selected a combination of projects that would provide significantly more water quality benefits than the LTCP CSO control projects.

As summarized in Chapter 1 of this document, the Integrated Plan evaluation identified three stormwater projects that would result in deferral of six CSO control projects included in the LTCP. The stormwater projects would be implemented by 2025, and completion of the deferred CSO control projects would be delayed until 2030. The three stormwater projects are described in more detail in Chapter 3, Plan Alternatives, and in Chapter 8 of *Volume 3, Integrated Plan.* The Integrated Plan projects include the following:

- Natural Drainage System (NDS) Partnering
- South Park Water Quality Facility
- Expanded Street Sweeping (Arterials)

Six LTCP CSO control projects were identified for deferral in the Delridge, East Waterway, Duwamish, Portage Bay, and Montlake basins. Table IPS-1 in *Volume 3, Integrated Plan* summarizes the Integrated Plan projects and the LTCP projects identified for deferral. Under the Integrated Plan, approximately 1,600 MG/year of stormwater would be treated or removed from the Longfellow, Piper's, and Thornton Creek basins, through the implementation of NDS Partnering, the South Park Water Quality Facility, and the expansion of street sweeping on arterials (based on the volume of stormwater on streets to be swept). The LTCP projects proposed to be deferred would treat or remove approximately 1.4 MG/year in the Delridge, East Waterway, Duwamish, Portage Bay, and Montlake basins. Additional discussion of these findings is included in Chapter 8 of *Volume 3, Integrated Plan.*

Based on detailed evaluations conducted by the City's Integrated Plan team, the Integrated Plan would result in a greater reduction of pollutant loading than would occur for the LTCP Alternative. Implementation of the Integrated Plan projects would result in substantially greater reductions of total suspended solids, oil and grease, total and dissolved copper and zinc, phosphorus, PCBs, and PBDEs, among other constituents.

The Integrated Plan stormwater projects provide greater reductions for all RCOCs except for ammonia-N. The primary reason for the substantial increase in pollutant load reduction for the Integrated Plan projects is that the stormwater projects treat or remove much larger volumes of water than the comparable CSO control projects within their respective basins. In addition, the Integrated Plan stormwater projects treat larger volumes of water than the comparable CSO control projects during February through September, when human exposure with receiving waters is more likely.

CSO pollutant loads deferred from 2025 until after 2028 for the Integrated Plan would amount to between 2 and 7 percent of the existing uncontrolled CSO loads, and between 7 and 16 percent of the projected CSO loads in 2025 to all water bodies. These ranges of deferred CSO pollutant loads depend on the specific constituent, with the greatest reductions associated with total suspended solids, metals, oil and grease, and other constituents associated with street runoff. After the deferred LTCP CSO control projects are completed, their water quality benefits will add to the water quality benefits of the stormwater projects, resulting in further water quality improvements.

Figure 3-8 shows the location of the stormwater projects/programs that would be implemented and the LTCP CSO control projects that would be deferred under the Integrated Plan Alternative. The City selected the South Park Water Quality Facility, the arterial street sweeping expansion program, and the NDS Partnering project for the Integrated Plan because they provide the most pollutant reduction and other benefits as determined during the MODA evaluation. The six LTCP CSO control projects were identified for deferral because they are located in CSO basins determined by the LTCP team to be lower priority based on EPA guidelines and consideration of potential partnering opportunities with King County. The deferred LTCP CSO control projects would provide considerably smaller reductions in pollutant loads and exposures than the Integrated Plan stormwater projects.

The deferral of CSO pollutant load reductions for the Integrated Plan would primarily delay reductions to the Duwamish Waterway and the Ship Canal/Lake Union. The deferred CSO pollutant loads would amount to approximately 30 percent of existing uncontrolled CSO loads to the Duwamish Waterway, and less than 1 percent of existing uncontrolled CSO loads to the Ship Canal and Lake Union. However, stormwater pollutant load reductions by 2025 for the Integrated Plan would far exceed the deferred CSO pollutant loadings to each of these water bodies.

6.4.3 What are the potential operational effects of the No Action Alternative on surface water?

Under the No Action Alternative, pollutant loadings to receiving water bodies would not be reduced beyond levels provided from construction of projects included in the 2010 CSO Control Plan and currently planned NDS and RainWise projects. This alternative does not comply with the Consent Decree, and it would result in significant fines for the City. This alternative is not consistent with the City's Plan to Protect Seattle's Waterways.

CSO pollutant loadings would continue, with potential impacts highest for the Ship Canal and Lake Union because they currently receive the highest CSO pollutant loads of all water bodies in Seattle. Potential impacts would also be high for Longfellow Creek because it currently receives moderate CSO pollutant loads and is a relatively small receiving water body. Impacts would be moderate for Lake Washington and Duwamish Waterway, and lowest for Puget Sound and Elliott Bay, based on their relatively low existing CSO pollutant loads.

6.4.4 What measures are proposed to reduce or minimize impacts to surface water?

The LTCP and the Integrated Plan are intended to reduce impacts to surface water bodies in Seattle's waterways, and as such, they will lessen water quality impacts that are currently occurring. Implementation of either of these alternatives would result in anticipated benefits to receiving water bodies. Post-construction monitoring required in the Consent Decree will ensure that facilities are operating as intended, and it will include adjustments to improve facility performance if necessary.

6.5 Biological Resources

This section describes the types of impacts that could occur to biological resources within the Plan area resulting from operation of the Plan alternatives. In general, implementation of either alternative would reduce the volume of untreated sewage and stormwater runoff being discharged to surface waters, thereby reducing the potential for related adverse effects on biological resources and aquatic life in particular. Implementation of either the LTCP or Integrated Plan Alternative would comply with the Consent Decree, as well as other federal and state requirements.

Key Findings

Biological Resources

The *LTCP Alternative* would have negligible to minor operational effects in the Plan area. There would be long-term beneficial effects on fish and aquatic life from reducing CSOs. The *Integrated Plan Alternative* would provide additional water quality reductions, providing greater potential benefits to biota in the affected receiving water bodies.

The *No Action Alternative* would result in no additional improvements to CSO reductions in the Plan area, which could have long-term adverse effects on fish and aquatic life including listed species.

6.5.1 What are the potential operational effects of the LTCP Alternative on biological resources?

The LTCP Alternative would not cause ongoing impacts to terrestrial wildlife and would benefit aquatic species and habitats. Direct impacts to terrestrial habitats associated with constructing facilities and permanent aboveground access areas are discussed as construction impacts in Chapter 5 (see Section 5.5). Some of the projects, such as storage tanks, may include habitat enhancements, such as replanting with native plants. This would create new areas of habitat for species tolerant of urban conditions.

Pump stations and other surface facilities could generate noise depending on the specific design. Occasional noise associated with maintenance vehicles would also occur. Noise levels from operation of the facilities are not expected to result in impacts to wildlife because species in urban areas are more or less tolerant of some level of human activity.

All options would reduce the number of CSO events and lead to improved water quality, as described in Section 6.4, Surface Water. Consequently, all options would result in long-term, beneficial impacts for fish and other aquatic species. The total volume of the City's current CSO discharge would be decreased by nearly 60 percent with the implementation of all CSO control projects included in the LTCP options. No in-water construction would occur for any of the options, and therefore no permanent impacts to aquatic habitats would occur.

There are no adverse operational impacts on biological resources associated with the LTCP Alternative.

6.5.2 What are the potential operational effects of the Integrated Plan Alternative on biological resources?

In addition to the beneficial impacts described above for the LTCP Alternative, the Integrated Plan Alternative would result in additional pollutant reductions, particularly in the Duwamish Waterway. Reductions in metals loading, particularly copper, would benefit aquatic resources in these waterways. Thornton Creek, Piper's Creek, and Longfellow Creek would experience reduced pollutant loadings from NDS Partnering projects. Multiple drainages throughout the Plan area would benefit from the expanded street sweeping program as summarized in Section 6.4.

6.5.3 What are the potential operational effects of the No Action Alternative on biological resources?

None of the projects proposed under the No Action Alternative are expected to cause impacts to biological resources. Rain gardens could provide small areas of habitat in neighborhoods. However, the No Action Alterative would not result in any of the long-term, beneficial impacts as described for the LTCP and Integrated Plan Alternatives because no additional CSO or stormwater control projects would be implemented beyond those projects and programs currently funded or slated for implementation. Water quality in water bodies throughout the Plan area would continue to be negatively impacted by CSO and stormwater releases. Fish and other aquatic species, including threatened or endangered salmonids and marine mammals, and their habitats would continue to be exposed to CSO discharges at the current levels.

Impacts would be greater during the wet weather season (approximately October through May) when CSOs and stormwater discharges are more likely. CSO and stormwater discharges in Elliott Bay would continue to cause potentially adverse effects to listed species present during the wet weather season, including Pacific salmon, steelhead, bull trout, rockfish, killer whale, Steller sea lion, and humpback whale. Adult Chinook, steelhead, coho, and sockeye salmon are present in the Duwamish, Ship Canal, Lake Union, Union Bay, and Lake Washington during this time, and sockeye salmon are present in Thornton, Piper’s, and Longfellow Creeks. Thornton and Longfellow Creeks also support adult Chinook salmon, and Piper’s Creek contains adult chum during the winter months. Juvenile salmonids, which are dependent on shoreline and nearshore habitats near outfalls, are present during the winter months in many of the same water bodies, particularly the Duwamish and Lake Washington, and would be exposed to CSO releases. Thornton, Piper’s, and Longfellow Creeks support juvenile steelhead and coho salmon, and Piper’s Creek also contains cutthroat and chum.

6.5.4 What measures are proposed to reduce or minimize impacts to biological resources?

Because none of the Plan alternatives are expected to cause adverse impacts to biological resources, no mitigation measures are proposed. Mitigation measures for reducing noise associated with facility operations are discussed in Section 6.8, Noise and Vibration.

6.6 Energy and Climate Change

This section describes the types of impacts that could occur to energy use and the risks associated with climate change within the Plan area resulting from operation of the Plan alternatives.

6.6.1 What are the potential operational effects of the LTCP Alternative on energy and climate change?

6.6.1.1 Energy Use

Storage facilities that are drained and flushed by gravity are anticipated to have the lowest energy requirements. Conversely, underground tanks or tunnels that rely on pump stations for dewatering, and mechanical flushing systems to scour accumulated sediments, are anticipated to have higher operation and maintenance needs. Electric pumps and ventilation equipment would be required at facilities such as pump stations, storage tanks, flow transfers, and tunnel facilities. The pumps and equipment would be operated by electricity. Although operating the CSO facilities can be energy intensive, most of the equipment operates infrequently, only during storm events. Therefore, the CSO facilities are expected to have a minor impact on energy use or demand in the Plan area.

6.6.1.2 Greenhouse Gas Emissions

Operation of the CSO facilities would generate greenhouse gases. Although most electricity used in the city is generated by hydropower, which does not produce greenhouse gases, small amounts of electricity are generated by natural gas and coal which do produce greenhouse gases.

6.6.1.3 Risks from Climate Change

As described in Chapter 4, the major risks associated with climate change in Seattle are increased precipitation and sea level rise. Climate change and some aspects of climate variability are expected to increase rainfall in the winter. Increased rainfall likely means an increase in stormwater runoff from impervious surfaces in the basin. Increased precipitation could increase the number of CSO events if new facilities are not designed to include climate change projections. However, CSO storage tanks have been designed to address the changes expected from climate change and climate variability. The City has incorporated climate change modeling in its development of Plan alternatives and would incorporate additional modeling in the design of individual CSO facilities as projects move forward. The control volumes required for compliance with the once-per-year overflow requirement for the LTCP have been determined based on a 6 percent increase in precipitation and associated stormwater over the current levels. Six percent is within the range of precipitation increase predicted by climate change modeling for the future planning period. Refer to *Volume 2, LTCP* for further information on climate change modeling.

