4.8 Water Resources

4.8.1 Summary

The FWLE would increase the amount of impervious surface compared to existing impervious surfaces in the study area by between 14 percent for the SR 99 Alternative and 140 percent for the I-5 Alternative (see Table 4.8-1). This could potentially result in impacts to water quality; however, stormwater management and best management practices would be implemented for all light rail alternatives to protect surface waters from the additional surface runoff.

TABLE 4.8-1
Summary of Changes in Impervious Surface Within Alternative Footprints

Alternative	Existing Impervious Surface in Acres (Range with Options)	Proposed Impervious Surface in Acres (Range with Options)	% Increase in Impervious Surface (Range with Options)
SR 99 Alternative	**104** (81-123)	**119** (92-135)	**14** (10-14)
I-5 Alternative	**30** (24-40)	**72** (69-81)	**140** (102-189)
SR 99 to I-5 Alternative	**42** (41-57)	**76** (76-91)	**80** (61-84)
I-5 to SR 99 Alternative	**95** (69-101)	**111** (88-114)	**17** (13-27)

Note: The ranges provided show the potential range of impacts when each alternative is combined with one or more of its station or alignment options.

There would be five stream crossing locations with one or more alternatives or options. At four locations, stream impacts would be avoided by spanning the stream crossing with an elevated guideway. The I-5 Alternative would require relocation and/or piping of approximately 800 feet of Bingaman Creek in the stream's upper reach. With the exception of the relocation of Bingaman Creek, the project was found to have no adverse impacts on surface water bodies. All alternatives would be located within wellhead protection zones for Highline Water District in SeaTac and Lakehaven Utility District in Federal Way, but with appropriate design and best management practices, no adverse impacts to groundwater are expected.

4.8.2 Introduction to Resources and Regulatory Requirements

This section describes the affected water resources and potential hydrologic, flooding, and water quality impacts associated with the Federal Way Link Extension (FWLE) alternatives.

Appendix D4.8, Water Resources, contains the following supporting information:

- A list of relevant laws, ordinances, and guidelines
- A table of designated water uses for the water bodies in the study area
- A list of applicable stormwater ordinances and manuals
- Maps of major surface water bodies and stormwater facilities in the study area and hydrologic soil groups
- A table of changes in impervious surface
- Best management practices (BMPs) for stormwater impacts

A detailed discussion of wetlands, stream habitat, and stream/wetland buffers is presented in Section 4.9, Ecosystems.

4.8.3 Affected Environment

The study area for water resources consists of the stream basins within which the project would be constructed (Exhibit 4.8-1). Most of the study area lies along the topographic ridge that drains west to Puget Sound and east to the Green River valley within the Duwamish/Green Water Resources Inventory Area (WRIA) 9. The southern end of the study area is within the Puyallup/White WRIA 10. Topography in the study area ranges from a high elevation of roughly 500 feet along the SR 99/I-5 corridor to sea level at Puget Sound. Virtually all of the study area crossed by the FWLE alternatives is urbanized. The greatest areas of development are along the SR 99 corridor and in the area surrounding the Federal Way Transit Center. Other areas are characterized by lower-density residential development and greater concentrations of vegetation. following sections address surface waters, floodplains, groundwater, and stormwater management.

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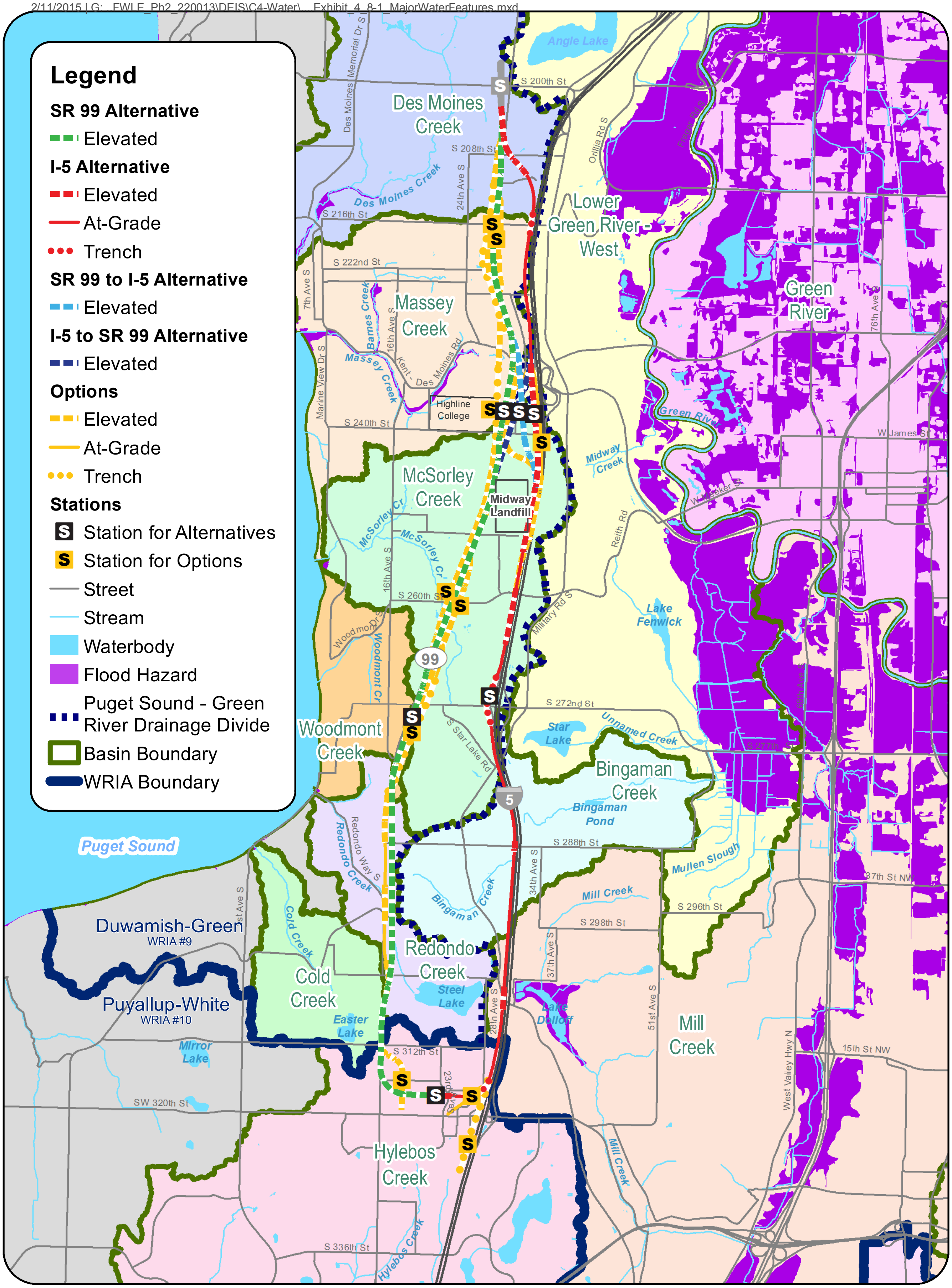


Data Sources: King County, Cities of Des Moines, Federal Way, Kent, SeaTac (2013).

N

0 0.5 1 2 Miles

EXHIBIT 4.8-1
Major Water Features

Federal Way Link Extension

4.8.3.1 Surface Water

Exhibit 4.8-1 shows the major streams within the study area. Given the relatively narrow width and steep sides of the study area, the local streams are generally short and no more than a few miles long.

The west side of the study area drains to the East Passage of Central Puget Sound. The primary streams in the study area that flow to Puget Sound include Des Moines Creek, Massey Creek, McSorley Creek, and Redondo Creek. The primary streams flowing east to the Green River include Bingaman Creek and Mill Creek, both in the southeastern portion of the study area.

The southernmost portion of the study area encompasses the northern end of the Hylebos Creek Basin. Runoff from this portion of the Hylebos Basin flows south to a large wetland south of S 348th Street. The wetland is the headwaters of Hylebos Creek, which flows south and then west, emptying into Commencement Bay east of downtown Tacoma.

All of these stream basins are highly urbanized and exhibit high stream flows (peak flows) during storm events, a characteristic typical of developed basins. Urbanization has also changed base flow and increased seasonal flow fluctuations from pre-development conditions. These changes can have major effects on the physical, biological, and chemical nature of the stream. More information on these stream characteristics is available in the FWLE Ecosystems Technical Report, Appendix G2.

A basin plan was developed for Des Moines Creek (Des Moines Basin Committee, 1997) that recommended a large regional detention facility be constructed in the basin to reduce peak stormwater runoff. A basin plan was also prepared for Hylebos Creek (King County Surface Water Management Division, 1991). There are several large regional detention ponds in the upper portion of the basin, and some stream and riparian restoration projects have been carried out in the middle reaches of the basin.

Lakes in the study area include Angle Lake, Star Lake, Steel Lake, and Lake Dolloff. These lakes are of moderate size and have a relatively small area contributing runoff.

The shorelines of Angle Lake, Star Lake, and Steel Lake are almost completely developed with single-family residences, docks, and piers. These lakes have good to excellent water quality. Lake Dolloff is undeveloped along its north side, with low-density residential development along the remaining shoreline. Lake Dolloff is classified as having fair water quality but is considered eutrophic.

Eutrophic

A lake is eutrophic when it has high levels of nutrients that promote high algae production (algal blooms). This typically results in periods of very low water clarity. This can also result in low dissolved oxygen levels in the lake water that can adversely affect aquatic species (King County Lakes Program, 2013).

Under the Washington Administrative Code (WAC) 173-201A, the state Department of Ecology (Ecology) has assigned water uses to each of the water bodies in the study area. These are shown in Appendix D4.8. These uses define the water quality standards that must be met for each water body. Ecology prepares a state-wide water quality assessment on a periodic basis to develop a list of impaired waters that do not meet water quality standards, also known as the 303(d) Impaired Waters List. Water bodies in the study area not meeting Ecology's water quality standards for criteria are summarized in Table 4.8-2. Within the study area, bacteria and dissolved oxygen are the two parameters that most commonly do not meet Ecology's water quality standards. Water quality violations are also shown for copper in Des Moines, Massey, and McSorley creeks. However, a recent study failed to find water quality violations for copper in these three streams and recommended that the 303(d) List be modified accordingly (Ecology, 2012a).

TABLE 4.8-2
Water Bodies Not Meeting Water Quality Standards (303[d] List)

	Dissolved Oxygen	Bacteria	Copper	PCBs (tissue)	Bioassessment
East Passage (Puget Sound)		✓		✓	
Des Moines Creek	✓	✓	✓		
Massey Creek	✓		✓		
McSorley Creek	✓	✓	✓		
Redondo Creek		✓			
Unnamed Creek[a]	✓	✓			
Hylebos Creek	✓				✓

Source: Ecology, 2013.
[a] Flows from Star Lake to the Green River.
PCBs = polychlorinated biphenyls

4.8.3.2 Floodplains

Flood insurance rate maps (FIRMs) have been published by the Federal Emergency Management Agency for the study area (Federal Emergency Management Agency, 1995). Only two flood hazard areas have been mapped within to the study area, but are not within 200 feet of any of the alternatives. One of them follows the upper portion of the south fork of Massey Creek, west of SR 99 (Exhibit 4.8-1). The second flood hazard area is located around Lake Dolloff, and extends to the east side of Interstate 5.