Key Findings

Energy and Climate Change

Both the *LTCP Alternative* and *Integrated Plan Alternative* would have minor operational effects on energy use. The greenhouse gas emissions produced by operating and maintaining CSO facilities are not expected to cause appreciable climate change impacts. SPU has incorporated climate change modeling in its development of Plan alternatives and would incorporate additional modeling in the design of individual CSO facilities to minimize risks from anticipated changes in precipitation and sea level rise.

Sea level rise is not anticipated to impact the proposed projects in the Ship Canal and Lake Washington Neighborhoods because the U.S. Army Corps of Engineers maintains Lake Washington at levels that are lower than the elevation of the project sites. The City would avoid locating CSO facilities in other areas of the city that are vulnerable based on sea level rise projections.

6.6.1.4 Comparison of Energy and Climate Change Impacts among the LTCP Options

All of the LTCP options include proposed facilities that would require electrical power and increase energy use in the city. As described above, the increased use is expected to be minor. Climate change and climate variability have the potential to impact the proposed project due to increases in sea level and rainfall. All of the LTCP options would be designed to handle increased precipitation predicted by climate change modeling, and the projects would not be located in areas vulnerable to projected sea level changes. Therefore, all of the projects are expected to minimize risk from climate change. Differences among the LTCP options are described below.

Neighborhood Storage Option

CSO control facilities (tanks, pipes, sewer system improvements) would have minor operational effects on energy use as a result of pumping and electrical equipment requirements. The Neighborhood West Ship Canal Tunnel would have slightly higher energy requirements as described below for the Shared West Ship Canal Tunnel Option. Overall, energy use would be higher under the Neighborhood Storage Option compared to the other options because this option has the highest number of City and King County independently constructed CSO facilities.

Shared Storage Option

The larger shared storage tanks under the Shared Storage Option have slightly higher energy requirements than smaller tanks under the Neighborhood Storage Option. However, overall energy use would be expected to be lower because the shared tanks eliminate 10 City and 3 King County independently constructed CSO facilities.

Shared West Ship Canal Tunnel Option

The Shared West Ship Canal Tunnel Option would potentially have a slightly higher electrical requirement than tanks under both the Neighborhood Storage and Shared Storage Options because of the electricity needed to pump the deeply stored water. However, overall energy use would be expected to be lower than the Neighborhood Storage Option because 4 City and 1 King County independently constructed CSO facilities would be eliminated.

Shared Ship Canal Tunnel Option

The Shared Ship Canal Tunnel Option would have slightly higher energy use than the Shared West Ship Canal Tunnel because of the electrical energy requirements of the larger tunnel. However, overall energy use would be the most reduced under this option compared to the Neighborhood Storage Option because it eliminates 15 City and 3 King County independently constructed CSO facilities, the most of all the options.

6.6.2 What are the potential operational effects of the Integrated Plan Alternative on energy and climate change?

In addition to the CSO control facilities under the LTCP, the South Park Water Quality Facility would use energy on an intermittent basis. In general, impacts from the Integrated Plan Alternative would be very similar to the LTCP Alternative.

6.6.3 What are the potential operational effects of the No Action Alternative on energy and climate change?

Energy requirements from operation of projects implemented under ongoing programs are minimal.

Natural drainage systems do not require energy and would be located away from areas prone to sea level rise. Sewer system improvements and the planned storage projects included in the 2010 Plan Amendment would require electrical power, but the small increase in electrical demand is not expected have a major effect on electrical use in the city.

Any existing CSO facilities located in areas prone to sea level rise could be flooded, reducing their ability to effectively handle CSO events.

6.6.4 What measures are proposed to reduce or minimize energy and climate change impacts?

The City would undertake the following measures to reduce the impacts of CSO facilities on energy and to protect the facilities from the risks of climate change:

- Comply with state and City requirements related to energy efficiency of the new CSO facilities.
- Include evaluations of greenhouse gas emissions as required by the City in project-level SEPA analyses.
- Incorporate climate change modeling into design of CSO facilities.
- Utilize the adaptation planning pathways incorporated in the City's *Sea Level Rise Planning Guidance for Capital Projects* (City of Seattle, 2011d) to design and locate CSO facilities.

6.7 Environmental Health and Public Safety

This section describes the types of impacts that could occur to environmental health and public safety within the Plan area from operation of the Plan alternatives.

Key Findings

Environmental Health and Public Safety

Overall, the *LTCP Alternative* is expected to reduce environmental health risks associated with CSOs by reducing untreated discharges. Pathogens and toxic organic and inorganic constituents would be reduced to a greater level under the *Integrated Plan Alternative* than the LTCP Alternative. Once the deferred CSO control projects are implemented, they will add to the long-term loading reduction achieved by the Integrated Plan stormwater projects.

Under the *No Action Alternative*, water quality in surface waters throughout the Plan area would continue to be negatively impacted by CSO releases from uncontrolled outfalls and by stormwater discharges. The No Action Alternative is not compliant with the Consent Decree and is not consistent with the City's Plan for Protecting Seattle's Waterways.

6.7.1 What are the potential operational effects of the LTCP Alternative on environmental health?

Operation of the CSO facilities is expected to reduce the risk to human health by reducing CSO events that release untreated wastewater to surface water bodies. Reduced CSO discharges would reduce potential contamination that could reach Plan area beaches, thereby lowering the potential for human contact with contaminated waters. Water quality improvements from reduced CSO events may also help reduce contamination of fish and shellfish that are caught in the area and consumed.

As described in Chapter 5, contaminated materials could be encountered during construction, and some facilities, such as storage tanks and tunnels, could be constructed on contaminated sites. In both cases, the contaminated materials would be removed, resulting in improved conditions and reducing the potential for long-term environmental health impacts.

All options would reduce the number of CSO events and lead to improved water quality, as described above. None of the LTCP Alternative options are expected to cause adverse impacts to environmental health.

6.7.2 What are the potential operational effects of the Integrated Plan Alternative on environmental health and public safety?

As described in Section 6.4.2, a number of contaminants conveyed in CSOs and stormwater pose potential environmental health concerns. While both the LTCP Alternative and the Integrated Plan Alternative would substantially reduce pollutant loading, the Integrated Plan provides a higher level of pollutant reduction.

Pollutant load and human exposure evaluations conducted as part of the Integrated Plan indicated fecal coliform bacteria (an indicator for pathogens) would be reduced to a greater level under the Integrated Plan Alternative than the LTCP Alternative. As described above in Section 6.4, this is largely due to the greater volume reduced by the Integrated Plan Alternative, and because reductions from Integrated Plan projects would be greater during the months when potential for human contact is highest, between February and September. Refer to Chapters 6 and 8 of *Volume 3, Integrated Plan* for a more detailed discussion of the evaluation methodology and results for human exposure. In general, reduction in environmental health risks would be greatest under the Integrated Plan Alternative.

Under the Integrated Plan Alternative, both the stormwater projects and the deferred LTCP projects would reduce pollutant loads to water bodies. However, the stormwater projects would benefit water bodies throughout the city, while deferred LTCP projects would largely benefit the Duwamish Waterway and the Ship Canal. The Integrated Plan Alternative would result in substantially larger reductions in pollutant loads than the LTCP projects alone. These large reductions should bring accompanying reductions in environmental health risks.

NDS Partnering would construct bioretention facilities (i.e., engineered rain gardens) in the storm sewer system basis that drain to Piper's, Thornton, and Longfellow Creeks. Concerns have been raised by citizens regarding the potential safety risks and mosquito breeding potential associated with ponded water within bioretention facilities. However, proper siting and design of these facilities will minimize health and safety risks.

The South Park Water Quality Facility would treat runoff from approximately 250 acres in the 7th Avenue S drainage system, prior to discharge to the Lower Duwamish Waterway. The primary objectives are to reduce flows and loads of total PCBs, metals, bacteria, and other pollutants, which would be anticipated to reduce environmental health risks in these water bodies.

Expanded street sweeping would focus on the storm sewer system basins. Increased sweeping of arterials would remove potential stormwater pollutants from a drainage area of approximately 1,736 acres. The primary objective of expanded street sweeping would be to reduce loads of total PCBs, metals, bacteria, and other particulate-bound pollutants and prevent these pollutants from entering receiving waters, where environmental and public health risks could occur. Expanded street sweeping, in particular, is shown to provide substantial fecal coliform load reduction, resulting in lower levels of pathogens in receiving waters.

The stormwater projects provide larger load reductions for the key drivers for human exposure (PCBs and fecal coliform) than the LTCP projects that would be deferred. The primary reason is that the stormwater projects would treat larger volumes than the LTCP projects. Because the stormwater discharges are much more frequent than CSO discharges, they are more likely to present an exposure and environmental health risk.

Refer to *Volume 3, Integrated Plan*, for more information on pollutant reductions anticipated under the Integrated Plan Alternative.

6.7.3 What are the potential operational effects of the No Action Alternative on environmental health and public safety?

The No Action Alternative would not implement any additional CSO or stormwater control projects beyond those projects and programs currently funded or slated for implementation. Water quality in surface waters throughout the Plan area would continue to be negatively impacted by CSO releases from uncontrolled outfalls and by stormwater discharges. Contaminated discharges could continue to affect swimming beaches and fishing areas, causing potential environmental health impacts. People could be exposed to pathogens or other pollutants through direct contact with contaminated water or sediments (e.g., swimming or wading), ingestion of pathogen-containing water, or eating contaminated fish or shellfish. The No Action Alternative does not comply with the Consent Decree and is not consistent with the City's Plan for Protecting Seattle's Waterways.

The risk of CSOs having a harmful effect on humans from pathogens or other contaminant exposure ultimately depends on the extent of human activity in water bodies near CSOs during and immediately after a discharge event. Because CSO events largely occur during heavy rainfall in the cooler months, the potential number of individuals swimming or wading is likely fairly low, but activities on and near the water occur year-round. These risks could continue or potentially worsen under the No Action Alternative.

Natural drainage systems that are not maintained or properly sited could create breeding areas for mosquitoes. Mosquitoes breed in standing water and require at least a week to complete their life cycles. Generally rain gardens are designed to drain quickly, usually within several hours or a day. Thus, rain gardens that are properly sited and have quickly draining soils are unlikely to provide good breeding conditions for mosquitoes (Rector et al., 2012). Rain gardens require maintenance to keep vegetation healthy and to prevent standing water.

6.7.4 What measures are proposed to reduce or minimize impacts to environmental health and public safety?

The proposed projects and programs associated with the LTCP and Integrated Plan Alternatives would help to reduce environmental health risks and do not require further mitigation. As part of ongoing programs, the City undertakes the following measures to minimize impacts of natural drainage systems:

- The City maintains roadside rain gardens to prevent standing water and reduce the potential for mosquito breeding.
- The City provides education and incentives to encourage property owners to maintain rain gardens.

6.8 Noise and Vibration

This section describes the types of noise and vibration impacts that could occur from operation of the Plan alternatives.

6.8.1 What are the potential operational effects of the LTCP Alternative on noise?

Some facilities associated with storage tanks, pipes, and tunnels could generate noise during operation, including the following:

- Odor control facilities. Where passive odor control systems (without ventilation fans) are used, no noise control is required. Otherwise, odor control facilities, and any ventilation facilities, would be provided with noise reduction and attenuation measures as required to conform to permissible noise levels.
- Fans. Fans associated with heating, ventilating, and air conditioning would be contained within a facility vault. Fans would generate a steady, continuous sound and would operate 24 hours a day, 7 days a week.