4.8.3.3 Groundwater

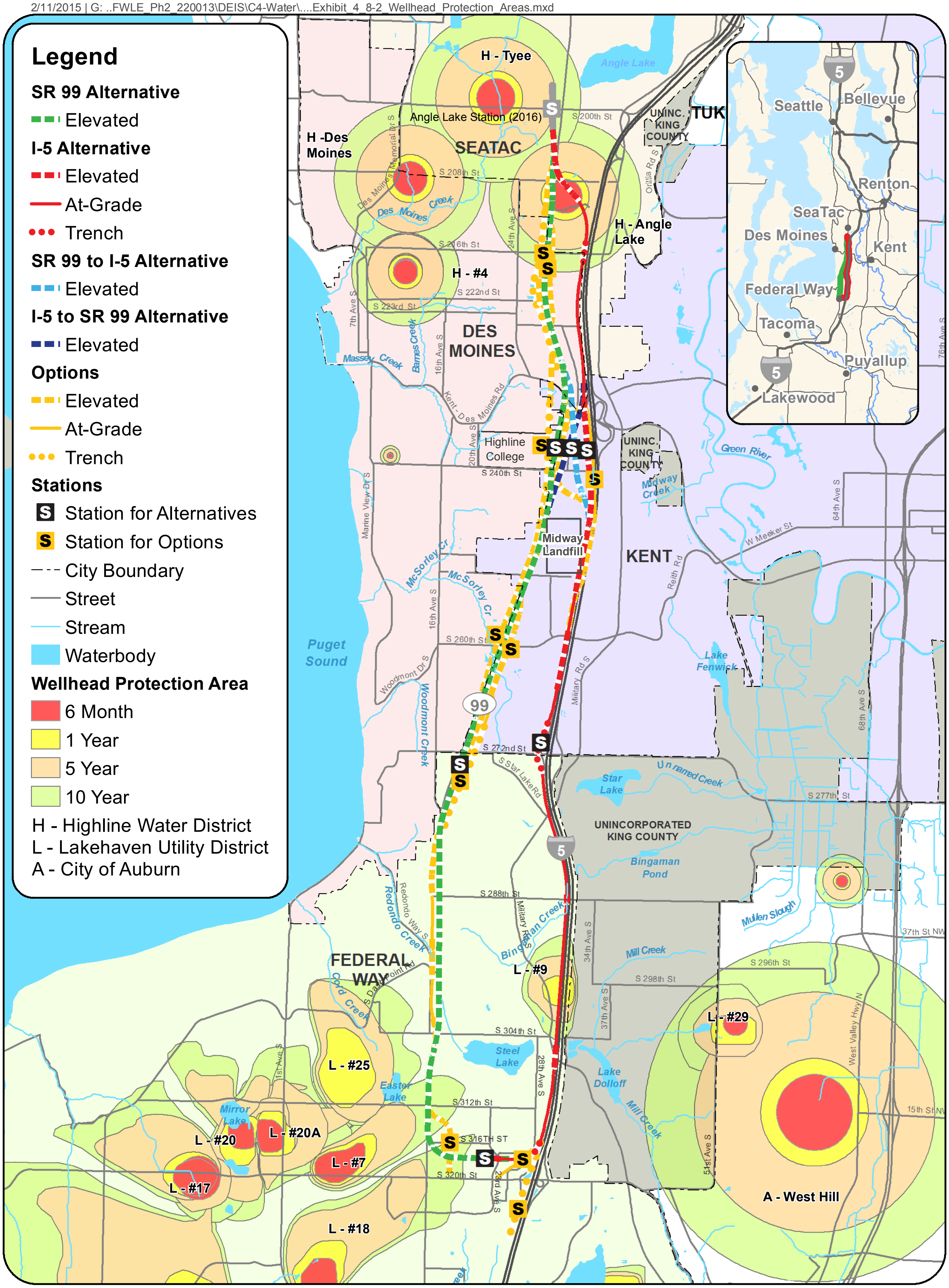
There is no U.S. Environmental Protection Agency (EPA)-designated Sole Source Aquifer within the study area. However, groundwater provides an important municipal water supply in the southern portion of the study area. Wellhead protection zones have been designated around a number of municipal drinking water supply wells in the study area (Exhibit 4.8-2). Each zone defines an area of land where infiltrating water would take a given period of time to directly recharge the municipal well. Four zones representing recharge times of 6 months, 1 year, 5 years, and 10 years are typically shown. Wells in the study area with wellhead protection areas include:

- Highline Water District: #14, Des Moines, Tyee, and Angle Lake wells
- Lakehaven Utility District: Wells #7, #9, #17, #18, #20, #20A, #25 and #29

Midway Landfill, operated by the City of Seattle, is a Superfund site that was closed in 1983, after which groundwater monitoring indicated that contaminants had entered the groundwater (EPA, 2000). Leachate from the landfill has migrated though the base of the landfill and entered a relatively porous formation known as the Upper Gravel Aquifer. It subsequently flowed to the underlying Southern Gravel Aquifer, which flows both east and west. The volatile organic compounds (VOCs) 1, 2-dichloroethane and vinyl chloride were the primary contaminants of concern.

Remedial actions were undertaken in the 1990s to address the contamination. The landfill was capped and offsite run-on to the landfill was diverted. A stormwater pond was constructed to treat surface runoff from the landfill. Discharge from that pond enters McSorley Creek. These and other actions greatly reduced the amount of leachate from the landfill, causing groundwater levels below the landfill to fall. Concentrations of VOCs in downgradient wells have also declined and are now below or approaching the Remedial Action Goals for the landfill (EPA, 2010).

An additional contaminant, 1, 4-dioxane, was detected in the groundwater in 2005 and has been added to the list of monitored compounds. Both 1, 2-dichloroethane and vinyl chloride are known to exist in monitoring wells upgradient of the landfill. This indicates that



Data Sources: King County, Cities of Des Moines, Federal Way, Kent, SeaTac (2013). Washington Department of Health (2014)

N

0 0.5 1 2 Miles

EXHIBIT 4.8-2
Wellhead Protection Areas

there are additional sources of these contaminants, outside of the Midway Landfill.

More information on the Midway Landfill can be found in Section 4.11, Geology and Soils, and Section 4.12, Hazardous Materials.

4.8.3.4 Stormwater Management

Due to existing development within the study area, an extensive stormwater drainage system exists along the project alternatives. The stormwater ordinances and manuals applicable to each of the four cities in the FWLE corridor are listed in Appendix D4.8. With the exception of Kent, which has its own manual, the cities have adopted the 2009 King County *Surface Water Design Manual* (King County Department of Natural Resources and Parks, 2009). The cities of Kent, SeaTac, and Federal Way have developed addendums to the King County manual that address local concerns. The King County manual is currently being revised and is expected to be released in 2015. Washington State Department of Transportation (WSDOT) stormwater management design standards would apply to the portion of the project that lies within WSDOT right-of-way, although WSDOT may apply the standards of the local jurisdiction.

Meetings were held with stormwater staff at each of the cities to discuss the project, identify possible drainage issues, and gather relevant information. SR 99 and associated stormwater facilities have been upgraded through all four jurisdictions within the past decade. As a result, none of the jurisdictions experience any serious drainage problems along that corridor (personal communications with Will Appleton, Mike Bryan, Loren Reinhold, and Beth Tan, May 2013). Only one major stormwater facility upgrade is planned within the project corridor. The existing Executel Pond (refer to Appendix Exhibit D4.8-1a), located in the northern portion of the study area (in the city of SeaTac, west of SR 99), will be impacted by the planned extension of SR 509 (HNTB, 2004). As a result, this pond will be relocated to the west of its existing location (personal communication, Mike Bryan, May 30, 2013). A large wetland lies along the upper reach of the South Fork of McSorley Creek, upstream of SR 99. Proper stormwater management for the protection of this critical area is a priority for the City of Kent (B. Tan, personal communication, 2013).

WSDOT operates a drainage system serving I-5. Most of the drainage system was originally installed when the area surrounding I-5 was undeveloped, and much of the system consists of ditches that drain either to local streams or to the drainage systems of the adjacent cities. A few detention ponds have been constructed to manage road runoff as part of highway improvements over the past several decades. WSDOT reports that there are no substantial flooding or local drainage problems associated with I-5 within the study area (A.L. Williams, personal communication, 2013). There are currently no major funded additions or improvements to the I-5 drainage system planned in the project vicinity by WSDOT.

4.8.4 Environmental Impacts

4.8.4.1 No Build Alternative

Under the No Build Alternative, light rail would not be extended in the FWLE corridor and the potential impacts on water resources identified for the FWLE build alternatives would be avoided. As a result, there would be no direct water resource impacts associated with this alternative. However, the water quality benefits from stormwater treatment associated with the proposed project would not be realized.

4.8.4.2 Build Alternatives

This section describes the direct and indirect impacts of the FWLE alternatives on water resources. Construction impacts are discussed in Chapter 5.

Direct Impacts

Potential long-term impacts on water resources were initially assessed using GIS to overlay alternative footprints on a map of surface water bodies and identify stream crossings by alternative or option. These crossings and the characteristics of the associated water bodies were then visually reviewed in the field. GIS data of impervious surfaces in the study area were combined with design data layers to determine the change in impervious area and pollution-generating impervious surfaces (PGIS). No shorelines of the state, shorelines of statewide significance, or designated floodplains lie within 200 feet of any constructed features of this study area. Therefore these resources would not be impacted and are not discussed further.

Direct impacts that would be permanent in nature are described in this section, first by impacts that are common to all alternatives, and then by impacts specific to an alternative or option.

Impacts Common to All Alternatives

Sound Transit would minimize impacts on water resources through project design and development in compliance with stormwater management regulations. Examples of measures to control impacts include minimizing the extent of impervious surfaces, avoiding the placement of project elements in or near water resources where possible, and installing appropriate stormwater management facilities. Sound Transit's *Link Design Criteria Manual* (Sound Transit, 2012) requires stormwater facilities for its projects to conform to the requirements of local jurisdictions.

Chapter 30 of Sound Transit's *Link Design Criteria Manual* emphasizes sustainability measures, including low-impact development (LID) as a preferred stormwater management method, if appropriate and feasible. Also, the 2012 Ecology *Stormwater Management Manual for Western Washington* requires LID approaches to stormwater management to the extent feasible. Up to 50 percent of the project corridor, depending upon the alternative or option selected, is underlain by highly infiltrative soils that would likely be suitable for LID measures. Although the high degree of existing development may limit such opportunities, LID measures would be incorporated into project design where feasible.

Low-impact Development

LID is a stormwater and land use management strategy that strives to mimic pre-disturbance hydrologic processes by emphasizing conservation, use of on-site natural features, site planning, and distributed stormwater management practices (BMPs) that are integrated into a project design. LID BMPs emphasize pre-disturbance hydrologic process of infiltration, filtration, storage, evaporation and transpiration. Common LID BMPs include: bioretention, rain gardens, permeable pavements, minimal excavation foundations, vegetated roofs, and rainwater harvesting.
Source: http://www.ecy.wa.gov/programs/wq/stormwater/municipal/LID/Resources.html.

There are a number of existing stormwater facilities within the study area, as shown in Appendix D4.8. During detailed design, Sound Transit will explore the potential for joint use of these facilities to manage project runoff. The Executel Pond in the City of SeaTac and the stormwater facilities serving SR 99 and I-5 may be suitable for joint stormwater management.

Surface Water

To evaluate potential impacts to surface water, Sound Transit considered:

- *Increases in impervious surfaces*: Impervious surfaces increase runoff volumes that can escalate flooding and flow frequencies, which in turn can contribute to stream erosion. In addition, impervious areas subject to vehicular traffic and other pollution-generating activities accumulate contaminants that are transported to water bodies by stormwater runoff if not treated, which can negatively impact water quality.

- *Stream crossings*: All stream crossings would be on elevated guideways, but columns in and around stream channels or buffers can pose a risk to water quality. Potential stream impacts are summarized under the discussion of individual alternative and option impacts.
- *Type and size of parking facilities*: Most of the parking facilities would be located in areas of existing vehicular use, including existing parking facilities. The SR 99 Alternative has two out of three parking facilities within existing park and rides, while the I-5 Alternative has three out four parking facilities within existing park and rides. All project parking facilities would be designed to incorporate stormwater management features.
- *Proposed BMPs*: LID strategies would be considered in addition to stormwater treatment and flow control facilities.

Sound Transit is committed to designing the project to meet the stormwater management requirements of the local jurisdictions. The project would also comply with applicable permit requirements. Stormwater detention and treatment for all necessary project components would be incorporated into the project design, and stormwater would not be discharged directly into the stormwater drainage systems for SR 99 or I-5. For those portions of the project lying outside of these two roadways, the condition of the local drainage system would be reviewed with the appropriate jurisdiction. Appropriate management of project runoff would be developed to avoid intensifying any existing drainage problems. In addition, control of project runoff at its source using LID techniques would be implemented in project design, as site conditions allow.

Impervious Surfaces

FWLE would add both pollution-generating and non-pollution-generating impervious surfaces in the vicinity of the light rail alternatives. Runoff from pollution-generating impervious surfaces can increase pollutant loads to streams, causing water quality degradation. Pollution-generating impervious surfaces (PGIS) generally include station facilities such as parking areas, bus holding areas, and access roads, and also include road improvements needed to accommodate the project. Non-pollution-generating impervious surfaces include the light rail tracks (including ties and ballast), guideways, and station platforms.

Stormwater treatment would be provided for all runoff from project-related PGIS, thus protecting water quality. In general, runoff from non-PGIS surfaces would not be treated. Flow control would be provided for all runoff from project-related impervious areas. Additional information on calculation of the impervious surface and PGIS is presented in Appendix D4.8.

Groundwater

The project would result in a net increase of impervious area, as shown in Tables 4.8-1 and 4.8-3. This would reduce the amount of groundwater recharge within the general study area. The soils along the project alignments are generally conducive to onsite management of stormwater via infiltration. If LID features are incorporated into project design, it could offset the effects of any net decrease in pervious area. Thus, the project is not expected to substantially impact groundwater levels. Project stormwater runoff would be treated, as required, prior to release, and groundwater quality would not be adversely impacted.

TABLE 4.8-3
Proposed Changes in Impervious Surface in Acres (Range of Acreage with Options)

Alternative	Total Area	Existing Conditions			Conditions with FWLE Build Alternatives		
			Impervious			Impervious	
		Pervious	PGIS	Non-PGIS	Pervious	PGIS	Non-PGIS
SR 99 Alternative	**120** (97 to 136)	**17** (8 to 24)	**85** (63 to 104)	**19** (13 to 24)	**2** (1 to 2)	**97** (63 to 107)	**22** (22 to 39)
I-5 Alternative	**73** (69 to 78)	**43** (34 to 53)	**22** (18 to 33)	**8** (5 to 9)	**1** (1 to 1)	**38** (36 to 44)	**34** (31 to 37)
SR 99 to I-5 Alternative	**76** (76 to 92)	**34** (33 to 39)	**33** (31 to 47)	**9** (9 to 15)	**1** (1 to 1)	**45** (45 to 57)	**31** (31 to 37)
I-5 to SR 99 Alternative	**113** (92 to 115)	**18** (14 to 20)	**78** (59 to 85)	**17** (12 to 17)	**2** (1 to 2)	**82** (57 to 84)	**29** (29 to 34)

PGIS = pollution-generating impervious surface.

A number of sections of the alternatives and design options would lie within excavated trenches generally ranging in depth from 20 to 40 feet. The trenches would be constructed with solid concrete sides and bottoms designed to permanently maintain the integrity of the trench. The trench lining would be water-tight to avoid seepage of groundwater into the trench. Some local changes in groundwater flow paths might occur but no significant long-term groundwater impacts are expected to occur.

All alternatives would cross two wellhead protection zones at the north end of the study area (Angle Lake Well and Tyee Well; Exhibit 4.8-2). Both wells are operated by the Highline Water District and lie within the city of SeaTac. The city of SeaTac can place special requirements for projects located in a critical recharge area such as a wellhead protection zone. Within these zones the project would consist of electrified train track, a non-pollution-generating surface. The City of Federal Way places restrictions on the use and/or storage of petroleum products and other hazardous materials within wellhead protection zones.

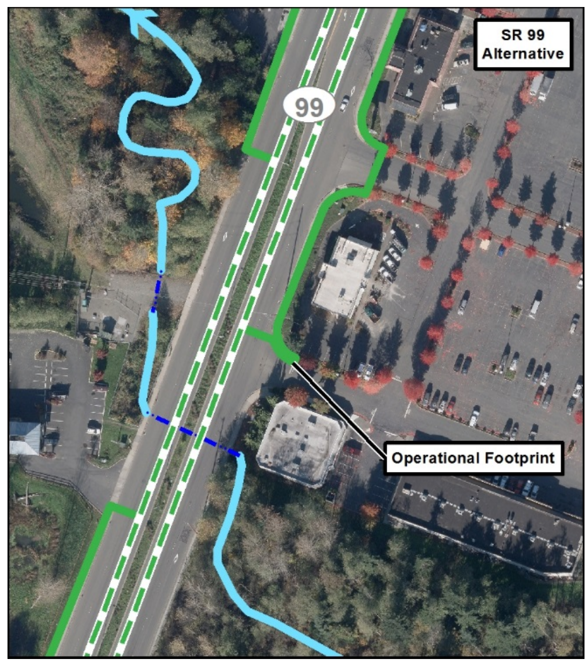
Sound Transit would consult with the City of SeaTac and Lakehaven Utility District during final design regarding proposed stormwater management measures within recharge zones to protect groundwater quality. No adverse impacts on groundwater are expected.

Impacts by Alternative

SR 99 Alternative

<u>*Surface Water*</u>

The SR 99 Alternative would be located in the median of SR 99 where the road intersects with McSorley Creek and Redondo Creek, and road improvements would not affect the culverts in these locations (see Exhibits 4.8-3 and 4.8-4 and Inset B1 to Exhibit 4.8-3, at right). Massey Creek begins west of SR 99 and therefore would not be affected by this alternative.



Inset B1 to Exhibit 4.8-3: SR 99 Alternative at McSorley Creek

<u>*Impervious Surface*</u>

The SR 99 Alternative and options would have a project guideway and road improvements footprint ranging from 92 to 135 acres.

Table 4.8-1 summarizes the range of impervious surface changes that would result from the different alternatives compared to existing conditions. Acreages of increase in PGIS and non-PGIS are shown in Table 4.8-3.

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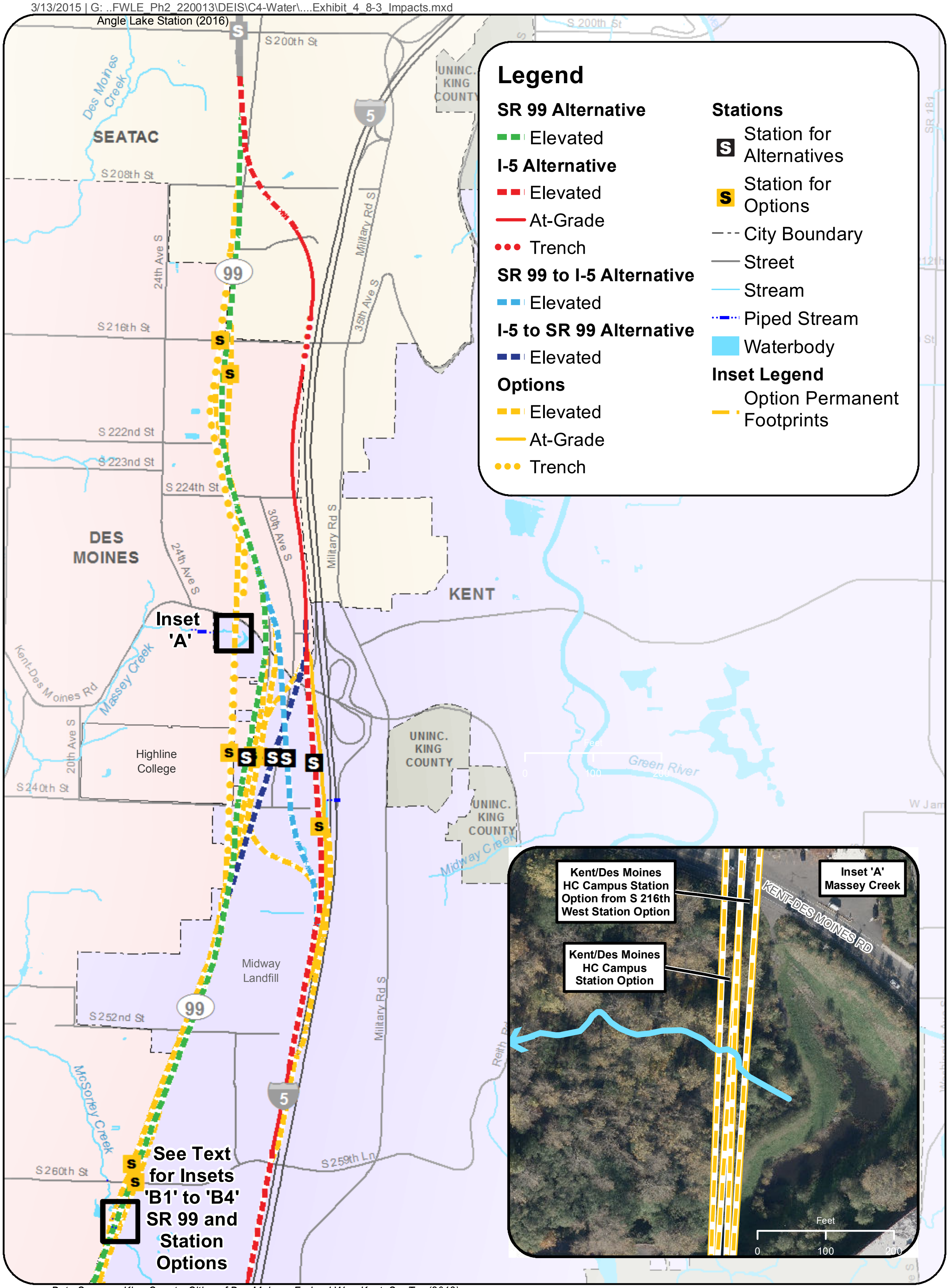


Data Sources: King County, Cities of Des Moines, Federal Way, Kent, SeaTac (2013).

N

0 0.25 0.5 1 Miles

EXHIBIT 4.8-3
Stream Crossings (North)

Federal Way Link Extension

While the guideway would be exclusive and non-PGIS, PGIS would increase by about 10 acres due to the station park-and-rides and some road improvements along SR 99.

Groundwater

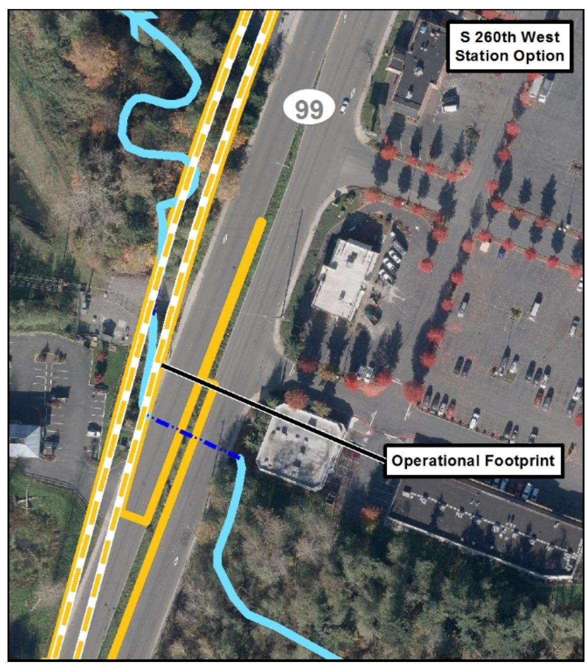
Approximately one-quarter mile of the SR 99 Alternative would be within the 10-year recharge zones for Lakehaven Utility District Wells #7 and 18, which are located immediately west of SR 99. The SR 99 station options would not change this impact.

SR 99 Station Options

Surface Water

The Kent/Des Moines HC Campus Station Option would cross the uppermost section of Massey Creek just west of SR 99 (Exhibit 4.8-3, Inset A). The creek channel lies approximately 200 feet south of the foot of the road embankment within a 600-foot-long, undeveloped, depressed area. The guideway associated with this option would fully span the creek and most if not all of its buffer and would not impact the stream**.**

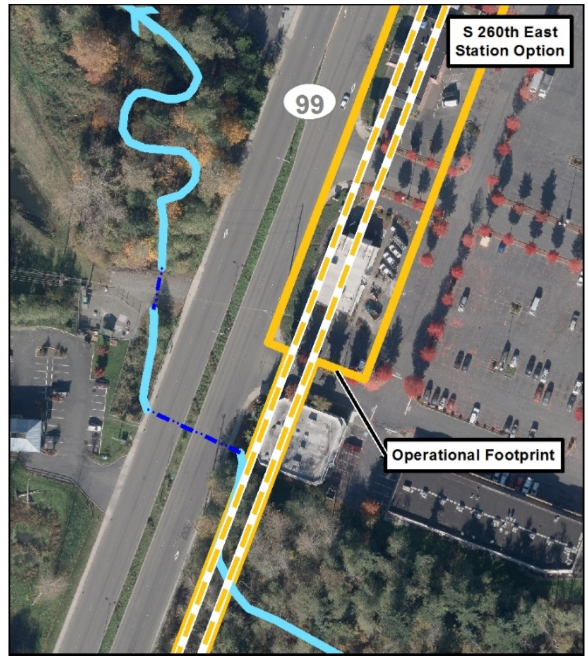
Immediately west of SR 99, the South Fork of McSorley Creek flows west and then north for approximately 300 feet after exiting a culvert under SR 99. The S 260th West Station Option would span this creek on an elevated guideway on the west side of SR 99 and would not have any direct impacts (Exhibit 4.8-3, Inset B2). The S 260th East Station Option would cross McSorley Creek on the east side of SR 99 and would span the creek on an elevated guideway (Exhibit 4.8-3, Inset B3). No direct impacts to the creek would occur from this option, although there is potential for impacts on adjacent wetlands and/or wetland or stream buffers from the placement of guideway columns.



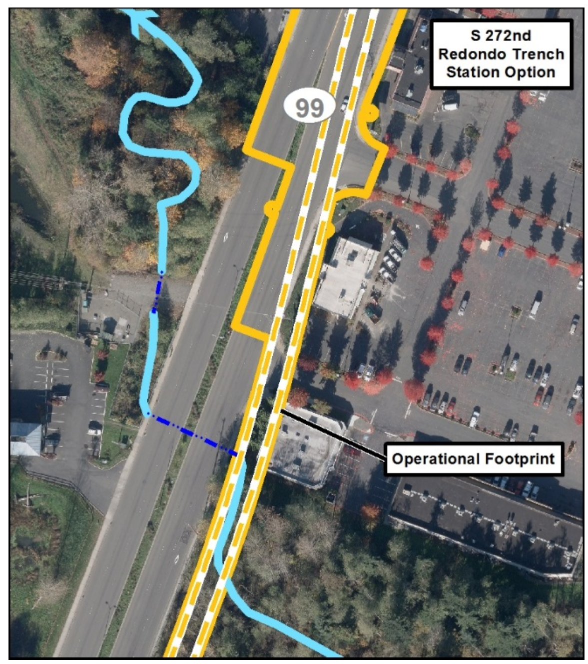
Inset B2 to Exhibit 4.8-3: S 260th West Station Option at McSorley Creek

The S 272nd Redondo Trench Station Option would have the same impacts to McSorley Creek as the S 260th East Station Option (Exhibit 4.8-3, Inset B4). This option would also travel along a utility access road that runs on the east side of the ravine carrying Redondo Creek north of Redondo Way S (Exhibit 4.8-4, Inset C).