Key Findings

Noise and Vibration

The net operational effects of the *LTCP Alternative* would be minor in the Plan area. Noise would be generated under all options by pump stations and odor control facilities. All facilities would be designed and maintained to reduce noise to permissible levels. Because the Neighborhood Storage and Shared Storage Options have the most project sites needing pump stations and other facilities, potential noise impacts are greatest for these options. Overall potential for noise impacts would be reduced under the Shared Storage and shared tunnel options because of fewer City and King County-only CSO facilities. No additional noise impacts are expected from the *Integrated Plan Alternative.*

- Tipping buckets, which flush a storage tank with clean water after a CSO event. Noise from tipping buckets is only generated after CSO events and would largely be contained within the tank itself.
- Pump stations. Pumps generate sound on an intermittent basis and most of the noise would be contained within the facility vault.
- Maintenance activities. Maintenance of the facilities would be infrequent and occur only during daytime hours, resulting in a minor source of noise.

Most noise-generating equipment associated with storage tanks and tunnels would be located below ground. All facilities would be designed to comply with the City’s maximum allowable noise limits and, in all but the quietest of locations, to not exceed existing background noise levels at facility sites.

There would be no long-term sources of vibration at storage tank, pipe, or tunnel sites.

6.8.1.1 Comparison of Noise Impacts among the LTCP Options

Specific evaluation of noise levels and impacts is addressed at the project level when facility sites are known and site-specific background noise levels can be investigated. However, a general comparison of the potential noise impacts among the LTCP options is provided. Noise would occur from: (1) operation of pump stations and mechanical and electrical facilities, and (2) maintenance activities associated with projects included under the LTCP. Noise-related impacts would be minor under all options.

Because the Neighborhood Storage and Shared Storage Options would potentially have the most pump stations and other facilities, they would have a higher potential for noise impacts. Some pump stations and mechanical facilities could be located in residential areas, particularly in the Lake Washington, Longfellow Creek / Duwamish, and Ship Canal Neighborhoods.

The Shared West Ship Canal and Shared Ship Canal Tunnel Options would potentially have fewer pump stations and mechanical facilities than the other options, so operational noise impacts would potentially be the least under these options.

6.8.2 What are the potential operational effects of the Integrated Plan Alternative on noise?

Storage pipes, tanks, and tunnels constructed under the Integrated Plan Alternative would have the same operational noise impacts as under the LTCP Alternative, but construction of these facilities would be delayed in some neighborhoods. Operation of the projects specific to the Integrated Plan Alternative would have minimal noise impacts. Natural drainage systems would not generate noise. Street sweeping would only occur on arterial streets and would not generate noise in excess of typical vehicle noise. The South Park Water Quality Facility could generate some operational noise from ventilation fans and maintenance activities. However, the facility would be located in an industrial area and operational noise would not impact residences or other sensitive receptors.

6.8.3 What are the potential operational effects of the No Action Alternative on noise?

Operation of sewer system improvements and natural drainage systems would not generate noise.

6.8.4 What measures are proposed to reduce or minimize noise impacts?

A noise analysis for each project would be performed during final design. Once project sites are selected and receiving properties are identified, noise regulations (see Table 4-8) can be used to determine the level at which project-generated noise would be considered significant. Project- and location-specific mitigation measures would be determined at that time. Potential mitigation measures could include the following:

- Pump station and odor control facility designs would include attenuation measures for fan noise and pump and motor noise as needed to comply with noise levels specified by the City of Seattle and to address location-specific factors as determined during project design.
- Facility vault access hatches would be designed to be relatively thick and to have seals at the perimeters to contain noise within the vault.
- Noise-producing ventilation air intakes and exhausts would be placed in a direction facing away from sensitive receptors whenever possible.

6.9 Land Use and Visual Quality

This section describes the types of impacts that could occur to land use and visual quality within the Plan area from operation of the Plan alternatives.

Key Findings

Land Use and Visual Quality

Potential land use impacts associated with CSO control projects under the *LTCP Alternative* include conversion of land in residential, commercial, or industrial areas to public utility uses. These impacts differ between the options because of different property requirements of tanks vs. tunnels. The completed facilities would largely be constructed below ground; aboveground facilities would have minimal visual impacts with the use of site appropriate design and screening. Stormwater projects constructed under the *Integrated Plan Alternative* are not expected to cause major long term impacts to land use.

6.9.1 What are the potential operational effects of the LTCP Alternative on land use and visual quality?

6.9.1.1 Consistency with Seattle Comprehensive Plan Policies

The Plan is consistent with the overall goals and policies of the Comprehensive Plan, and individual goals and polices related to utilities and environment that call for improving water quality and minimizing CSO events. Consistency with individual Comprehensive Plan goals and policies related to land use, transportation, and other resources would depend on the details of the future projects.

6.9.1.2 Land Conversion or Easement Restrictions

Potential land use impacts associated with the proposed CSO facilities include conversion of land in residential, commercial, or industrial areas to public utility uses. Residents of residential areas in which CSO facilities are located could perceive the facilities as being inconsistent with local land use policies. As described in Section 4.8.1.2, locating such facilities in residential zones requires a Council Conditional Use Permit which requires public notification and input.

Storage pipes included in the LTCP Alternative would be located within the public right-of-way and would not cause land use changes. Storage pipes and other CSO control projects constructed within existing rights-of-way or City property would generally be most compatible with existing zoning and planning policies. Storage tanks and tunnels would require permanent access hatches or shafts for maintenance, but those access sites would require less property for permanent easements than the areas used for construction. To the extent possible, the City would attempt to avoid locating storage facilities such as storage tanks and tunnel portals in parks, and no facilities would be built on beaches. However, limitations in available sites for facilities may necessitate locating storage facilities in or adjacent to a park in some cases, potentially affecting current and future recreational uses. See Section 6.10, Recreation.

The presence of underground storage tanks would restrict certain future uses at the site of the facility. Typical uses for the tops of storage tanks include athletic fields and parking facilities. The City would retain more area in ownership or by permanent easement for a storage tank than for a tunnel.

In contrast to storage tanks, the City would be able to sell or lease approximately 75 percent of the tunnel launch portal lands required for construction back to private ownership where it could be developed for zoned uses (e.g., industrial, commercial). Approximately 0.5 acre would be retained by the City to house the pump station, odor control, and permanent shaft (approximately 30-foot-diameter caisson) for access and maintenance. All of the area used for the smaller, recovery end of the tunnel would be retained by the City. Additionally, tunnel shafts would be required to accept flows from each contributing City and King County CSO basin (depending on the LTCP option).

6.9.1.3 Redevelopment Potential

Construction of tunnel portals could occur in contaminated soils, given the probable location of the tunnel portal along the Lake Washington Ship Canal within historically industrial areas. Remediation of these sites would be required prior to tunnel construction. Once the tunnel has been constructed, much of the tunnel launch portal land could be sold back to private ownership. Remediation would make these areas more attractive for private developers.

6.9.1.4 Visual Impacts

The completed facilities would largely be constructed below ground (Figure 6-2). Aboveground facilities would have minimal visual impacts with the use of appropriate design and screening. Visible facilities would include pump stations and other facilities (if located above ground) to support storage tanks, pipes, and tunnels. Typically the size of these facilities ranges from a small shed to as large as a small residential house; they are designed to blend in with the neighborhood. Some storage facilities would 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.

Figure 6-2. Typical Underground Storage Tank (Genesee CSO Storage Tank Rendering)

6.9.1.5 Comparison of Land Use and Visual Quality Impacts among the LTCP Options

As described above, storage tanks, and to a lesser extent storage tunnels, could potentially cause minor long-term land use impacts depending on the sites selected. Visual impacts for all options would be minor because aboveground facilities would be relatively small and designed to blend with the surrounding neighborhood. While impacts would generally be similar among the LTCP options, the following differences exist.

Neighborhood Storage Option

This option would have the most storage tanks located throughout the Plan area with the potential to cause permanent land use changes. Private property or permanent easements could be acquired for any of the LTCP options, but they would likely be greatest under the Neighborhood Storage and Shared Storage Options. Current land uses would be permanently changed to become storage facilities, but the tanks and associated equipment would largely be underground. The presence of underground storage tanks would restrict certain future uses at the site of the facility. While there is the potential to redevelop the surface area into certain beneficial uses, the previous land use at the site could be permanently altered. Typical uses for the tops of storage tanks include passive recreation, athletic fields, and parking facilities. The City would retain more area in ownership or by permanent easement for a storage tank than for a tunnel.

Ballard would have the largest storage tank (occupying an estimated 60,000 square feet). The completed facilities would be designed to visually blend with the surroundings, but it is likely that they will have a different appearance than preconstruction conditions. Storage pipes would be constructed in street rights-of-way and would have less potential for land use changes.

Storage pipes located in the Lake Washington Neighborhoods, Longfellow Creek /Duwamish Neighborhoods, and in Magnolia would be constructed in street rights-of-way and would not have a long-term impact on local residential and commercial land uses. Tanks located in the Ship Canal Neighborhoods and the East Waterway area could result in long-term, localized land use impacts given the number of tanks that would potentially need to be sited on industrial lands. The City has heard public concerns about converting the city’s limited industrial lands to other uses.

The Neighborhood West Ship Canal Tunnel would have similar impacts in Ballard and Fremont/Wallingford as described below for the Shared West Ship Canal Tunnel Option.

Shared Storage Option

The impacts would be similar to the Neighborhood Storage Option. While fewer sites in the Ship Canal Neighborhoods would be used for storage tanks, and no tank would be sited in the East Waterway area, potential land use impacts from siting larger shared tanks could occur in the Lake Washington Neighborhoods. These tanks would occupy an estimated 35,000 square feet (North Union Bay) and 40,000 square feet (Montlake). There is a greater potential for conversion of residential lands for storage tanks in the Lake Washington Neighborhoods under this option, with perceived inconsistency with adjacent residential land use. As noted above, the City would retain more area in ownership or by permanent easement for a storage tank than for a tunnel, and the presence of an underground tank restricts certain future uses of the site.

Shared West Ship Canal Tunnel Option

This option would have less potential for long-term land use impacts than both the Neighborhood Storage and Shared Storage Options since the tunnel would replace the need to site several storage tanks in the Ship Canal Neighborhoods (Ballard and Fremont/ Wallingford), and less property would need to be retained by the City following construction. In contrast to storage tanks, the City would be able to sell or lease approximately 75 percent of the tunnel launch portal lands in Ballard required for construction back to private ownership where it could be developed for zoned uses (e.g., industrial, commercial). Approximately 0.5 acre of the launch portal would be retained by the City to house the pump station, odor control, and permanent shaft for access and maintenance. All of the area used for the smaller, recovery end of the tunnel in Fremont/Wallingford would be retained by the City. Some additional areas would be retained for permanent shafts as required to accept flows from each contributing City and King County CSO area.

Shared Ship Canal Tunnel Option

Similar to the Shared West Ship Canal Tunnel Option, less property would need to be retained following construction of the tunnel compared to the Neighborhood and Shared Storage Options. The City would be able to sell or lease approximately 75 percent of the tunnel launch portal lands on the south side of the Ship Canal required for construction back to private ownership where it could be developed for zoned uses (e.g., industrial, commercial). Approximately 0.5 acre would be retained by the City to house the pump station, odor control, and permanent shaft for access and maintenance. All of the area used for the smaller, recovery end of the tunnel in North Union Bay would be retained by the City. Compared to the Shared West Ship Canal Tunnel Option, the Ship Canal Tunnel would result in less potential for land use impacts in Ballard and more potential for land use impacts on the south side of the Ship Canal and in North Union Bay.