A portion of this option would lie directly above the upper-most section of the creek for a length of 150 feet after it crosses under SR 99 from the east. The elevated guideway would fully span this section of the creek and no permanent adverse impacts would occur to Redondo Creek.



Inset B3 to Exhibit 4.8-3: S 260th East Station Option at McSorley Creek



Inset B4 to Exhibit 4.8-3: S 272nd Redondo Trench Station Option at McSorley Creek

Impervious Surface

When compared to the SR 99 Alternative, the S 216th West Station Option would have the greatest increase in impervious surface, while the S 272nd Redondo Trench Station Option would have the least increase.

Groundwater

There would be no additional groundwater impacts with any of the SR 99 Station options.

I-5 Alternative

Surface Water

Bingaman Creek is a perennial stream that flows parallel to the west side of I-5 within the WSDOT right-of-way in the vicinity of S 288th Street (Exhibit 4.8-4, Inset E). The stream enters the right-of-way at the Camelot Square Mobile Home Park (approximately 450 feet south of S 288th Street). It then runs north along the western edge of the I-5 right-of-way, parallel to the freeway within a narrow (approximately 50-foot) band of forest lying between an I-5 sound wall and the mobile home park.

The creek crosses under S 288th Street and continues north along the I-5 right-of-way for approximately 600 feet before turning east under I-5 in a culvert. North of S 288th Street is a 300-foot-wide forested area that lies west of I-5; however, the creek continues to closely parallel the freeway in this area. The I-5 Alternative would be located directly over the creek both north and south of S 288th Street.

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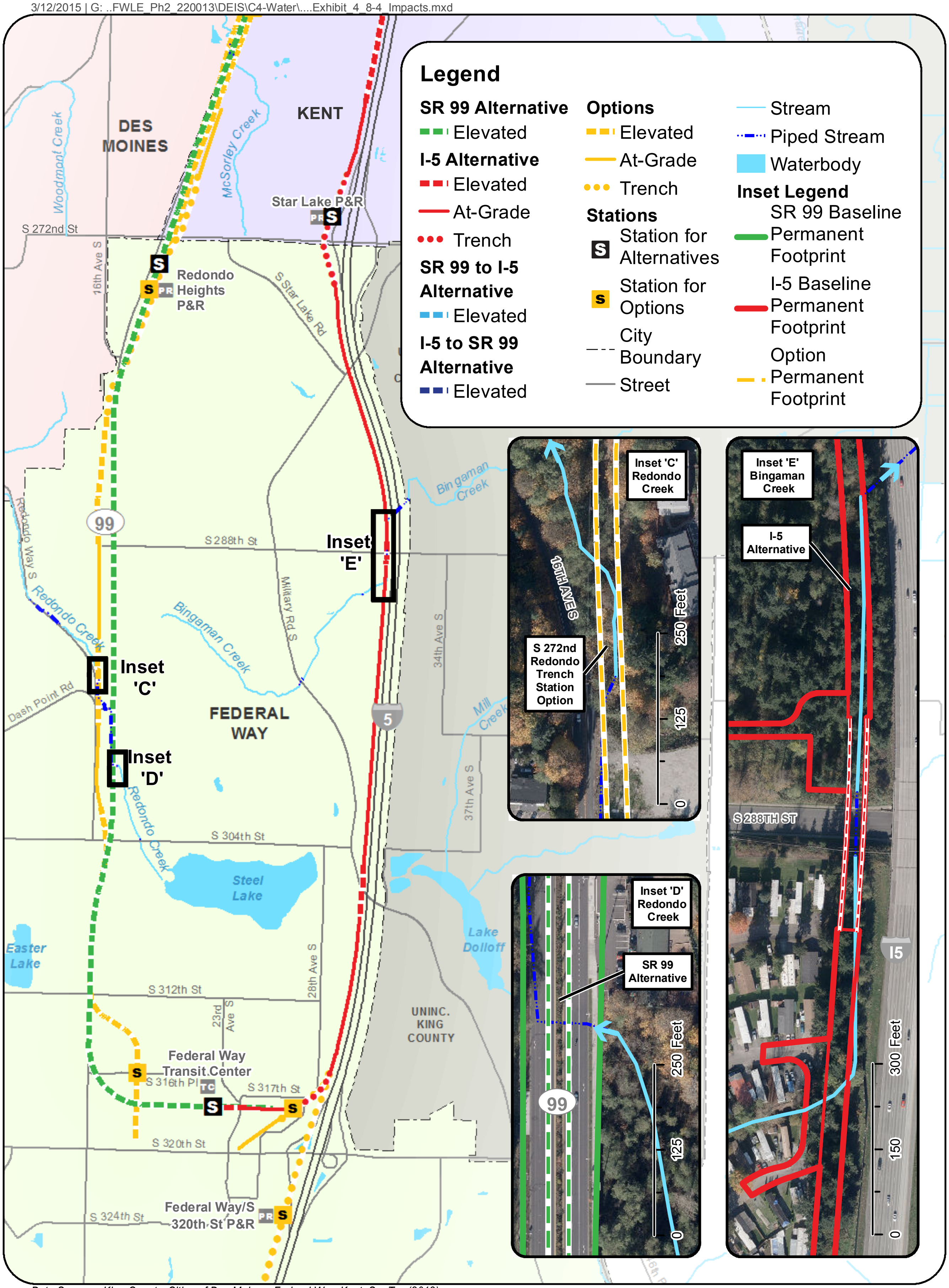

Data Sources: King County, Cities of Des Moines, Federal Way, Kent, SeaTac (2013);

N

0 0.25 0.5 1 Miles

EXHIBIT 4.8-4
Stream Crossings (South)

Federal Way Link Extension

Elevated guideway would support the track immediately north and south of S 288th Street. However, retained fill would cover the creek channel for approximately 410 feet north and 390 feet south of S 288th Street, eliminating a total of 800 feet of stream channel, and would require piping of the creek. Impacts on Bingaman Creek are discussed further in Section 4.9.4.2.

The alignment would impact an existing WSDOT stormwater pond located between S 259th and S 272nd Streets (refer to Appendix D4.8 Exhibit D4.8-1b). This would require the reconstruction or relocation of this pond.

Impervious Surface

The I-5 Alternative and options would have a project guideway and road improvements footprint ranging from 69 to 81 acres. As shown in Table 4.8-1, the I-5 Alternative would have the greatest impervious surface within the project footprint (140 percent) because much of the guideway would be constructed over currently pervious areas that currently lie adjacent to I-5.

Groundwater

A one-half-mile length of the I-5 Alternative lies within the 1- and 5-year recharge zones for Lakehaven Utility District Well 9, a short distance north of Steel Lake (refer to Exhibit 4.8-2). Potential impacts on groundwater from construction through the Midway Landfill are discussed in Section 4.12, Hazardous Materials, and Chapter 5, Construction.

I-5 Station and Alignment Options

Surface Water

There would be no additional surface water impacts with any of the I-5 station or alignment options.

Impervious Surface

The I-5 Alternative and options would all increase impervious surface. The I-5 options could have more or less impervious surface than the I-5 Alternative. The Federal Way I-5 Station Option would have the greatest increase in new impervious surface and the Kent/Des Moines SR 99 East Station Option would have the least increase in new impervious surface compared to the I-5 Alternative.

Groundwater

There would be no additional groundwater impacts with any of the I-5 station or alignment options. The Landfill Median Alignment

Option would avoid potential impacts on the Upper Gravel Aquifer and Southern Gravel Aquifer in the Midway Landfill.

SR 99 to I-5 Alternative

Surface Water

This alternative would have the same impacts to Bingaman Creek as the I-5 Alternative, discussed above.

Impervious Surface

The SR 99 to I-5 Alternative and options would have a project guideway and road improvements footprint ranging from 76 to 91 acres. Increases in impervious surface would range from 61 to 84 percent.

Groundwater

This alternative would be located within the 1- and 5-year recharge zones for Lakehaven Utility District Well 9 plus the two Highline Water District wellhead protection zones. Impacts would be the same as described for the SR 99 and I-5 alternatives.

I-5 to SR 99 Alternative

Surface Water

This alternative would have the same potential impacts on McSorley Creek as the SR 99 Alternative. Potential impacts from the S 260th West Station Option, the S 260th East Station Option, or the S 272nd Redondo Trench Station Option would be the same as described under the SR 99 Alternative Station Options.

Impervious Surface

The I-5 to SR 99 Alternative and options would have a project guideway and road improvements footprint ranging from 88 to 114 acres. Increases in impervious surface would range from 13 to 27 percent.

Groundwater

This alternative would also cross the same wellhead protection zones as discussed above under the SR 99 Alternative. Impacts would be the same as described for the SR 99 Alternative.

Indirect Impacts

Future population in Washington is expected to increase, which would likely increase vehicular traffic and put development pressure on many parts of the state. The proposed project could be expected to shift some future vehicle traffic to light rail and reduce vehicle-related stormwater pollutants. The project could also attract residents and increase density in the urban areas, which could reduce development pressure and associated increases in stormwater runoff in undeveloped areas in other portions of the watershed. The project would also support redevelopment in the areas around the stations, which could lead to associated infrastructure improvements. Upgraded stormwater treatment in these redeveloped areas would improve water quality. Therefore, the proposed project could indirectly offset some adverse impacts on water resources caused by population increases.

4.8.5 Potential Mitigation Measures

The project would be designed to comply with all federal, state, and local regulations, which would control potential impacts to water resources through project planning, design, and the application of required BMPs (see Appendix D4.8). Measures to minimize long-term impacts include LID stormwater facilities; avoidance of the use of galvanized or copper roofs for project facilities; stormwater flow control using detention or filtration ponds or vaults, or dispersion; and water quality treatment using water quality ponds, bioretention, or media filter vaults. With these impacts controlled, as described in Section 4.8.3, the impacts on water resources are expected to be minor with the exception of the relocation of Bingaman Creek with the I-5 Alternative.

The only location requiring specific mitigation measures would be Bingaman Creek with the I-5 Alternative or the SR 99 to I-5 Alternative. North of S 288th Street, Bingaman Creek lies within a 300-foot-wide wooded area that is owned by King County Fire District #26. Relocating the creek to the west, away from footprint of the guideway and its associated columns, may be feasible in this location. If this approach is not feasible, at least 390 feet of the creek would need to be placed in a pipe. Offsite stream mitigation would be pursued to mitigate this adverse project impact. More information can be found in Section 4.9.5 (Ecosystems).

4.9 Ecosystems

4.9.1 Summary

Ecosystem resources within the FWLE corridor are limited and effects of the FWLE alternatives would be minor. The SR 99 Alternative and the I-5 to SR 99 Alternative would have the fewest impacts on wetlands and associated buffers, and would avoid impacts on streams, although station and alignment options would increase these impacts. The I-5 Alternative and SR 99 to I-5 Alternative would have greater impacts on wetlands and associated buffers, and would directly impact one stream, Bingaman Creek. The I-5 Alternative would result in the greatest loss of vegetation and habitat due to clearing of forested areas along the west side of I-5. Table 4.9-1 summarizes the permanent impacts by alternative on wetlands, buffers, streams and vegetation. Temporary, construction-period impacts are addressed in Chapter 5.

TABLE 4.9-1
Summary of Ecosystem Impacts

Alternative	Acres of Wetlands Impacted (Range with Options)[a]	Acres of Wetland Buffer Impacted (Range with Options)	Acres/Linear Feet of Streams Impacted (Range with Options)	Acres of Stream Buffer Impacted (Range with Options)	Acres of Vegetation Impacted (Range with Options)
SR 99 Alternative	**<0.1** (< 0.1-0.7)	**0.2** (0.2-0.8)	**0** (0-0)/ **0** (0-0)	**<0.1** (<0.1-0.5)	**3.5** (1.6-7.6)
I-5 Alternative	**1.1** (0.5 – 1.2)	**1.1** (0.9-2.3)	**0.2** (0.2-0.2)/ **1,055** (1,055 to 1,055)	**2.4** (2.4-2.4)	**35.4** (31.2-37.1)
SR 99 to I-5 Alternative	**0.5** (0.5-1.2)	**0.9** (0.9-1.1)	**0.2** (0.2-0.2)/ **1,055** (1,055 to 1,055)	**2.4** (2.4-2.4)	**29.1** (28.5-31.2)
I-5 to SR 99 Alternative	**<0.1** (<0.1-0.0.5)	**0.3** (0.3-0.7)	**0** (0-0)/ **0** (0-0)	**<0.1** (<0.1-0.5)	**5.1** (4.7-8.8)

Note: The ranges provided show the potential range of impacts when each alternative is combined with one or more of its station or alignment options.
[a] To provide a conservative estimate of wetland impacts, the impact analyses for all alternatives and options assumed a "worst-case" footprint for the long term that would remove all of the wetland and buffer within the footprint of the alternative or option.

4.9.2 Introduction to Resources and Regulatory Requirements

An ecosystem is the complex of a community of organisms and its environment functioning as an ecological unit (Merriam Webster Dictionary, 2013). Ecosystems are composed of many living organisms and the environment they inhabit. For the purposes of the Draft EIS, Sound Transit identified ecosystem components in the study area as wetlands, streams, and vegetation that would support fish and wildlife, including threatened and endangered species. All impacts are described using these ecosystem components.

Wetlands, streams, and fish and wildlife species and their habitats within the FWLE corridor are protected by federal, state, and local regulations, which govern planning, land use, and management activities that may affect such resources.

These regulations, as well as applicable guidance from federal, state, and local agencies, were considered as part of this analysis because they must be addressed later in permitting phases of the project, or because they prescribe certain procedures that must be followed during the preparation of the EIS. The Ecosystems Technical Report, Appendix G2, provides detailed information on the regulations, analysis methods, affected environment, species, and impacts discussed in this section.

4.9.3 Affected Environment

The study area for wetlands, streams, and wildlife habitat was measured from each side of the permanent, operational footprint for each alternative or option, as follows:

- Wetlands: 300 feet
- Streams: 100 feet upstream and 300 feet downstream of crossings
- Vegetation and wildlife habitat: 200 feet

The evaluation of ecosystem components was based on literature reviews; consultation with federal, state, and local agencies and their websites; field work; and review of aerial mapping. Field assessments of wetlands and stream crossings intersected by the operational and construction footprints of the FWLE alternatives were also conducted to provide existing conditions for impacts analysis. The ecosystem components were assessed by applying classification systems specific to the resource. The following subsections describe the ecosystems found in the study areas. Wetlands, streams, and vegetation descriptions are presented for the general SR 99 and I-5 corridors. Descriptions of wildlife habitat and potential occurrence of federally and state-listed fish and wildlife species are presented in a single discussion for both corridors due to the similarity of the habitat and potential species occurrence in the corridors.

4.9.3.1 Wetlands

The FWLE corridor is located on the broad, flat terrace between Puget Sound and the Green River Valley. The plateau includes landforms such as depressions, slope and seep areas, and stream valleys that may support wetlands. The wetlands now present in the area may represent fragments of larger historical wetland systems, or they may be recently formed wetlands that have developed as a result of changes in land use and surface water drainage patterns over the last 50 years of development in the corridor. Details for each of the wetlands within the study area are provided in the Ecosystems Technical Report (Appendix G2), and the wetlands are shown on Exhibits 4.9-1 through 4.9-4.

SR 99 Corridor

Seventeen wetlands were identified within the SR 99 Alternative study area. The identified wetlands vary in overall size from less than 0.1 acre to more than 108 acres. The McSorley Creek Wetland (Wetland 12-1) is the largest undisturbed wetland in the FWLE corridor, and forms the headwaters of McSorley Creek. Wetlands in the study area are primarily deciduous forested wetlands dominated by red alder, although the vegetation cover in wetlands immediately adjoining SR 99 is disturbed and dominated by invasive species. The Massey Creek wetlands (Wetlands 6-1 through 6-4) are located on undeveloped parcels and are less disturbed than other smaller wetlands in the study area.

I-5 Corridor

Sixteen wetlands were identified within the I-5 Alternative study area. The identified wetlands vary in size from less than 0.1 acre to over 108 acres (McSorley Creek Wetland [12-1]). Other wetlands in the I-5 Alternative study area are generally small, isolated features. Wetlands in the I-5 corridor are primarily deciduous forested wetlands dominated by red alder trees. Scrub-shrub and emergent wetlands, less common in the I-5 corridor, are predominantly vegetated with willows and reed canary grass.

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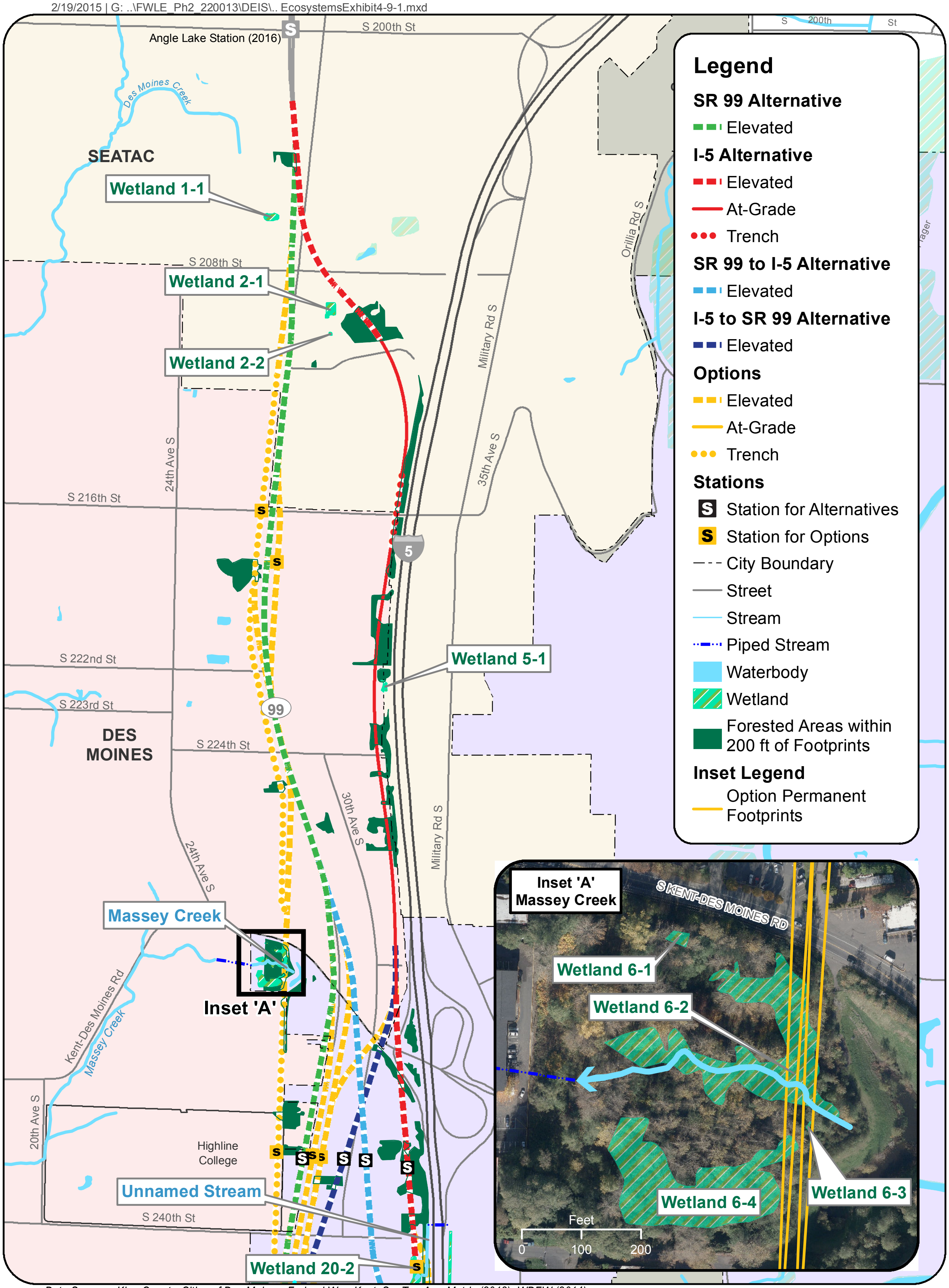

Data Sources: King County, Cities of Des Moines, Federal Way, Kent, SeaTac, AeroMetric (2013). WDFW (2014).

N

0 0.25 0.5 Miles

EXHIBIT 4.9-1

Ecosystems Resources

Angle Lake Station to Kent/Des Moines Station

Federal Way Link Extension

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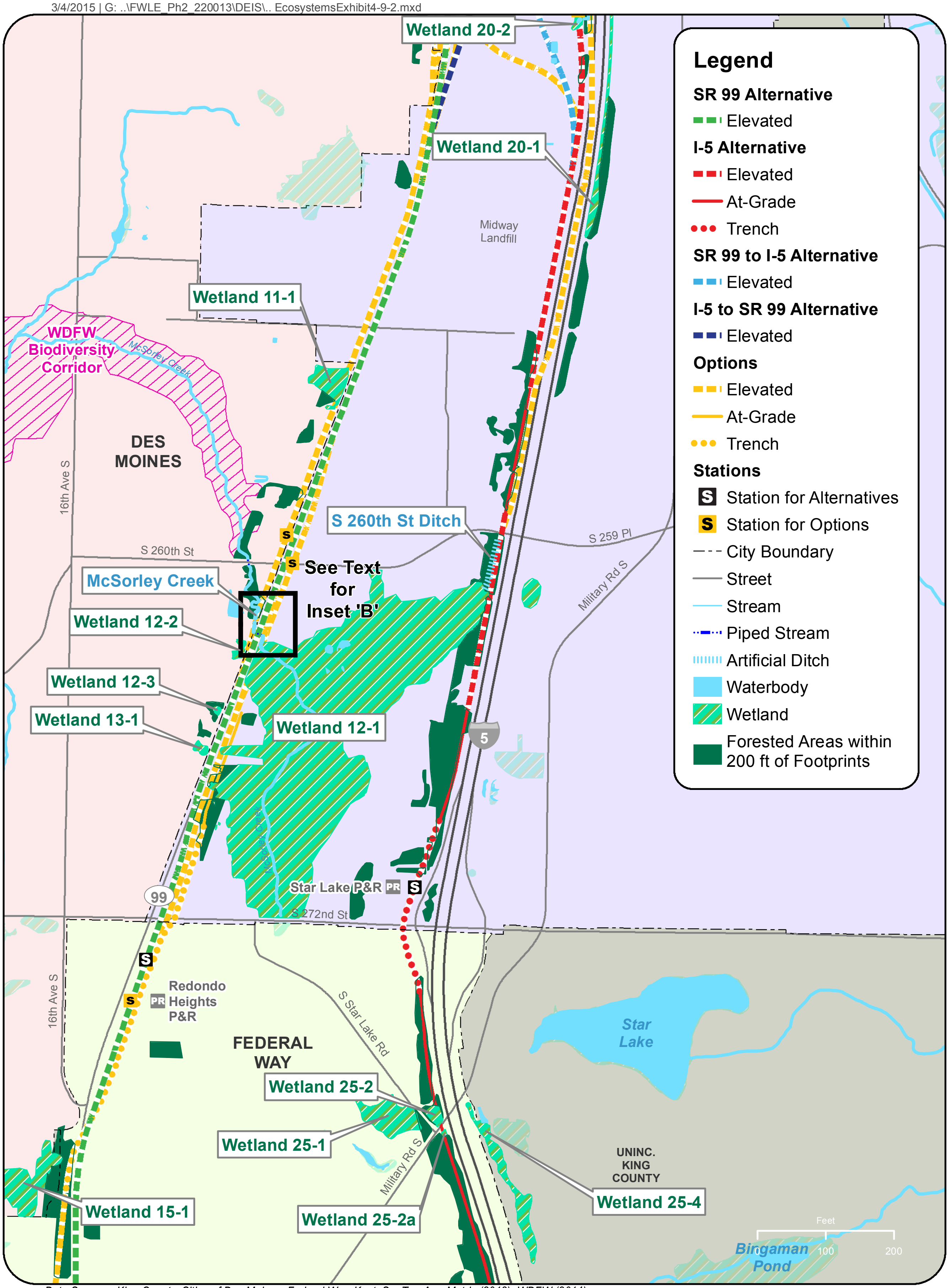

Data Sources: King County, Cities of Des Moines, Federal Way, Kent, SeaTac, AeroMetric (2013). WDFW (2014).