6.9.2 What are the potential operational effects of the Integrated Plan Alternative on land use and visual quality?

Stormwater projects constructed under the Integrated Plan are not expected to cause major long-term impacts to land use or visual quality. The South Park Water Quality Facility is expected to have a footprint of less than 1 acre and there is likely available City property within the basin that is suitable for the facility. The facility would likely be sited in an industrial-zoned area, surrounded by industrial land uses. The visual impact of the facility is expected to be minimal, because the aboveground structure would be less than two stories high, resembling a pump station building.

Long-term land use impacts from NDS Partnering projects would be minimal because the projects would be implemented in neighborhoods on a voluntary basis, and they would be installed to blend with neighborhood character. Projects such as rain gardens constructed within public rights-of-way would add vegetated elements and streetscaping to existing neighborhoods. The projects would result in narrower roads that can provide a traffic calming effect, which could be a beneficial impact in some neighborhoods. Some neighborhoods would experience increased community interaction, as residents collaborate to develop landscaping plans and implement stewardship programs. Because ongoing maintenance would be an important component in the long-term effectiveness of these facilities, the City would implement a maintenance and monitoring program. The City's early experiences with rain gardens would be used to implement projects that function according to design, are safe, and are sustainable. The facilities would be sited in areas with appropriate soils, and they would only be implemented in areas where the neighborhood has volunteered to be a part of the program.

Land use impacts associated with expanded street sweeping are not expected to occur. Residential parking would not be affected by the expanded program, and because only minimal parking occurs on arterials at night, indirect land use impacts are not expected.

6.9.3 What are the potential operational effects of the No Action Alternative on land use and visual quality?

Operation of sewer system improvements and NDS projects implemented under ongoing programs is not expected to result in land use or visual quality impacts. The planned CSO control projects included in the 2010 Plan Amendment would have minor land use impacts. Visual quality impacts would be limited to the aboveground support facilities needed for the CSO control projects and are also expected to be minor.

6.9.4 What measures are proposed to reduce or minimize impacts to land use and visual quality?

The City would undertake the following measures to mitigate land use and visual quality impacts for all proposed projects:

- Minimize the size of permanent aboveground facilities and design them to blend with the surroundings.
- Locate and aim any artificial lighting away from adjacent roadways, residential areas, and water bodies. Use the minimum wattage necessary to provide the necessary illumination.
- Sell or lease portal land in excess of what is needed back to private ownership.

Additional site-specific measures would be identified during project design.

6.10 Recreation

This section describes the types of impacts that could occur to recreational activities, parks, and beaches within the Plan area resulting from operation of the Plan alternatives.

6.10.1 What are the potential operational impacts of the LTCP Alternative on recreation, parks, and beaches?

The operation of CSO facilities such as sewer system improvements, storage pipes, and flow transfers would cause few impacts to recreation, parks, and beaches because the facilities would be located in public rights-of-way. To the extent possible, the City would attempt to avoid locating CSO facilities such as storage tanks and tunnel portals in parks, and no facilities would be built on beaches.

However, because of limitations in available sites for facilities, it may be necessary to locate storage tanks or tunnel portals in or adjacent to a park or athletic field, or in parking areas or other associated park land. Locating CSO facilities in parks could constrain the use of that portion of a park for certain future park uses. Any underlying utility facility could preclude future development on the site for some uses. Close coordination with Seattle Parks and Recreation would occur to avoid and minimize impacts. Siting a CSO facility in a park would require compliance with Initiative 42 (Ordinance No. 118477) which requires a public hearing and an ordinance finding that any change of a park use to another usage is necessary (see Section 4.9.1.4).

In contrast to storage tanks, which require only small access hatches as permanent surface features, the City would need to retain a portion of the surface area above the tunnel shafts (approximately 30–foot-diameter caisson) for permanent access and maintenance. This permanent area could occupy as much as 0.5 acre.

Key Findings

Recreation

Overall, the operational effects from the *LTCP Alternative* on recreational activities are expected to be minor. Reductions in pollutant loading would benefit long-term water quality and help maintain beneficial uses at area beaches. Water contact recreation would be enhanced by improved water quality in Lake Washington, Portage Bay, and Lake Union, in particular. If located in a park, storage facilities would constrain certain future uses of that area for park purposes. However, recreational amenities could be provided on top of storage tanks following construction. The *Integrated Plan Alternative* would not result in additional impacts to recreation. The *No Action Alternative* would result in no additional improvements to water quality in the Plan area water bodies, with ongoing adverse effects on swimming beaches.

If the City locates a storage tank in a park, the area over the tank would be restored and opportunities would be explored to provide park amenities on the surface. Associated CSO facilities could take up a small area of the park and would be designed to blend in with the park surroundings. The CSO facility would be designed and constructed to ensure that recreational activities (such as walking, biking, sports, etc.) at parks would not be impacted by the operation of CSO facilities, and that planned or programmed future recreational uses would be maintained to the extent possible. If the City locates a storage tank or tunnel portal on athletic fields, the fields would be restored following construction and no long-term changes in use of the fields would occur. If a CSO facility is built in or adjacent to a park with a National Park Service grant, close coordination with Seattle Parks and Recreation would occur to ensure that the project does not interfere with grant compliance.

In general, the LTCP Alternative would reduce pollutant loading to the area's water bodies, with potential long-term benefits to water-based recreation. In particular, parks within the Ship Canal and Lake Union would experience the highest level of pollutant reduction, followed by Lake Washington, Longfellow Creek, and Puget Sound.

6.10.1.1 Comparison of Recreation Impacts among the LTCP Options

Differences among the options within each neighborhood are as follows.

Neighborhood Storage Option

This option would have the most tanks located throughout the Plan area, thereby resulting in the greatest potential to result in long term effects to an existing park or recreational facility. Parks in the Ship Canal Neighborhoods would have the greatest potential to be affected, given the number of tanks located in those neighborhoods. Once construction is complete, recreational activities at parks would be returned to preconstruction uses to the greatest extent possible. Potential future changes in park use could be constrained if permanent CSO facilities are located within the park area.

Parks in the Ship Canal Neighborhoods that could be near CSO facilities include the Burke Gilman Trail in the Fremont/Wallingford neighborhood, Discovery Park, and small neighborhood parks. Lake Washington Neighborhoods have a high concentration of parks, including both small neighborhood parks and major parks such as the Washington Park Arboretum, Madison Park, and numerous parks designed by the Olmsted Brothers. One of the major roads in the area is Lake Washington Boulevard, which was designed by the Olmsted Brothers and is a city park. It is likely that a storage pipe would be built in the right-of-way of Lake Washington Boulevard under this option because few other areas are available. The Leschi neighborhood has a particularly high concentration of parks and few roads suitable for construction in the right-of-way, so it is likely that storage pipes would be built directly adjacent to parks in this neighborhood. CSO facilities in the Longfellow Creek/Duwamish Neighborhoods are less likely to be constructed near parks, though smaller neighborhood parks and the Longfellow Creek Green Space are located in the Delridge neighborhood. CSO facilities in the Central Waterfront neighborhood are unlikely to be directly adjacent to a park, but the neighborhood does include many significant recreational facilities such as the Sculpture Park, the Aquarium, and small neighborhood parks.

The Neighborhood West Ship Canal Tunnel would have similar impacts in Ballard and Fremont/Wallingford as described below for the Shared West Ship Canal Tunnel Option.

Shared Storage Option

This option would have similar potential impacts as the Neighborhood Storage Option. While fewer sites in the Ship Canal Neighborhoods would be used for storage tanks, potential park and recreation impacts from siting larger shared tanks could occur in Fremont/Wallingford (Burke Gilman Trail and Fremont Canal Park) and in the Lake Washington Neighborhoods. The Montlake neighborhood is more likely to be affected under this option because of the relatively larger amount of parkland, including Montlake Boulevard (an Olmsted Park). The storage tank in North Union Bay would be located in proximity to the University of Washington Athletic Complex (including fields, a golf course, a ballpark, and an outdoor track) and the Union Bay Natural Area. Potentially impacted parks in other neighborhoods would be the same as under the Neighborhood Storage Option.

Shared West Ship Canal Tunnel Option

The tunnel would replace the need to site several storage tanks in the Ship Canal Neighborhoods (Ballard and Fremont/Wallingford), reducing the potential for long-term impacts to parks and recreational facilities. However, the tunnel portal site could be located in or adjacent to existing or planned parks and greenways. Potentially impacted parks in other neighborhoods would be the same as under the Neighborhood Storage Option.

Shared Ship Canal Tunnel Option

Tunnel portals would be located along the south side of the Ship Canal and North Union Bay where there are many park and recreation areas, including sports fields owned and operated by Seattle Pacific University and the University of Washington, as well as the Burke Gilman Trail and numerous neighborhood parks. Fields and parking lots associated with the University of Washington Athletic Complex could be impacted. However, no storage tanks would be built in the Ship Canal or Lake Washington Neighborhoods, reducing the potential to affect parks and recreational opportunities in these neighborhoods. Potentially impacted parks in the Longfellow Creek/Duwamish and Elliott Bay/Lake Union Neighborhoods would be the same as under the Neighborhood Storage Option.

6.10.2 What are the potential operational effects of the Integrated Plan Alternative on recreation, parks, and beaches?

Storage pipes, tanks, and tunnels constructed under the Integrated Plan Alternative would have the same recreational impacts as under the LTCP Alternative. The elements specific to the Integrated Plan Alternative are not expected to result in recreation impacts. Natural drainage systems would be constructed largely in residential areas and the completed projects would not impact passive recreation such as walking and biking. Expanded street sweeping would use main arterial roads and would occur at night, so it would be unlikely to impact recreational use of streets. The South Park Water Quality Facility would be located in an industrial area and would not be near any recreational uses.

In general, the Integrated Plan Alternative would results in greater reduction of pollutant loading to the area's water bodies than the LTCP Alternative, although both alternatives would provide overall benefits to water-based recreation. Water-based recreation in the Duwamish River would receive the highest level of initial benefit because of proposed projects within that basin.

6.10.3 What are the potential operational effects of the No Action Alternative on recreation?

Sewer system improvements would cause no direct impacts to recreation, parks, and beaches. Natural drainage solution projects such as rain gardens could be constructed adjacent to or in parks. These facilities are not expected to affect recreation or use of the parks. Rain garden plantings would blend with park landscaping. The CSO control projects included in 2010 Plan Amendment could be located in or near parks and beaches. Those projects either have been completed or will undergo separate SEPA analysis, as appropriate.

The No Action Alternative would result in no additional improvements to water quality in the Plan area. Indirect effects on water-based recreational activities at swimming beaches and in Plan area water bodies associated with continued CSO discharges would continue and potentially worsen.

6.10.4 What potential measures are proposed to reduce or minimize impacts to recreation?

The City would undertake the following measures to mitigate park and recreational impacts for all proposed projects:

- Comply with the conditions of Initiative 42 (Ordinance No. 118477) related to siting public facilities in parks.

- Coordinate closely with Seattle Parks and Recreation Department to minimize potential operational impacts for current and future recreational activities.

Additional site-specific measures, including mitigation for project-related impacts, would be identified during project design.

6.11 Historic, Cultural, and Archaeological

Operation of projects implemented under the Plan alternatives is anticipated to have no effect on historic, cultural, and archaeological resources within the Plan area.

6.12 Transportation

This section describes the types of impacts that could occur to transportation within the Plan area from operation of the Plan alternatives.

Key Findings

Transportation

Overall, the operational effects from vehicle trips generated by facility maintenance under all Plan alternatives are expected to be minor.

6.12.1 What are the potential operational effects of the LTCP Alternative on transportation?

When constructed, the CSO 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 most common visits to storage facilities by City maintenance staff would occur quarterly and after a CSO event, typically requiring only one vehicle. In the first year or so of use, City staff may elect to visit the site periodically during or after a CSO event, which would also typically require only one vehicle. The frequency and number of vehicles represent a very small portion of the overall traffic in the project vicinity. Occasional maintenance may be required at these locations, which could generate a small number of localized vehicle trips. This is expected to occur infrequently and would not affect roadway operations. Therefore, no long-term impacts on transportation are expected to result from the LTCP Alternative.

6.12.2 What are the potential operational effects of the Integrated Plan Alternative on transportation?

Operation of the additional projects implemented under the Integrated Plan Alternative would have minimal transportation impacts. Projects implemented under NDS Partnering may generate occasional maintenance trips that would have negligible effects on traffic operations. The South Park Water Quality Facility could also generate occasional vehicle trips with minimal effect on roadway operations. Expanded street sweeping would consist of expanding the extent of a program that is already in place. Street sweeping would only occur on arterial streets at night when traffic is low and would not affect roadway operations.

6.12.3 What are the potential operational effects of the No Action Alternative on transportation?

Completed projects under the No Action Alternative are not expected to cause transportation impacts.

Occasional maintenance may be required at locations of sewer system improvements, natural drainage projects, and CSO control projects completed under the 2010 Plan Amendment, which could generate a small number of localized vehicle trips. These trips would be expected to occur infrequently and would not affect roadway operations.

6.12.4 What measures are proposed to reduce or minimize impacts to transportation?

Because there would be no impacts to transportation, no mitigation measures are proposed.

6.13 Utilities

This section describes the types of impacts that could occur to utilities (largely wastewater utilities) within the Plan area from operation of the Plan alternatives. Potential impacts to other utilities including water, electrical, natural gas, and communications are highly project-specific and will be evaluated at the future project implementation stage.

Key Findings

Utilities

Implementation of the *LTCP Alternative* would require close coordination with numerous utilities within the service area. King County's West Point Treatment Plant would receive additional sewage flows, but these additional flows would have little effect on the peak loading to West Point. However, annual average flows would increase, resulting in greater operational and maintenance costs to King County. The potential implications to King County's combined sewer system vary depending upon the option implemented. For all LTCP options, the City would work together with King County to analyze and mitigate downstream operational and capital impacts to the King County System.

Impacts to public utilities would be largely related to selection of an LTCP option. No additional impacts are expected to occur related to the implementation of *Integrated Plan* stormwater projects.

6.13.1 What are the potential operational effects of the LTCP Alternative on utilities?

Implementation of the LTCP will require close coordination with numerous utilities, in particular, wastewater and stormwater utilities within the service area. Because the City's collection system network sends wastewater to King County for treatment, coordination with King County will be particularly important. King County's West Point Treatment Plant would receive additional sewage flows as a result of Plan implementation. The high variability in flow rates within the sewer system associated with heavy storms could be challenging to manage at the King County West Point Treatment Plant.

Based on City modeling, these additional flows will have little effect on the peak loading to King County's West Point Treatment Plant and may potentially reduce peak loading. However, annual average flows will increase, resulting in greater operational and maintenance costs. Seattle and King County will address the incremental cost of these flows in their sewage disposal agreement. The potential implications to King County's combined sewer system vary depending upon the option implemented, as described below. In general the operational implications associated with shared options will require greater coordination with King County than the Neighborhood Storage Option.

Neighborhood Storage Option

This option would generally have minimal operational impacts to utilities within the service area once construction is complete. Sewer system improvements in North Union Bay and a flow diversion in Portage Bay, as well as flow diversions in the South Delridge and East Waterway neighborhoods, would modify the flow volumes diverted to the King County system. This could result in operational impacts if not adequately coordinated with the County. However, all flow diversions would be undertaken in accordance with signed agreements with King County to ensure that impacts do not occur or are mitigated.

This option would result in the largest number of independent storage and conveyance (pipeline and pump station) facilities constructed and operated by both the City and the County, resulting in accompanying operation and maintenance requirements for each facility. Implementing the Neighborhood West Ship Canal Tunnel option would reduce the total number of facilities constructed, which could reduce the operational impacts associated with the individual storage facilities, but would result in operational considerations for the tunnel.

Shared Storage Option

The Shared Storage Option would result in three shared storage projects, including a shared tunnel in the Fremont/Wallingford neighborhood, a storage tank in the North Union Bay neighborhood, and a storage tank and flow diversion structures in the Montlake/Leschi neighborhoods. Shared projects would require close coordination regarding operation and maintenance considerations, cost sharing, and other factors. Close coordination of these projects between utilities can avoid any decrease in the operational efficiency of shared facilities. Long-term agreements will be made prior to the decision to implement the shared projects; therefore, significant long-term impacts are not anticipated. Implementation of this option would eliminate the need for several City and King County independent storage facilities, which would reduce the overall operational and maintenance requirements.

Shared West Ship Canal Tunnel Option

The Shared West Ship Canal Tunnel Option would require substantial coordination with King County during project planning, design, and construction. The Shared West Ship Canal Tunnel Option may reduce the operational complexity of controlling neighborhood storage tanks or even shared storage tanks, as it provides one large storage facility for all flows to be managed through a single point of discharge to the West Point Treatment Plant. Substantial coordination with King County would be needed during the planning, design, construction, and operation of the shared tunnel to capture all potential benefits.

Shared Ship Canal Tunnel Option

The Shared Ship Canal Tunnel Option would require substantial coordination with King County during project planning, design, and construction. As with the Shared West Ship Canal Tunnel Option, this option may reduce the operational complexity of controlling neighborhood storage tanks or even shared storage tanks, as it provides one large storage facility for all flows to be managed through a single point of discharge to the West Point Treatment Plant. Additional City and King County flows would be handled by the larger, Shared Ship Canal Tunnel, further reducing operational complexity. Substantial coordination with King County would be needed during the planning, design, construction, and operation of the shared tunnel to capture all potential benefits.

6.13.2 What are the potential operational effects of the Integrated Plan Alternative on utilities?

Operation of the additional projects implemented under the Integrated Plan Alternative would not have any anticipated adverse impacts on utilities.

6.13.3 What are the potential operational effects of the No Action Alternative on utilities?

Operation of projects completed as part of ongoing programs under the No Action Alternative is not expected to cause utility impacts. Under the No Action Alternative, no additional CSO control measures would be completed. Therefore, no additional storage would be constructed within the City's combined sewer system, resulting in continued and likely more frequent and/or higher volume overflows occurring into the future. Implementation of the No Action Alternative would not comply with the Consent Decree, and it could potentially result in significant fines for the City, with potential impacts to City ratepayers.

6.13.4 What measures are proposed to reduce or minimize impacts to utilities?

For all LTCP options, the City would work together with King County to analyze and mitigate downstream operational and capital impacts to the King County System. If downstream impacts cannot be successfully mitigated, then there is the potential that the County will be required to build new or larger downstream capital facilities to accommodate the LTCP options. Even with adequate mitigation though, there would likely be an increase in the County's operations & maintenance (O&M) costs to account for the additional flows from the City's system.

6.14 Socioeconomics and Environmental Justice

This section describes the types of socioeconomic and environmental justice impacts that could occur within the Plan area from operation of the Plan alternatives.

> **Key Findings**
>
> ***Socioeconomics and Environmental Justice***
>
> The operational effects of both the *LTCP Alternative* and *Integrated Plan Alternative* would be minor to moderately beneficial, and there would be no adverse operational effects that would be predominantly borne by minority or low-income populations and underserved communities. The *No Action Alternative* could result in minimal to substantial adverse impacts on environmental justice populations in the Plan area.

6.14.1 What are the potential operational effects of the LTCP Alternative on socioeconomic conditions and environmental justice populations?

6.14.1.1 Neighborhood Cohesion

The greatest impact of storage facilities on socioeconomic conditions, including neighborhood cohesion, would occur during construction. Once the facilities are completed, the disruptions would be minor and infrequent. Sewer system improvements and storage pipes, tanks, and tunnels would be located underground and would not cause impacts. Some associated facilities would generate noise, but noise levels are not expected to exceed the City's maximum noise levels. Some facilities also have the potential to produce odor, but that potential is minimal because the facilities would include state-of-the-art odor reduction equipment. None of the completed facilities would have long-term effects on community facilities (churches, schools, community centers, or libraries). There would be no changes to travel routes and durations, transit service, pedestrian access, or the character of land uses in neighborhoods. Therefore, none of the options would have long-term operational effects on neighborhood cohesion.

6.14.1.2 Environmental Justice

Because the LTCP options would result in very limited and minor operational effects, there would be no adverse operational effects that would be predominantly borne by minority or low-income populations. These minor impacts would affect all populations including historically underserved and low-income residents of neighborhoods in the Plan area. While the Longfellow Creek/Duwamish Neighborhoods have a greater presence of minority and low-income populations in comparison to other neighborhoods in the Plan area, none of the options include projects that would have greater operational disturbance in this area than in the other Plan neighborhoods. Given the distribution of the LTCP projects throughout the city, these minor operational effects on neighborhoods would not fall disproportionately on environmental justice populations. Implementation of the LTCP Alternative would not result in any identifiable effects that would be specific to any minority, low-income, or underserved community.

Under the LCTP Alternative, CSO discharges would be reduced, which would indirectly result in a long-term, beneficial impact on human health and safety. There would be beneficial effects on those who fish along the piers or waterfront as a result of improved water quality. These effects would be the same regardless of option. The improved water quality that would be achieved could increase the number of salmon and other fish species over time and could indirectly benefit Native American fishing in the area.

6.14.1.3 Comparison of Socioeconomic and Environmental Justice Impacts among the LTCP Options

Generally, none of the projects proposed for any of the LTCP Alternative options would have environmental justice impacts. While socioeconomic impacts would be minor and are generally similar among the LTCP options, the following differences exist.

Neighborhood Storage Option

The availability of sites ranging from 0.5 acre to 2 acres that are suitable for storage tanks is limited in the Plan neighborhoods. Economic and business impacts could result if economically important industrial or commercial lands are purchased or leased for this purpose.

The Neighborhood West Ship Canal Tunnel would have similar impacts in the Ship Canal Neighborhoods as described below for the Shared West Ship Canal Tunnel Option.

Shared Storage Option

Shared storage tanks (and a flow transfer in the East Waterway area) would reduce the total number of new storage tanks required in the city (by both the City and King County). This would reduce the amount of property acquisition or permanent easements required.

Shared West Ship Canal Tunnel Option

Under the Shared West Ship Canal Tunnel Option, beneficial effects on local economic activity in the Ship Canal Neighborhoods could occur over time once construction is completed and previous vacant industrial or commercial lands (if used for tunnel portals) become more attractive for investment. Lands reclaimed or repurposed for industrial or commercial use after construction of tunnels could stimulate economic activity, provide opportunities for new or expanded business and employment, and generate more tax revenues.

Shared Ship Canal Tunnel Option

Impacts would generally be the same as the West Ship Canal Tunnel Option and could potentially be beneficial.

6.14.2 What are the potential operational effects of the Integrated Plan Alternative on socioeconomic conditions and environmental justice populations?

The effects of the additional Integrated Plan stormwater projects would be minor to moderately beneficial. There would be no adverse operational effects that would be predominantly borne by minority or low-income populations and underserved communities. Under the Integrated Plan Alternative, both the stormwater projects and the deferred LTCP projects would reduce pollutant loads to water bodies. However, the deferred LTCP projects would benefit the Duwamish Waterway and the Ship Canal while the stormwater projects would benefit water bodies throughout the city. The Integrated Plan Alternative would result in substantially larger reductions in pollutant loads than the LTCP projects alone. This should bring large reductions in environmental health risks, which are often predominantly borne by minority or low-income populations.

6.14.3 What are the potential operational effects of the No Action Alternative on socioeconomic conditions and environmental justice populations?