EXHIBIT 4.9-2

Ecosystems Resources

Kent/Des Moines Station to S 272nd Station

Federal Way Link Extension

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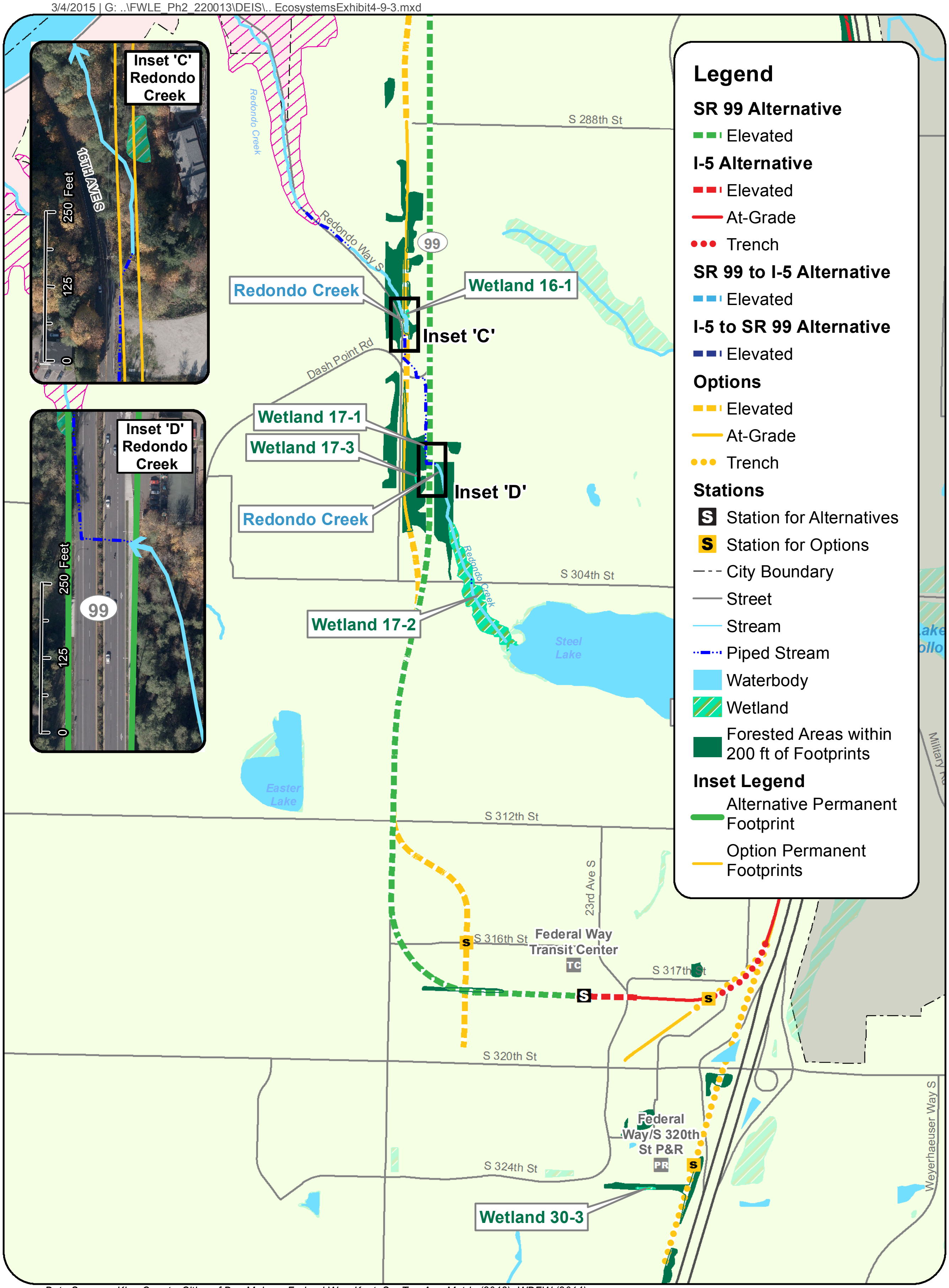


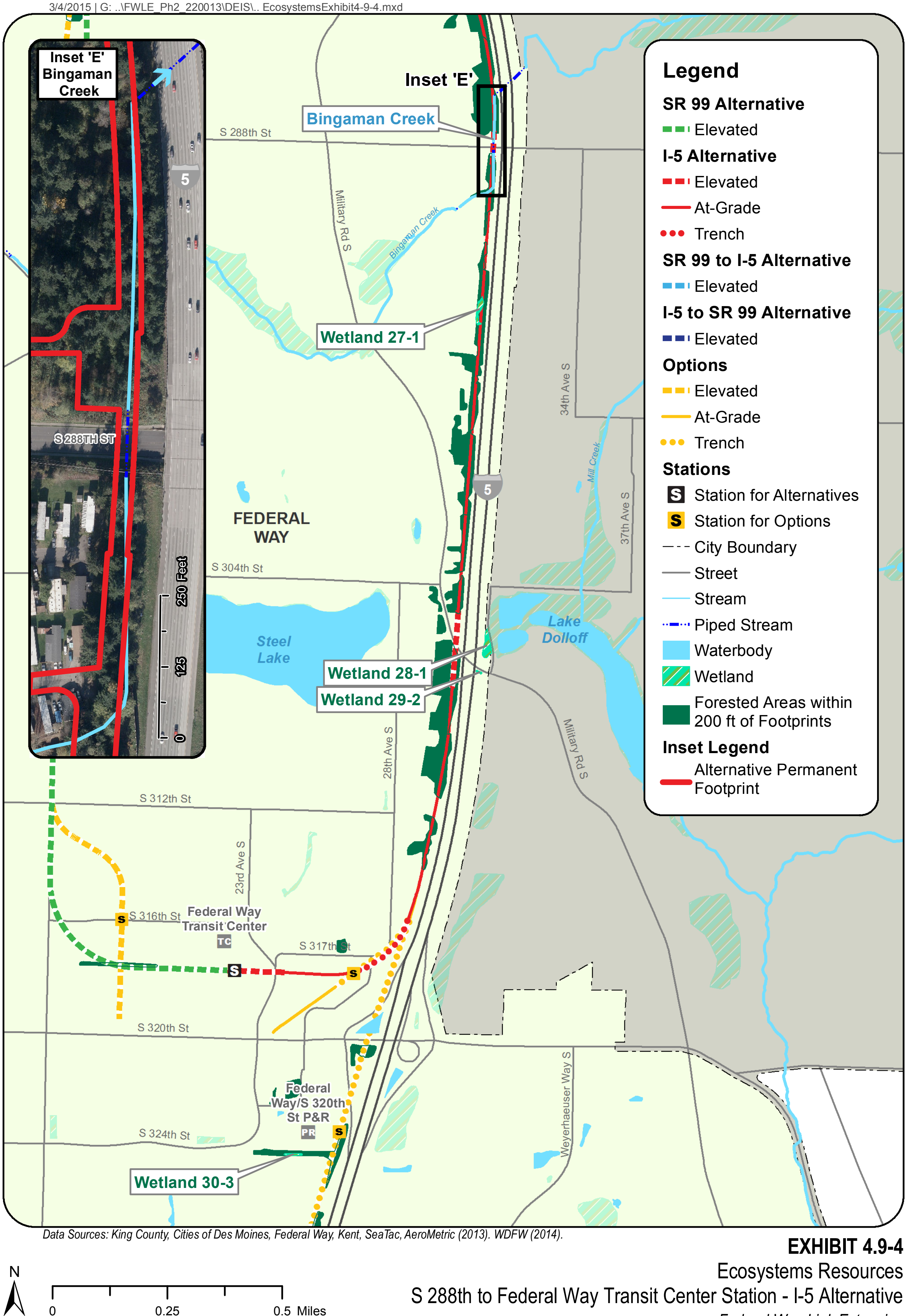
Data Sources: King County, Cities of Des Moines, Federal Way, Kent, SeaTac, AeroMetric (2013). WDFW (2014).

EXHIBIT 4.9-3

Ecosystems Resources

S 288th to Federal Way Transit Center Station - SR 99 Alternative

Federal Way Link Extension



Data Sources: King County, Cities of Des Moines, Federal Way, Kent, SeaTac, AeroMetric (2013). WDFW (2014).

EXHIBIT 4.9-4
Ecosystems Resources
S 288th to Federal Way Transit Center Station - I-5 Alternative

4.9.3.2 Streams and Aquatic Habitat

Four named streams, one unnamed stream, and a drainage ditch intersect the FWLE alternatives. There is limited biological information available on the small creeks that intersect the study area (described below by corridor). In general, these are low-gradient streams typical of Puget Sound lowland drainages that receive their flow from springs, seeps, lake outlets, rainfall, and groundwater runoff. All of these creeks have undergone the types of habitat degradation associated with development and urbanization. Streams in the FWLE corridor are listed in Table 4.9-2 and shown on Exhibits 4.9-1 through 4.9-4. Stream type terminology varies between jurisdictions, but all are based on the size of the stream and its ability to support fish.

Aquatic habitat surveys were conducted 300 feet downstream and 100 feet upstream of each stream crossing, and on the entire stretch of any stream paralleling the project within 200 feet from the edge of the alternative, where access allowed. The width of the riparian area alongside the streams observed in the field was typically restricted to within 50 feet or less of the stream and determined by the edges of roadways and development, as well as by rights-of-way access and property boundaries. Aquatic habitat conditions and functional status were evaluated based on fish life histories, spawning and rearing habitat requirements, seasonal use and field observations. Habitat was assessed with the assumption that anadromous fish might one day be able to access the area even if they cannot under present conditions. To the extent information is currently available or could be ascertained in the field, downstream fish passage obstructions, including types of impediments to fish passage, were also identified for each stream reach.

SR 99 Corridor

Three streams intersect the SR 99 study area and are described in Section 4.8, Water Resources. Within the study area, Massey Creek originates from a stormwater pond and flows west through a forested depressional area wetland for approximately 500 feet (Exhibit 4.9-1). The stream channel is very shallow and poorly defined with some standing water and side channels through the wetland. A vertical drain and culvert downstream serves as a complete barrier to fish passage and no fish are present in this reach.

TABLE 4.9-2
Streams in the Federal Way Link Extension Study Area

Stream Name	Corridor	Stream Type per City Code[a]	Jurisdiction	Local Jurisdiction Stream Buffer Width	Stream Type per WAC 222-16-031[b]	Documented Salmonid Presence in Study Area
Massey Creek	SR 99	Type 3	Kent	40 feet	Type 3	No
McSorley Creek (west of SR 99)	SR 99	Type F	Des Moines	115 feet	Type 3	No
McSorley Creek (east of SR 99)	SR 99	Type 3	Kent	40 feet	Type 3	No
Redondo Creek (downstream of Dash Point Road)	SR 99	Major Stream	Federal Way	115 feet	Type 3	No
Redondo Creek (east side of SR 99)	SR 99	Minor Stream	Federal Way	65 feet	Type 5	No
Bingaman Creek	I-5	Major Stream	Federal Way	115 feet	Type 3	No
Unnamed stream in I-5 right-of-way (north of S 240th Street)	I-5	Type 3	Kent	40 feet	Type 5	No
S 260th Street Ditch[c]	I-5	n/a	Kent	n/a	n/a	No

[a] Type 3 streams are segments of natural waters within bankfull width of defined channels that are perennial or intermittent streams within the portion of the channel where there is no documented salmonid use. Type F streams are those that are salmonid-bearing or (as is the case here) have the potential to support salmonids. Major streams are streams that contain or support resident or migratory fish. Minor streams are any streams that do not meet the definition of "major stream."

[b] Stream classifications according to WAC 222-16-031 are provisionally based on definitions where fish use has not been determined. Upon FWLE alternative selection and final EIS preparation, these stream type determinations may change as a result of more detailed surveys.

[c] The City of Kent does not regulate activities in artificial drainages intentionally created from nonwetland sites, including, but not limited to, grass-lined swales, irrigation and drainage ditches, retention or detention facilities, and landscape features (Kent City Code 11.06.040)

McSorley Creek flows northwest out of a large wetland area east of SR 99 (Exhibit 4.9-2). The stream channel within the wetland contains good habitat conditions for fish, and is somewhat isolated from the surrounding urban developed areas by a large riparian area of mixed forest. Cutthroat trout and coho salmon have been documented in McSorley Creek from the mouth at Puget Sound upstream to at least 16th Avenue S (Washington Department of Fish and Wildlife [WDFW], 2014a, b). The culvert under SR 99 is listed as a partial barrier to fish passage (WDFW, 2014a). The reach of McSorley Creek in the project corridor is mapped as non-fish-bearing (Washington Department of Natural Resources [WDNR], 2014). However, observations during field visits indicate that although this reach is isolated from McSorley Creek where fish are known to be present, the reach contains habitat that has the potential to support fish (see Appendix G2). The stream channel has a predominantly gravel substrate with vegetated banks including tree cover for shading and large woody debris recruitment, and is low-gradient with a variety of riffle and run habitat.

Redondo Creek originates at Steel Lake and passes under S 304th Street and through a wetland on the east side of SR 99, after which it is conveyed within the stormwater system under SR 99 before emerging from a culvert near the intersection of SR 99 and Dash Point Road (Exhibit 4.9-3). From this crossing, Redondo Creek flows northwest for approximately 1 mile to Puget Sound. Coho salmon are documented as present downstream of S 291st Place to Puget Sound (WDFW, 2014a; StreamNet, 2014). Redondo Creek passes through several pipe systems and its confluence with Puget Sound is also from within a pipe. Approximately 750 feet downstream of the culvert under SR 99 and Dash Point Road, the creek enters a vertical drain structure that poses a complete passage barrier to fish moving upstream into the study area.

I-5 Corridor

Bingaman Creek enters the I-5 study area from a mobile home park approximately 500 feet south of S 288th Street, and then runs north along the western edge of the I-5 right-of-way. It crosses under S 288th Street and continues north along the I-5 right-of-way for approximately 600 feet where it enters a culvert under I-5. The creek continues eastward of I-5, where it eventually connects to Bingaman Pond in the Green River watershed. Due to its habitat features and connection to Bingaman Pond, the reach in the study area has the potential to support fish, although this reach is likely dry during part of the year (Appendix G2). Cutthroat trout are potentially present in Bingaman Creek, including the study area west of I-5 (WDFW, 2014b). Despite the stream being perennial, the habitat in the reach north of S 288th street could potentially support cutthroat trout that may move in and out of the reach during periods of flow. WDFW Salmonscape (2014a) and Kerwin and Nelson (2000) also report Bingaman Creek as having the potential to support coho salmon if barriers downstream of Bingaman Pond connecting to Mill Creek were not present. Potential fish presence is based on available habitat, and other species such as sculpins may also be present, but fish species actually currently inhabiting Bingaman Creek are undocumented (Fisher, pers. comm. 2014).