Under the No Action Alternative, CSO discharges would not be reduced beyond what is planned as part of the 2010 Plan Amendment. No further improvements in current environmental health risks associated with pollution of the Plan area water bodies would occur. These current health risks are predominantly borne by low-income, tribal, and subsistence fishing communities, and immigrant families for whom fishing the Duwamish River, the Lake Washington system, and Puget Sound is rooted in cultural traditions.

Sewer system improvements and natural drainage systems included in the No Action Alternative are not expected to cause socioeconomic or environmental justice impacts.

6.14.4 What measures are proposed to reduce or minimize socioeconomic and environmental justice impacts?

The City actively solicited public participation as part of the planning process for the Plan and gave equal consideration to all input from persons regardless of age, race, income status, or other socioeconomic or demographic factors. The City will continue public participation efforts as projects are advanced consistent with the City's social and racial justice initiative.

CHAPTER 7

Cumulative Impacts

7.1 What are cumulative impacts and why do we study them?

Cumulative impacts are the effects that may result from the incremental impact of an action when added to other past, present, and reasonably foreseeable future actions, regardless of who undertakes them. Generally, an action can be considered cumulative if: (a) effects of several actions occur in the same locale; (b) effects on a particular resource are similar in nature; and (c) effects are long-term in nature. It is appropriate to evaluate the cumulative effects of a comprehensive program such as the **Plan to Protect Seattle's Waterways** (the Plan) in this programmatic EIS, to get a full understanding of the tradeoffs, impacts and benefits associated with the Plan alternatives and options.

7.2 How were cumulative impacts identified and evaluated?

Cumulative impacts were analyzed by identifying projects within the same geographic area (city of Seattle) and time period (2015 - 2030). First, similar CSO reduction projects being pursued by the City and King County during the same timeframe were identified and analyzed to determine whether cumulative impacts could occur from the combined projects (Section 7.3.1 below). Then other major capital projects were identified using plans, agency web sites, and other available information (Section 7.3.2). Due to the extended timeframe of Plan implementation, many major ongoing projects in Seattle are expected to be completed by the time the LTCP CSO control and Integrated Plan stormwater projects would be built. Therefore, the types of projects that could be under construction at the same time as the Plan projects are discussed.

7.3 What are the reasonably foreseeable projects and actions that could affect or be affected by the Plan alternatives?

7.3.1 Combined Sewer Overflow Control Projects

Other projects that could occur in the same neighborhoods or coincide with implementation of the LTCP include CSO control projects being constructed by the City and King County. Table 7.1 lists CSO reduction projects being constructed under the City's 2010 CSO Plan Amendment. These projects are part of the No Action Alternative, and would be constructed regardless of the implementation of the Plan. Together, these projects are expected to store approximately 5 million total gallons of combined sewage. Only one of these projects would occur in the same neighborhood as LTCP projects (Central Waterfront). A more complete description of these projects, can be found at www.seattle.gov/CSO.

Table 7-1. Storage Projects (2010 Plan Amendment)		
CSO Basin / Basin #	**Project Description**	**Completion Date**
Windermere		
13	Storage tank in Magnusson Park	2014
Genesee		
40/41	Storage tank at 49th Avenue South and Lake Washington Boulevard	2015
43	Storage tank at 53rd Avenue South and Lake Washington Boulevard	2015
Central Waterfront		
70, 71, and 72	Increased conveyance to King County Elliott Bay Interceptor and storage	2018
Henderson North		
44 45	Storage tank in Seward Park Storage tank in ROW	2018

Table 7-2 lists CSO control projects included in King County's Long-Term CSO Control Plan Amendment (King County, 2012a). Several of the King County CSO control projects would be located within Plan neighborhoods, including one each in the North Union Bay, Montlake, and Fremont/Wallingford neighborhoods, and five in the Longfellow Creek/Duwamish Neighborhoods. Under three of the four LTCP options, projects would be shared between the City and King County.

Table 7-2. King County CSO Control Projects				
King County CSO Project	**Independent Project**	**Shared Project**	**Project Planning and Implementation**	**Proximity to LTCP Projects**
University	2.9 MG storage tank	Shared Storage Option: Joint 5.2 MG storage tank Ship Canal Tunnel: Conveyance to tunnel	2022-2028	In North Union Bay neighborhood
Montlake	6.6 MG storage tank	Shared Storage Option: Joint 7.9 MG storage tank Ship Canal Tunnel: Conveyance to tunnel	2022-2028	In Montlake neighborhood
3rd Ave West	4.2 MG storage tank	Shared Storage Option: Joint 7.2 MG storage tank Ship Canal Tunnel: Conveyance to tunnel	2017-2026	In Fremont/ Wallingford neighborhood
11th Ave West	Conveyance to Ballard Siphon	Ship Canal Tunnel: Conveyance to tunnel	2025-2031	Between Fremont/ Wallingford and Ballard neighborhoods

Table 7-2. King County CSO Control Projects				
King County CSO Project	**Independent Project**	**Shared Project**	**Project Planning and Implementation**	**Proximity to LTCP Projects**
Chelan Ave	3.9 MG storage tank	No shared project	2017-2025	In Longfellow Creek/ Duwamish neighborhoods
W. Michigan-Terminal 115	0.3 MG storage pipe	No shared project	2019-2025	In Longfellow Creek/ Duwamish neighborhoods
Hanford #1	Conveyance to Bayview Tunnel	No shared project	2011-2019	In Longfellow Creek/ Duwamish neighborhoods
Hanford #2 - Lander St - King St - Kingdome (HLKK)	151 MGD wet weather treatment facility	Shared Storage Option, West Ship Canal Tunnel Option, and Ship Canal Tunnel Option: HLKK treatment facility would receive flows from East Waterway	2021-2031	In Longfellow Creek/ Duwamish and Elliott Bay neighborhoods
Brandon St – S. Michigan (Georgetown)	66 MGD wet weather treatment facility	No shared project	2012-2022	In Longfellow Creek/ Duwamish neighborhoods

7.3.2 Other Major Construction Projects

Several major construction projects in Seattle will be complete by the time LTCP projects begin construction, including the SR-520 Bridge Replacement. Major transportation projects that could be under construction simultaneously with LTCP CSO control projects include the Sound Transit U-Link Extension (to be completed in 2016), Lynnwood Link Extension (construction in 2018 - 2023), East Link Extension (construction in 2015 - 2021), Waterfront Project (Elliott Bay Seawall and Waterfront Seattle Core projects), the Alaskan Way Viaduct Replacement Project, WSDOT’s SR-509 and SR-167 project, Colman Ferry Dock Replacement, and other roadway and transit improvements. Transportation projects throughout the city are discussed in Section 4.11.

Over the next 15 years, Seattle City Light will be building new substations in Interbay, SODO, South Lake Union (Denny Way Substation), and the northeast and northwest parts of the city, as well as expanding capacity at the North, Duwamish, Shoreline, University, and Creston substations (Seattle, 2005). The City of Seattle has adopted a Capital Improvement Program for 2013-2018 which lists 622 individual capital projects to be constructed over the five-year period (Seattle, 2013). The Capital Improvement Program is updated yearly.

Given the extended timeframe of the Plan projects, other major projects that are not yet anticipated would likely have construction periods that overlap with Plan projects. Minor construction (such as single- and multi-family residential or commercial construction, road resurfacing, bridge repair, and general maintenance projects) could also cause localized cumulative construction impacts if located in close proximity to Plan projects.

Major capital transportation projects that are planned within the Plan area include both roadway and transit improvements. Construction schedules span several years. Figure 7-1 illustrates major planned transportation projects and other major infrastructure projects planned for the area.

7.4 What are the potential construction-related cumulative impacts of the LTCP Alternative?

Major construction projects have been underway in the greater Seattle area for the past decade. The long term effects of dealing with construction-related impacts can negatively affect residents, businesses, and those who travel through the area, resulting in impacts that range from temporary inconvenience to loss of residences, businesses, and quality of life. The primary construction impacts related to LTCP projects and include traffic and slowdowns, increased dust and emissions, and construction noise. In addition, in many neighborhoods, residents and workers have experienced ongoing construction noise and traffic delays for years from unrelated construction efforts. “Construction fatigue” could be worse in neighborhoods that have seen a high level of construction for major projects in recent years, such as Montlake and the University District. Neighborhoods such as Ballard that have experienced high levels of construction for new residential and commercial structures are also at high risk for construction fatigue.

Other major construction projects (either King County CSO control projects or other projects) could contribute to cumulative impacts on transportation or air quality even if located farther away from LTCP or Integrated Plan projects. Other construction projects in the same neighborhood or affecting another portion of the same arterial as LTCP or Integrated Plan projects could also contribute to traffic congestion.

Simultaneous construction of t Plan projects and other CSO control projects is unlikely to cause cumulative noise impacts, because projects would not be close enough together that noise from two CSO control projects would be audible at any one receptor. However, cumulative impacts from other projects, even minor construction projects, could add to the noise levels near the Plan projects.

7.4.1 Comparison of Cumulative Impacts among the LTCP Options

All of the CSO facilities would include long-term construction projects that would overlap with other, unrelated construction projects throughout the city. While impacts are generally similar between the LTCP options, the following differences exist.

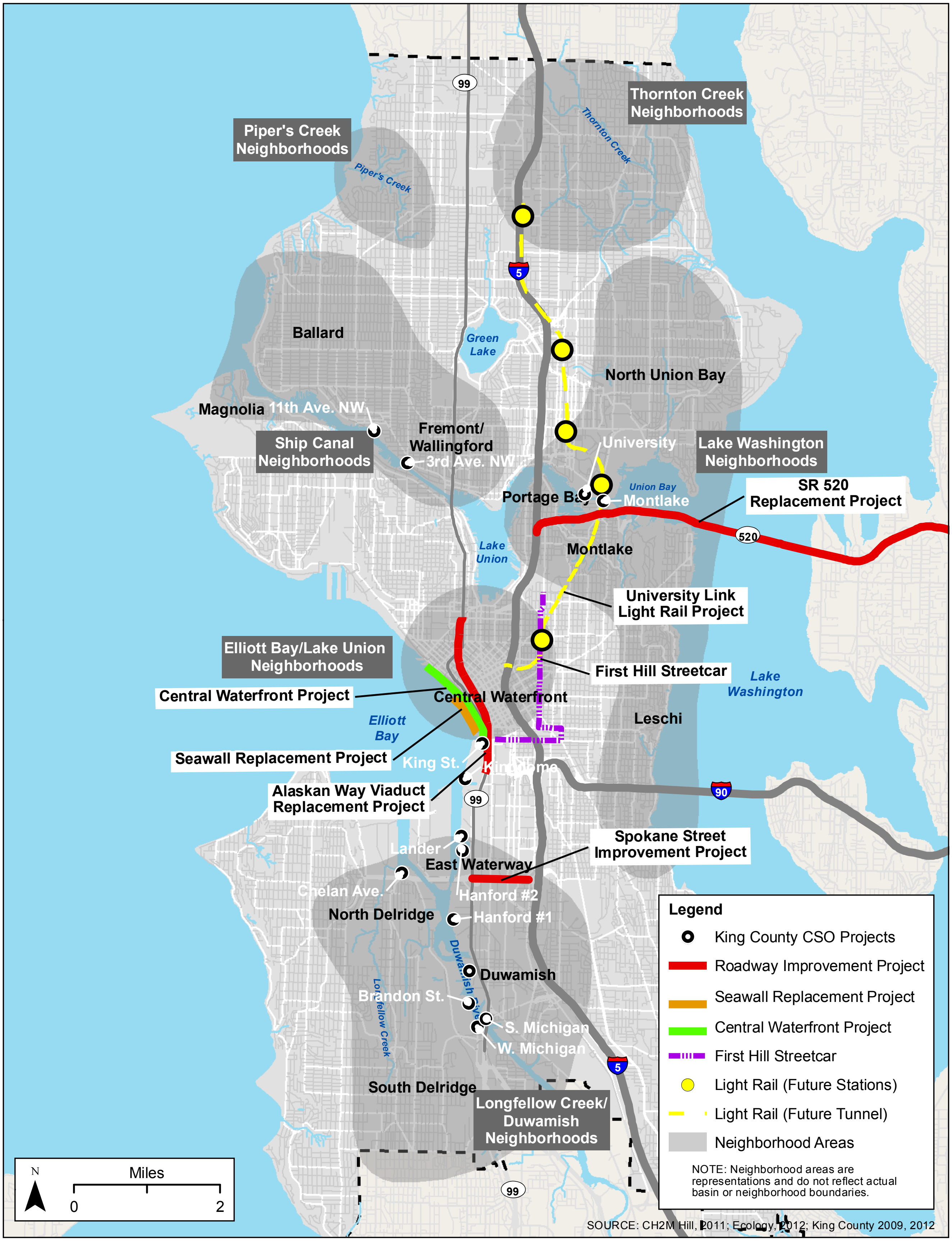


Figure 7-1 Major Planned Transportation Projects and King County CSO Locations.