There is a small unnamed stream channel that originates in Wetland 20-2 on the west side of I-5 just south of the Kent-Des Moines Road (Exhibit 4.9-4). This small channel flows north alongside I-5 for approximately 600 feet, then through a culvert under I-5. The channel is low-gradient and the bed is comprised of a thick layer of silt and organic material. The east bank is artificially created from the highway embankment materials and has been cleared of vegetation. This channel does not provide suitable habitat for salmonids or other fish species and is isolated from streams that are known to contain fish.

The only other surface water channel that intersects the I-5 study area is a drainage ditch south of 260th Street along a gravel road bed beside the I-5 embankment (Exhibit 4.9-2). This is a riprap-lined artificial channel that conveys water from a culvert under S 260th Street to the northern portion of the McSorley Creek Wetland area. This channel does not provide suitable habitat for fish and is not connected to any fish-inhabitable waters.

4.9.3.3 Vegetation

The FWLE corridor is within the western hemlock (*Tsuga heterophylla*) forest zone (Franklin and Dyrness, 1988). Western hemlock and western red cedar (*Thuja plicata*) are the dominant forest species in this zone, although Douglas fir (*Pseudotsuga menziesii*) is also very common. Deciduous species occur primarily in disturbed areas and along rivers and streams. Forested areas within 200 feet of the project footprint are shown on Exhibits 4.9-1 through 4.9-4.

SR 99 Corridor

Due to the heavily developed nature of the project corridor, most of the vegetation present in the SR 99 study area reflects landscaping practices for urban and suburban areas, with remnant tree canopy retained for shade or aesthetics. Within the maintained road rights-of-way, the vegetation includes a mixture of trees, native and non-native shrubs, landscaped areas, mowed grasses, and invasive weeds. Several notable areas of upland vegetation are present within the 400-foot-wide study area. The majority of these areas consist of mixed deciduous and coniferous forest with a disturbed understory (not a native upland classification). The largest remnant of native upland forest in the study area is located in the McSorley Creek riparian corridor to the west of SR 99.

I-5 Corridor

The undeveloped areas west of I-5 and the I-5 right-of-way are predominantly vegetated by non-native species with limited habitat value. The I-5 median is maintained clear of trees and the vegetation consists of mowed areas with mixed domestic and invasive grass species and weeds, and small patches of non-native shrubs. Three larger patches of contiguous forest cover were identified along the west side of I-5: one extending from Military Road/Star Lake Road to S 288th Street; one extending from approximately S 292nd Street to S 301st Street; and one extending from Military Road near S 304th Street to approximately S 311th Street. The forest patch located north of S 288th Street is dominated by native species, while the remaining forest patches are predominantly non-native.

4.9.3.4 Wildlife Habitat

The SR 99 and I-5 corridors are located within a mapped medium-density urban habitat zone, having 30 to 59 percent impervious surface (Chappell et al., 2001). Wetland and riparian areas can support reptiles and amphibians such as garter snakes and frogs. These areas also can support small mammal species and possibly some larger mammal species such as deer and coyote. The FWLE corridor lies within the Pacific Flyway, a migratory bird corridor consisting of the western coastal areas of North, Central, and South America. Wetlands, lakes, and forested areas in the project vicinity could serve as foraging, resting, or nesting grounds for migratory and resident bird species. The McSorley Creek Wetland area between SR 99 and I-5 has the largest tract of forested habitat along the FWLE corridor. The vegetated tracts along the McSorley Creek riparian corridor, which continue to the west of the study area through Saltwater State Park and out to the Puget Sound shoreline, also provide one of the few potential wildlife movement corridors in the area.

4.9.3.5 Threatened and Endangered Fish and Wildlife Species, Species of Concern, Essential Fish Habitat, and WDFW Priority Species

There is no Endangered Species Act (ESA) designated critical habitat in the FWLE corridor, and no listed fish species or federal species of concern are known to be present (WDFW 2014a,b; StreamNet, 2014; Kerwin and Nelson, 2000). The Magnuson-Stevens Fishery Conservation and Management Act protects essential fish habitat (EFH) for federally managed species of Pacific salmon, specifically

Chinook (*Oncorhynchus tshawytscha*), pink (*Oncorhynchus gorbuscha*), and coho salmon (*Oncorhynchus kisutch*). These species are not present within the study area; however, EFH also includes historic distribution and waters formerly accessible to salmon. Coho were likely present in Redondo, Bingaman, and McSorley creeks within the study area prior to development, and consequently these water bodies are included in EFH. Coho salmon, a federal species of concern, is known to currently inhabit the lower reaches of McSorley Creek downstream of passage barriers outside of the study area. The Oregon spotted frog (*Rana pretiosa*), a federally threatened species, historically occurred in the Green River at Kent; there are no current populations of Oregon spotted frog known to occur in the study area. The western toad (*Bufo boreas*) is a state candidate and federal species of concern that is found in Lake Washington and other water bodies in the area, but is unlikely to occur within most of the study area. The McSorley Creek Wetland may provide suitable habitat for western toads, but is unlikely to provide suitable habitat for Oregon spotted frogs since the wetland lacks extensive emergent habitat with good sun exposure that would be suitable for egg-laying, and it is located in a highly urbanized watershed. WDFW has also identified the McSorley Creek riparian corridor west of SR 99 as a Biodiversity Corridor, which is a WDFW priority habitat area.

4.9.4 Environmental Impacts

4.9.4.1 No Build Alternative

Under the No Build Alternative, the FWLE would not be constructed. The existing wetlands, streams, vegetation and wildlife habitat would not be directly or indirectly affected by the No Build Alternative. The potential environmental benefits of the FWLE would also not be realized under the No Build Alternative, including implementation of proposed mitigation for wetlands, streams, and regulatory buffers, which could improve the existing conditions of these resources; and opportunities to concentrate growth in urbanized areas instead of less-developed, rural areas where high-value habitat and wetlands are more prevalent.

4.9.4.2 Build Alternatives

The following subsections describe the direct and indirect impacts of the build alternatives. Construction impacts related to ecosystems are discussed in Chapter 5.

Direct Impacts

Potential operational impacts on wetlands and streams were initially assessed using GIS to overlay alternative FWLE footprints on a map of ecosystem resources. Potential operational impacts on wildlife and vegetation were assessed using GIS and existing vegetation cover layers to calculate the amount of undeveloped vegetated areas potentially affected by the FWLE alternatives.

To provide a conservative estimate of wetland impacts, the impact analysis completed for all alternatives and options assumed a “worst-case” at-grade footprint for the long term. No direct long-term impacts are anticipated outside of the “worst-case” at-grade footprint. However, based on factors such as the width and height of elevated guideways, some of the areas may not experience long-term impacts. Although elevated guideways would not permanently fill all wetlands within the permanent footprint, actual impacts would be mostly limited to shading under the guideway. During the Final EIS and/or the permitting phase, Sound Transit would reevaluate these assumptions to provide a more detailed assessment of long-term impacts and identify detailed temporary construction limits to distinguish which resources could be restored following construction.

In addition to the permanent physical footprint of the alternatives, vegetation would need to be maintained within 15 feet of the edge of the guideway to prevent debris from falling onto the guideway. This area is maintained and allows for grass and shrubs but not large trees. The loss of forest cover is considered a long-term impact on wildlife habitat because the type of vegetation and associated habitat would change in this zone. This area is considered a temporary impact on wetlands, streams, and their associated buffers because grass and/or shrub vegetation would be re-established following construction, which would provide wetland or stream buffer functions. This approach avoids counting permanent impacts in the same area twice.

Exhibits 4.9-1 through 4.9-4 show locations of potential impacts of the build alternatives and options on streams, vegetation, wildlife, and wetlands. Table 4.9-1 summarizes these impacts, which are described by alternative. Station or alignment options are described or quantified as an increase or decrease relative to the alternative(s) they are associated with.

Wetlands

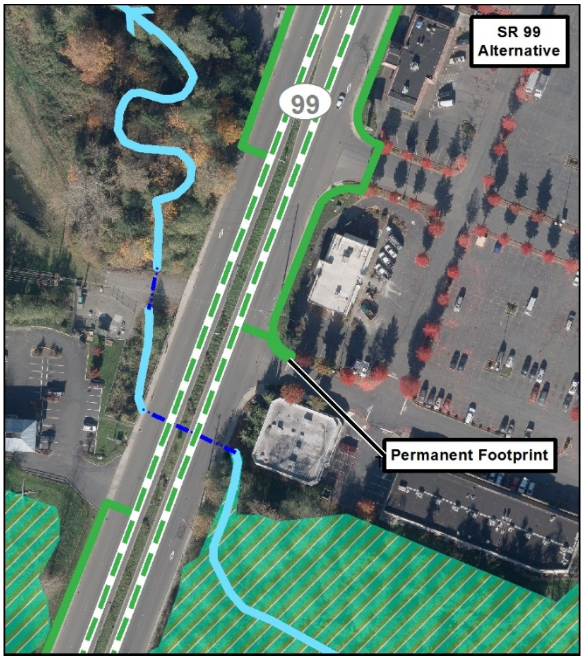
Wetlands Impacts Common to All Alternatives

The build alternatives would have direct, long-term impacts on wetlands and wetland buffers. Filling or excavating within wetlands for column placement, at-grade guideways, and retaining walls would result in loss of wetland area or loss of wetland function through changes to surface or subsurface water flows or permanent changes to vegetation. Along elevated profiles, grading and filling to install support columns and bridge support structures would result in long-term loss of wetland and wetland buffer area. Although elevated structures result in less fill-related impacts, they can potentially result in impacts from shading. Impacts can occur from shading as shading would affect the type of vegetation that could be established in these areas. At-grade and trench profiles would result in long-term loss of wetland and buffer acreage due to placing fill material in wetlands, excavating wetlands, or grading activities for new at-grade or trench guideways, stations, retaining and sound walls, and stormwater facilities. Grading and filling of wetlands can permanently change the capacity of a wetland to perform particular functions such as storing stormwater, filtering pollutants, protecting stream banks and providing habitat for wildlife. Elevated alignments would result in a smaller long-term footprint, allowing for retention of more wetland area and regeneration of vegetation under elevated structures, whereas at-grade alignments would permanently convert wetlands to a developed condition.

Wetlands Impacts by Alternative

SR 99 Alternative

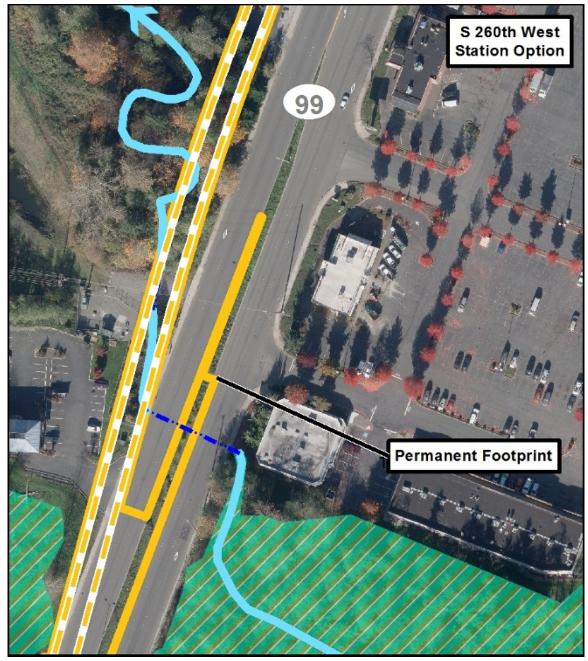
The SR 99 Alternative would be elevated, with the exception of some station options that include trenches, and would have impacts on less than 0.1 acre of wetland and 0.2 acre of wetland buffer. Although elevated structures can minimize the amount of permanent ground disturbance, the amount of sunlight available to the vegetation underneath may be reduced, resulting in shade-related impacts. Elevated guideway structures would be approximately 40 feet wide and more than 15 feet above the ground surface in most places; thus,



Inset B1 to Exhibit 4.9-2: SR 99 Alternative at McSorley Creek

shading and other impacts on vegetation would likely be minimal.

The SR 99 Alternative would result in less than 0.1 acre of long-term impacts on wetlands and 0.2 acre of long-term impacts on wetland buffers. This alternative could have up to 0.6 acre of additional wetland impact and 0.6 acre of additional wetland buffer impact if the Kent/Des Moines HC Campus Station Option, the S 260th East Station Option, and the S 272nd Redondo Trench Station Option were all selected. A segment of the S 272nd Redondo Trench Station Option would require trenching within a small portion of the McSorley Creek Wetland that adjoins the east side of SR 99.