7.4.1.1 Neighborhood Storage Option

Cumulative impacts would affect the greatest number of neighborhoods under the Neighborhood Storage Option, where a combined total of 27 storage tanks or pipes (18 by the City, and nine by King County) would be built by both the City and King County throughout the city over a multi-year period from approximately 2018 to 2025 or beyond. Neighborhoods most directly affected include the University, Montlake, Ballard, and Longfellow/Duwamish neighborhoods. Construction-related impacts from City and County projects would be greatest in these neighborhoods, with a duration ranging from one to five years, with the longest duration in the Ballard neighborhood for construction of a large storage tank. Under other LTCP options, these projects would be combined into a single shared project in each neighborhood. If a tunnel is used for the Neighborhood Storage Option, there would be two fewer tanks constructed. The construction of 27 storage tanks in the Seattle area represents a significant level of construction throughout the city.

7.4.1.2 Shared Storage Option

This option would have a lower potential for construction-related cumulative impacts than the Neighborhood Storage Option because some CSO control projects would be shared by the City and King County, but still represents a substantial level of construction throughout the city. This option would result in nine facilities constructed by the City, six by King County, and three shared facilities, for a total of 18 tanks. Construction durations at some locations could be as long as 4.5 years, with the longest durations in the Leschi and Montlake neighborhoods. Fewer storage tanks and pipes would be constructed in the Ship Canal and Lake Washington Neighborhoods, reducing the potential for cumulative impacts in these neighborhoods. This option also includes several storage tanks with the potential to be located in or near residential areas of the Ship Canal, Lake Washington, Longfellow Creek / Duwamish, and Central Waterfront neighborhoods, and replaces a storage tank with a flow transfer in the East Waterway neighborhood, which would reduce construction-related impacts in these neighborhoods.

7.4.1.3 Shared West Ship Canal Tunnel Option

This option would have a potential for cumulative impacts similar to the Neighborhood Storage Option, with 14 storage facilities constructed by SPU, eight by King County, and one shared facility for a total of 23 facilities constructed. The Shared West Ship Canal Tunnel would replace City and King County storage tanks in Ballard and Fremont/Wallingford, which would reduce construction-related impacts at the site of those tanks; however, the large tunnel would concentrate construction-related impacts at the launch portal (likely located along the Lake Washington Ship Canal in Ballard) for as long as 3.5 years. In East Waterway and Magnolia, flow transfers would replace storage tanks/pipes, which would reduce cumulative impacts in these neighborhoods.

7.4.1.4 Shared Ship Canal Tunnel Option

This option would affect the fewest number of neighborhoods throughout the city. This option would include three storage facilities constructed by the City, six by King County, and one shared facility for a total of 10 facilities constructed. Storage facilities would largely be eliminated in the Lake Washington Neighborhoods of Montlake, Madison Park, Portage Bay, and Leschi, thereby reducing the construction-related impacts in these neighborhoods. This option would also reduce the number of storage tanks in Ballard and Fremont/Wallingford. The large tunnel would be the largest single project associated with any of the LTCP options, and has the greatest potential to contribute to construction fatigue in the areas where the six- year construction project would be located. The launch portal would likely be located on the south side of the Ship Canal on the north slope of Queen Anne, and would be subject to the highest intensity of impacts over the approximate six-year construction duration. This option would reduce the number of King County projects being constructed, including projects slated for the University, Montlake, and Queen Anne (north slope) neighborhoods.

7.4.2 What are the potential construction-related cumulative impacts of the Integrated Plan Alternative?

The cumulative impacts associated with the Integrated Plan relate largely to construction of the LTCP storage facilities, as described above. Impacts resulting from the construction of the South Park Water Quality Facility would be offset by deferred construction of six CSO facilities, but overall impacts are not expected to be appreciably different from the LTCP. Impacts to the Duwamish River neighborhoods would be delayed associated with the deferral of three CSO projects, but the South Park Water Quality Facility would occur within that neighborhood. Cumulative impacts associated with expanded street sweeping and NDS Partnering are not expected.

7.5 What are the potential long-term cumulative operational impacts of multiple CSO reduction and/or stormwater treatment projects?

The LTCP projects would have long-term benefits to water quality in Plan area water bodies. After construction, the City's projects along with King County's projects would benefit water quality by reducing the frequency and volume of CSO events. This would reduce the potential for human health risks associated with CSO and stormwater discharges, and provide benefits to fish and aquatic habitat. As noted in Section 6.4 and 6.7, the Integrated Plan Alternative results in greater benefits to water quality, and accompanying reduction of potential risk to human and environmental health, than the LTCP Alternative.

Potential cumulative impacts to park properties could occur if the City and King County CSO (and/or stormwater) facilities are built in parks. As discussed in Section 6.10, constructing CSO storage facilities in parks could constrain future use of the park and preclude certain development in the park at a later date. There is a limited amount of park land in the city, and the cumulative impact of this project combined with other past and future projects could put constraints on the park system for future development.

Potential cumulative impacts to industrial-zoned properties could occur if the City and King County CSO facilities are located on industrial parcels. As discussed in Section 6.9, constructing CSO storage or stormwater facilities on industrial-zoned parcels could constrain future use of the parcel for other industrial uses and preclude future industrial development, if the areas are permanently retained by the City and King County. There is a limited amount of industrial land in the city, and the cumulative impact of this project combined with other past and future citywide infrastructure projects could limit the potential for future industrial development within selected areas of the city.

Potential operational issues associated with shared City facilities with King County could increase or change operational considerations for both King County and the City. For all LTCP options, the City would work together with King County to analyze and mitigate downstream operational and capital impacts to the King County System. If downstream impacts cannot be successfully mitigated, then there is the potential that the County will be required to build new or larger downstream capital facilities to accommodate the LTCP options. Even with adequate mitigation there would likely be an increase in the County's operations & maintenance (O&M) costs to account for the additional flows from the City's system.

To the greatest extent practicable, the City would try to time construction projects to minimize neighborhood impacts and reduce overall construction-related impacts in affected communities. The City will coordinate closely with the proponents of major projects throughout the city to minimize the potential for cumulative impacts; however, it is likely that some level of cumulative impact is unavoidable. As appropriate, the City will develop site-specific mitigation during project level review.

CHAPTER 8

REFERENCES

Bagley, Clarence B. 1916. *History of Seattle from the Earliest Settlement to the Present Time*. S. J. Clarke Publishing Company, Chicago.

Campbell, Sarah K. 1981. *The Duwamish No. 1 Site: A Lower Puget Sound Shell Midden*. University of Washington, Institute for Environmental Studies, Office of Public Archaeology, Seattle. On file, Washington State Department of Archaeology and Historic Preservation, Olympia.

Chrzastowski, M. 1983. *Historical Changes to Lake Washington and Route of the Lake Washington Ship Canal, King County, Washington.* USDI Geological Survey. To accompany Water Resources Investigation Open File Report 81-1182.

City of Seattle. 2002. *Seattle Views: An Inventory of 86 Public View Sites Protected Under SEPA (SMC 25.05.675)*. City of Seattle Department of Design, Construction and Land Use.

City of Seattle. 2005. *City of Seattle Comprehensive Plan: Toward a Sustainable Seattle (2004–2024).*

City of Seattle. 2007. *State of the Waters 2007, Volume I: Seattle Watercourses*. Prepared by Seattle Public Utilities.

City of Seattle. 2008. *2008 Seattle Greenhouse Gas Inventory*. City of Seattle Office of Sustainability & Environment.

City of Seattle. 2011a. *Change in Covered Employment – City of Seattle.* October 19, 2011. http://www.seattle.gov/dpd/cms/groups/pan/@pan/documents/web_informational/dpds019195.pdf. Accessed May 15, 2012.

City of Seattle. 2011b. *Seattle Bicycling Guide Map*. Seattle Department of Transportation.Accessed at: http://web6.seattle.gov/SDOT/BikeMap/.

City of Seattle. 2011c. *Seattle's Parks and Recreation 2011 Development Plan*. Adopted November 28, 2011. http://www.seattle.gov/parks/publications/Development/plan_2011_ADOPTED.pdf. Accessed April 23, 2012.

City of Seattle. 2011d. *City of Seattle Sea Level Rise Planning Guidance for Capital Projects*. July 1, 2011.

City of Seattle. 2012. *Seattle Biological Evaluation*. Revised October, 2012. Seattle, WA.

City of Seattle. 2013. *City of Seattle, Washington 2013-2018 Adopted Capital Improvement Program.* Seattle, WA.

City of Seattle Department of Planning and Development (DPD). 2005. *Environmentally Critical Areas – Best Accessed Science Review.* Prepared by Department of Planning and Development. Seattle, WA.

Climate Impacts Group. 2009. *The Washington Climate Change Impacts Assessment: Evaluating Washington's Future in a changing Climate.* University of Washington.

Elsner, M.M., L. Cuo, N. Voisin, J.S. Deems, A.F. Hamlet, J.A. Vano, K. EB. Mickelson, S. Lee and Dennis P. Lettenmaier. 2009. *Implications of 21st Century Climate Change for the Hydrology of Washington State.* Chapter 3 in Climate Impacts Group, 2009.

Employment Security Department. 2012. *Monthly Employment Report for March 2012.* Accessed at https://fortress.wa.gov/esd/employmentdata/docs/economic-reports/current-monthly-employment-report.pdf. Accessed May 15, 2012.

Federal Highway Administration (FHWA). 2006. *Construction Noise Handbook.* Prepared by U.S. Department of Transportation Research and Innovative Technology Administration. August 2006.

Federal Highway Administration (FHWA). 2009. *Manual on Uniform Traffic Control Devices for Street and Highways.* 23 CFR Part 655m Subpart F. December, 2009.

Federal Highway Administration and Sound Transit. 2006. *North Link Light Rail Transit Project, Final Supplemental Impact Statement.* 2006.

Federal Highway Administration and Washington State Department of Transportation. 2011. *SR 520, I-5 to Medina: Bridge Replacement and HOV Project, Final Environmental Impact Statement*. 2011.

Federal Highway Administration, Washington State Department of Transportation, and the City of Seattle. 2011. *Alaskan Way Viaduct Replacement Project, Final Environmental Impact Statements and Section 4(f) Evaluation.* 2011.

Federal Register. 2010. *General Provisions; Migratory Birds Revised List and Permits; Final Rules. 50 CFR Parts 10 and 21. Vol. 75, No. 39.* Accessed at: http://www.fws.gov/migratorybirds/RegulationsPolicies/mbta/10-13%20Final%20Rule%201%20March%202010.pdf.

Hays, D. W., K. R. McAllister, S. A. Richardson, and D. W. Stinson. 1999. *Washington State Recovery Plan for the Western Pond Turtle.* Washington State Department of Fish and Wildlife, 66 pp.

King County. 2009. *Comprehensive Sediment Quality Summary Report for CSO Discharge Locations.* King County Department of Natural Resources and Parks, Wastewater Treatment Division. December 2009.

King County. 2010. *Technical Memorandum 540: Environmental and Habitat Priorities – 2012 CSO Control Program Review. Final.* King County Department of Natural Resources and Parks, Wastewater Treatment Division. November 2010.

King County. 2012a. *2012 King County Long-term Combined Sewer Overflow Control Plan.* Wastewater Treatment Division. October 2012.

King County. 2012b. *KingStat Indicators – Aquatic Environment.* King County Water and Land Resources Division. Accessed at: http://your.kingcounty.gov/dnrp/measures/2012/indicators/aquatic-enviro.aspx.

King County Department of Transportation. 2012. *Water Taxi Route and Schedule Information*. Accessed at: http://www.kingcounty.gov/transportation/kcdot/WaterTaxi.aspx.

King County Metro. 2012a. *RapidRide Route, Schedule, and Project Information.* Accessed at: www.kingcounty.gov/transportation/kcdot/metrotransit/rapidride.aspx.

Lewarch, Dennis E., Lynn L. Larson, Leonard A. Forsman, Guy F. Moura, Eric W. Bangs, and Paula Mohr Johnson. 1996. *King County Department of Natural Resources Water Pollution Control Division Alki Transfer/CSO Facilities Project Allentown Site (45KI431) and White Lake Site (45KI438 and 45KI438A)*

Data Recovery. On file, Washington State Department of Archaeology and Historic Preservation, Olympia.

Natural Resources Conservation Service. 2012. *Web Soil Survey.* Accessed at: http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx. Accessed April 5, 2012.

NIDCD (National Institute on Deafness and other Communication Disorders). 2008. *Noise-induced Hearing Loss.* Accessed at: http://www.nidcd.nih.gov/health/hearing/noise.asp.

Pietsch, T.W. and S. DeVaney. 2012. *Key to the Fishes of Puget Sound*. Accessed at: http://www.burkemuseum.org/static/FishKey/.

PSCAA (Puget Sound Clean Air Agency). 2012. 2012 *Air Quality Data Summary.* Accessed at: http://www.pscleanair.org/news/library/reports/2012AQDSReport.pdf.

Rector, P.R., T. Duckworth, and C.C. Obropta. 2012. Rain Gardens and Mosquitoes. Fact Sheet FS 1175 of the Rutgers University Cooperative Extension. Accessed at: http://njaes.rutgers.edu/pubs/publication.asp?pid=FS1175.

Rosenberg, E.A., P.W. Keys, D.B. Booth, D. Hartley, J. Burkey, A.C. Steinemann, and D. P. Letternmaier. 2009. Precipitation Extremes and the Impacts of Climate Change on Stormwater Infrastructure in Washington State. Chapter 9 in Climate Impacts Group, 2009.

Snider, Stephanie. 2002. *Assessing Environmental Justice concerning Combine Sewer Overflows in Indianapolis, Indiana.* SPEA V-600 (2002).

Sound Transit, 2012a. *Projects and Plans.* http://www.soundtransit.org/Projects-and-Plans.xml. Accessed: April 2014.

Sound Transit, 2012b. *Route and Schedule Information (April)*. www.soundtransit.org.Accessed : April 2014.

SPU (Seattle Public Utilities). 2007. *Volume I: Seattle Watercourses. 2007,* Seattle Public Utilities Geotechnical Engineering,Seattle.

SPU (Seattle Public Utilities). 2010. *Combined Sewer Overflow Program 2010 CSO Reduction Plan Amendment.* Prepared for Seattle Public Utilities by Tetra Tech, Seattle Washington. May 2010.

SPU (Seattle Public Utilities). 2012a. *Long Term Control Plan (LTCP) Combined Sewage Overflow Preliminary Geotechnical Study: Fremont/Wallingford Basin Neighborhood and Shared Options.* January 2012. Seattle Public Utilities Geotechnical Engineering, Seattle.

SPU (Seattle Public Utilities). 2012b. *Long Term Control Plan (LTCP) Combined Sewage Overflow Preliminary Geotechnical Study: North Union Bay Basin Neighborhood and Shared Options.* January 2012. Seattle Public Utilities Geotechnical Engineering, Seattle.

SPU (Seattle Public Utilities). 2012c. *Long Term Control Plan (LTCP) Combined Sewage Overflow Preliminary Geotechnical Study: Delridge Basin Neighborhood and Shared Alternatives.* January 2012. Seattle Public Utilities Geotechnical Engineering, Seattle.

SPU (Seattle Public Utilities). 2012d. *Long Term Control Plan (LTCP) Combined Sewage Overflow Preliminary Geotechnical Study: Ballard, Ballard (Magnolia), Interbay, Portage Bay, Leschi, Madison Park/Union Bay, Montlake, and Duwamish Basin Neighborhood Alternatives.* February 2012. Seattle Public Utilities Geotechnical Engineering, Seattle.

SPU (Seattle Public Utilities). 2013a. *2012 Annual Report Combined Sewer Overflow (CSO) Reduction Program.* March 30, 2013.

SPU (Seattle Public Utilities). 2013b. *Draft Sea Level Rise Map for Year 2050.* Accessed at: http://www.seattle.gov/util/groups/public/@spu/@conservation/documents/webcontent/02_030004.pdf. July 8, 2013.

SPU (Seattle Public Utilities). 2013c. *RainWise Program SEPA Environmental Checklist*. February 5, 2013.

SPU (Seattle Public Utilities). 2014. *The Plan to Protect Seattle's Waterways Volume 2: Long-Term Control Plan.* 2014

Troost, Kathy G., and Derek B. Booth. 2008. Geology of Seattle and the Seattle area, Washington. In *Landslides and Engineering Geology of the Seattle, Washington, Area*, edited by Rex L. Baum, Jonathan W. Godt, and Lynn M. Highland, pp. 1-35. Reviews in Engineering Geology XX. The Geological Society of America, Boulder.

Troost, Kathy G., Dennis E. Lewarch, Julie K. Stein, and Lynn L. Larson. 1995. *Seismic and Aseismic Submergence of Archaeological Deposits in the Past 4,000 Years at Seattle, Washington*. On file, Washington State Department of Archaeology and Historic Preservation, Olympia.

Troost, Kathy G., Derek B. Booth, and William T. Laprade. 2003. *Quaternary geology of Seattle. Field Guide 4.* Geological Society of America, Boulder.

URS Corporation and BOAS, Inc. 1987. *The Duwamish No. 1 Site: 1986 Data Recovery*. On file, Washington State Department of Archaeology and Historic Preservation, Olympia.

U.S. Army Corps of Engineers. 2012a. *Lake Washington Ship Canal and Hiram M. Chittenden Locks.* Accessed at: http://www.nws.usace.army.mil/PublicMenu/Menu.cfm?sitename=lwsc&pagename=mainpage. Accessed: April 2012. U.S. Army Corps of Engineers, Seattle District, Seattle, Washington.

U.S. Army Corps of Engineers. 2012b. *Lake Washington Basin, Lake Washington Summary Hydrograph*. http://www.nwd-wc.usace.army.mil/nws/hh/basins/lwscsh.html. Accessed April 2012. U.S. Army Corps of Engineers, Seattle District, Seattle, Washington.

U.S. Department of Commerce, Bureau of the Census. 2010. *Summary File 1; 2006-2010 American Community Survey 5-Year Estimates.* US Census 2010.

U.S. Environmental Protection Agency, 1971. *Noise from Construction Equipment and Operations, Building Equipment, and Home Appliances.* Washington, D.C.

U.S. Environmental Protection Agency (EPA). 2011b. *Plan EJ 2014.* Office of Environmental Justice. Accessed online at http://www.epa.gov/environmentaljustice/plan-ej/index.html.

U.S. Fish and Wildlife Service, Department of the Interior (USFWS). 2007. *National Bald Eagle Management Guidelines.* May 2007. 23 pp.

Vano, J.A., N. Voisin, L. Cuo, A.F. Hamlet, M.M. Elsner, R.N. Palmer, A. Polebitski, and D. P. Lettenmaier. 2009. *Climate Change Impacts on Water Management in the Puget Sound Region.* Washington, USA. Chapter 3 in Climate Impacts Group, 2009.

Washington Natural Heritage Program (WNHP). 2012. *Review of Washington Natural Heritage Program Geographic Information data set for rare plant species and ecosystems.* Conducted May 2012.

Washington State Department of Ecology (Ecology). 2011. Update: Control of Toxic Chemicals in Puget Sound. Washington State Department of Ecology Environmental Assessment Program. February 2011. http://www.ecy.wa.gov/pubs/1103012.pdf

Washington State Department of Ecology (Ecology). 2012a. Surface Water Quality Standards website. Washington State Department of Ecology. http://www.ecy.wa.gov/programs/wq/swqs/index.html (accessed March - April 2012).

Washington State Department of Ecology (Ecology). 2012b. *Phase I Municipal Stormwater Permit Stormwater, National Pollutant Discharge Elimination System and State Waste Discharge General Permit for Discharges from Large and Medium Municipal Separate Storm Sewer Systems*. http://www.ecy.wa.gov/programs/wq/stormwater/municipal/phaseIpermit/1YR/PhaseIOneYearPermitwSignedCover.pdf. Issued on August 1, 2012.

Washington Department of Ecology (Ecology). 2013a. *Fish Consumption Rates Technical Support Document: A Review of Data and Information about Fish Consumption in Washington.* Version 2.0. January 2013.

Washington Department of Ecology (Ecology). 2013c. *Toxics Cleanup Program Website.* Washington State Department of Ecology. Accessed at: http://www.ecy.wa.gov/programs/tcp/sites_brochure/lower_duwamish/lower_duwamish_hp.html. Accessed January 2013.

Washington State Department of Ecology (Ecology). 2014. *Washington State's Water Quality Assessment and 303(d) List Website.* Washington State Department of Ecology. Accessed at: http://www.ecy.wa.gov/programs/Wq/303d/currentassessmt.html. Accessed April 2014.

Washington State Department of Ecology (Ecology) and King County. 2011. *Control of Toxic Chemicals in Puget Sound: Assessment of Selected Toxic Chemicals in the Puget Sound Basin, 2007-2011.* Washington State Department of Ecology, Olympia, WA and King County Department of Natural Resources, Seattle, WA. Ecology Publication No. 11-03-055. www.ecy.wa.gov/biblio/1103055.html

Washington State Department of Fish and Wildlife (WDFW). 2012a. *Priority Habitats and Species (PHS) on the Web.* Review of PHS data set for sensitive fish and wildlife species. Conducted May 2012.

Washington State Department of Fish and Wildlife (WDFW). 2012b. SalmonScape interactive mapping tool. Olympia, Washington. Accessed at: http://apps.wdfw.wa.gov/salmonscape/.

Washington State Department of Fish and Wildlife. 2008. *Priority Habitat and Species List.* Olympia, Washington. 177 pp.

Washington State Department of Transportation (WSDOT). 2012a. SR 99-Alaskan Way Viaduct, http://www.wsdot.wa.gov/Projects/.

Washington State Department of Transportation (WSDOT). 2012b. *SR 520 Bridge Replacement.* Accessed at: http://www.wsdot.wa.gov/Projects.

Washington State Department of Transportation (WSDOT). 2012c. *Work Zone Traffic Control Guidelines*. Publication No. M 54-44. February 2012.

Washington State Ferries, 2012, Route and Schedule Information (April). Accessed at: http://www.wsdot.wa.gov/ferries/.