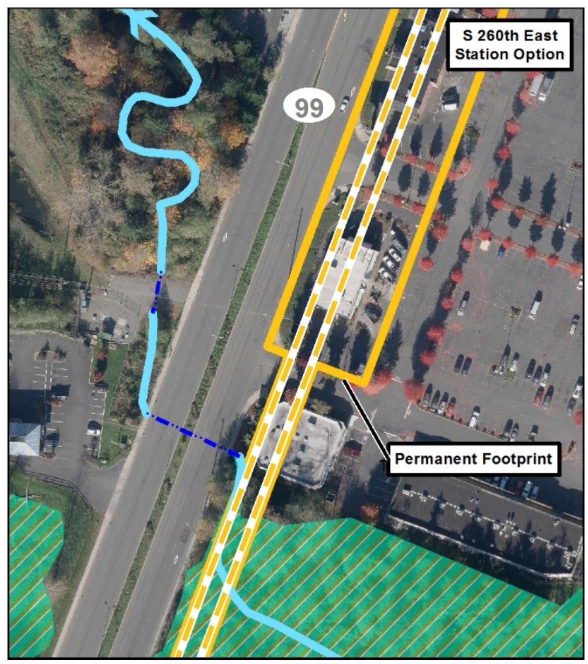


Inset B2 to Exhibit 4.9-2: S 260th West Station Option at McSorley Creek

I-5 Alternative

The I-5 Alternative would primarily be at-grade, which would permanently convert existing vegetated land and wetlands to a developed condition within the area of the project footprint.

The I-5 Alternative would result in a total of 1.1 acres of long-term impacts on wetlands, and 1.1 acres of long-term impacts on wetland buffers. This alternative could have up to 0.1 acre of additional wetland impact and 1.2 acres of additional wetland buffer impact if the Kent/Des Moines At-Grade Station Option and the Federal Way S 320th Park-and-Ride Station Option were both selected.



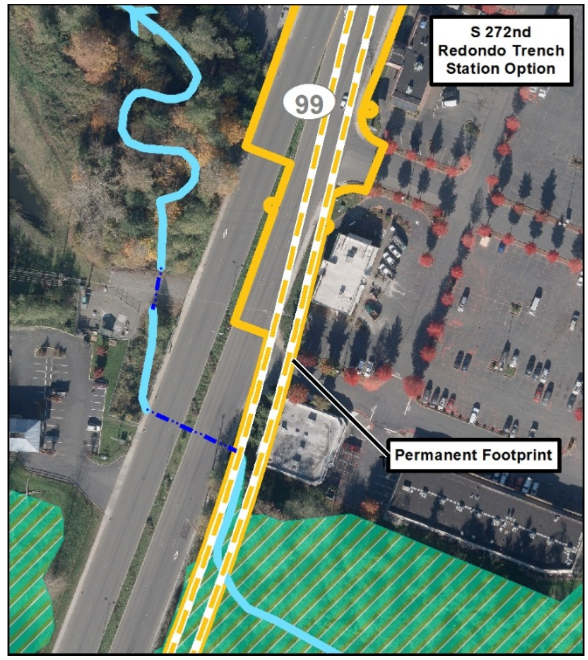
Inset B3 to Exhibit 4.9-2: S 260th East Station Option at McSorley Creek

SR 99 to I-5 Alternative

The SR 99 to I-5 Alternative would result in a total of 0.5 acre of long-term impacts on wetlands and 0.9 acre of long-term impacts on wetland buffers. It could have up to 0.7 acre of additional wetland impact and 0.2 acres of additional wetland buffer impact if the Federal Way S 320th Park-and-Ride Station Option were selected.

I-5 to SR 99 Alternative

The I-5 to SR 99 Alternative would result in less than 0.1 acre of long-term impacts on wetlands, and 0.3 acre of long-term impacts on wetland buffers. It could have up to 0.4 acre of additional wetland and wetland buffer impact if the S 260th East Station Option and S 272nd Redondo Trench Station Option were selected.



Inset B4 to Exhibit 4.9-2: S 272nd Redondo Trench Station Option at McSorley Creek

Streams and Aquatic Habitat

Impacts on streams could occur when alternatives either cross a stream or are parallel to a stream. Details of each stream impact are described below by alternative.

Stream and Aquatic Habitat Impacts by Alternative

SR 99 Alternative

Where the SR 99 Alternative would cross a stream channel, the structure would span the stream with the guideway columns on either side beyond the stream banks. This configuration would have little to no direct effect on in-stream habitat, with some effects on the surrounding riparian areas if trees and vegetation were lost. After construction, these areas could be replanted with native vegetation, and could result in habitat improvement. However, the presence of an elevated guideway near streams could preclude forest habitat development in those areas, reducing the potential for the recruitment of large woody material to adjacent streams. Shading from the structure may provide overhead cover and temperature regulation otherwise lost from removal of mature riparian vegetation. Additional noise and human activity associated with the operation of the FWLE would have minimal impacts on fish species since the study area streams are within highly urbanized environments.

The SR 99 Alternative would cross three streams, with no impacts on the Massey Creek stream buffer, less than 0.1 acre on the McSorley Creek stream buffer, and less than 0.1 acre on the Redondo Creek stream buffer. There would be no impacts on the stream channels themselves because all three channels are in culverts under SR 99 (Table 4.9-3). This impact could increase to 0.7 acre of stream buffer impact if the Kent/Des Moines HC Campus Station Option, the S 260th West Station Option, and the S 272nd Redondo Trench Station

Option were all chosen. All station and alignment options would continue to span the three creeks in the SR 99 study area and would avoid long-term impacts on the creeks.

I-5 Alternative

The I-5 Alternative would be located on the west side of I-5 and would be within WSDOT right-of-way south of Kent-Des Moines Road. Where streams are parallel to the I-5 Alternative, multiple columns would need to be placed within or in proximity to the stream channel for the distance where they are parallel, and impacts on the stream would consequently be more pronounced. Portions of the stream could be rerouted to avoid the columns, or column placement could be adjusted in order to span as much of the existing stream channel as possible.

The small unnamed stream south of Kent-Des Moines Road would not be affected beyond a small portion of the buffer for this stream, amounting to less than 0.1 acre. This small channel contains poor habitat and is not known to be inhabited by fish; none were observed during the field visit. Any impacts would occur outside the stream channel, and consequently there would be no effects on fish. An artificial drainage ditch on the north side of the McSorley Creek Wetland lies parallel to the I-5 corridor, but would not be directly impacted.

North of S 288th Street, Bingaman Creek flows north parallel to and west of I-5 within a wooded area approximately 300 feet wide (see Exhibit 4.9-4). The creek would be located directly under the I-5 Alternative, resulting in long-term impacts on 0.2 acre of the existing stream channel and 2.4 acres of the riparian forest buffer along this reach. Elevated guideways and columns placed alongside a stream channel would have impacts on the riparian vegetation and bank characteristics that would reduce large woody debris (LWD) and nutrient inputs and vegetative cover to the stream bank and channel.

On the north side of S 288th Street there is undeveloped forested land on the west side of Bingaman Creek that is a potential location for the realignment of the stream channel. Realigning portions of a stream channel to avoid columns could alter the hydrology of the reach and would also affect flows and sedimentation downstream. To avoid loss of stream habitat, rerouting would only be feasible in areas where undeveloped space allowed for recreating a functional stream channel with riparian vegetation outside the light rail footprint. The new recreated stream channel could improve habitat by creating structure such as meanders, riffles, and pools, and placement of LWD. If no potential area for rerouting the stream channel exists, then the stream would likely have to be conveyed through an artificial channel or piped, and would result in a loss of fish habitat within the affected reach. This stream channel was observed to be dry during a field visit in January 2014 and would therefore most likely remain dry in late summer as well. If construction occurred during this dry period, then impacts on any fish inhabiting the stream would be avoided and fish could resume use of the modified channel when flows return.

To the south of S 288th Street, Bingaman Creek lies between an I-5 sound wall to the east and a narrow band (up to 50 feet wide) of forested area to the west that adjoins a mobile home park. Given the narrow, steep banks in this location and the low elevation of the guideway, placement of the guideway columns in this corridor would most likely require relocating and piping the creek within the I-5 right-of-way. Piping this reach would impact any fish species that inhabit this area, although existing habitat is poor and no fish were observed during the field visits. Small species such as sculpin could potentially inhabit this reach and would be displaced by the guideway through this reach.

The I-5 station and alignment options would not have any additional impacts on streams or stream buffers.

SR 99 to I-5 Alternative

The SR 99 to I-5 Alternative avoids most of the stream crossings in the study area, but would have the same direct impacts on Bingaman Creek associated with the I-5 Alternative described above. The SR 99 to I-5 station options would not have any additional impacts on streams or stream buffers.

I-5 to SR 99 Alternative

The I-5 to SR 99 Alternative would span McSorley Creek and Redondo Creek with no direct impacts on the creeks and less than 0.1 acre of impact on stream buffers. Impacts would be greater with some station and alignment options, with up to 0.5 acre of additional stream buffer impact with the S 260th East Station Option and the S 272nd Redondo Trench Station Option.

Vegetation and Wildlife

Vegetation and Wildlife Impacts Common to All Alternatives

The amount of forest cover removed for each build alternative is used to indicate the potential for long-term adverse effects on vegetation and wildlife (Table 4.9-3). The clearing of trees, snags, and understory vegetation for project construction would result in the loss of nesting and foraging sites for many species of birds, as well as reduced availability of hiding cover for small mammals. As with wetland vegetation, elevated structures would have less impact on upland vegetation than at-grade trackways, although forested vegetation would be permanently converted to herbaceous and shrub vegetation cover under elevated guideways. Where the tracks would be at-grade there would be long-term loss of all vegetation within the project footprint. The vegetation management zone that extends 15 feet beyond the footprint of the rail is considered a long-term impact on forested vegetation and wildlife habitat because forested vegetation would not be allowed to regenerate in this area.

Potential impacts of alignments in forested areas would include habitat loss and an increased risk of introducing or spreading invasive species. The risk of disturbance to wildlife due to increased human access, noise, and light would be low because the affected areas are located close to roadways and urban development. The alignments in the areas with the greatest amount of forest cover along I-5 and around McSorley Creek east of SR 99 are located along the edges of these areas near the roadways. None of the proposed alignments cut through the middle of any large undisturbed areas and consequently the potential for fragmentation of wildlife habitat is minimal. The FWLE corridor is highly urbanized and is located alongside existing roadways. Where alignments would be elevated, passage of ground-dwelling animals underneath would be maintained. Impacts on vegetation and habitat are summarized in Table 4.9-3.

Vegetation and Wildlife Impacts by Alternative

SR 99 Alternative

The SR 99 Alternative would result in a total of 3.5 acres of forested cover removed. The potential additional station at S 216th Street (East option), Kent/Des Moines SR 99 East Station Option, Kent/Des Moines HC Campus Station Option, Kent/Des Moines SR 99 Median Station Option, and Federal Way Transit Center SR 99 Station Option would reduce these impacts by traveling through more developed areas, while the potential additional station at S 216th Street (West option), both options (West and East) for the potential additional station at S 260th Street, and the S 272nd Redondo Trench Station Option would increase these impacts. The options for the SR 99 Alternative could result in a range of 1.6 to 7.6 acres of long-term impacts.

I-5 Alternative

The I-5 alternative would result in a total of 35.4 acres of forested cover removed. The Kent/Des Moines At-Grade Station Option, Kent/Des Moines SR 99 East Station Option, Landfill Median Alignment Option and Federal Way I-5 Station Option would reduce these impacts by traveling through more developed areas, while the Federal Way Transit Center S 320th Park-and-Ride Station Option would increase these impacts. The options for the I-5 Alternative could result in a range of 31.2 to 37.1 acres of long-term impacts.

SR 99 to I-5 Alternative

The SR 99 to I-5 alternative would result in a total of 29.1 acres of forested cover removed. This area could increase if the S 216th West Station Option and the Federal Way Transit Center S 320th Park-and-Ride Station Option were also selected. The options for the SR 99 to I-5 Alternative could result in a range of 28.5 to 31.2 acres of long-term impacts.

I-5 to SR 99 Alternative

The I-5 to SR 99 alternative would result in a total of 5.1 acres of forested cover removed. This would decrease if the Federal Way Transit Center SR 99 Station Option were selected, and would increase if one of the S 260th Street potential additional station options and the S 272nd Redondo Trench Station Option were selected. The options for the I-5 to SR 99 Alternative could result in a range of 4.7 to 8.8 acres of long-term impacts.

Threatened and Endangered Fish and Wildlife Species, Species of Concern, and WDFW Priority Species

Potential long-term impacts on threatened and endangered species (aquatic and terrestrial) include direct mortality, disturbance and displacement effects, and loss or degradation of habitat. Following the identification of a preferred alternative, compliance with the ESA would be assessed and documented through a No Effect memorandum, Biological Assessment, or other ESA documentation.

The assessment will also include a review of potential effects on EFH, as required by the Magnuson-Stevens Fishery Conservation and Management Act.

4.9.4.3 Indirect Impacts

Indirect impacts from operations could result in long-term wetland degradation from stormwater discharges, and alterations in wetland hydrology; however, proper stormwater detention and treatment activities could minimize long-term indirect effects on wetlands.

For aquatic species and habitat, indirect impacts resulting from any of the build alternatives would be minimal due to the heavily developed surrounding areas. The FWLE would not interfere with future projects that may provide habitat improvements, such as the replacement of culverts under SR 99 that are currently fish barriers, or projects that may enhance vegetated and wetland areas in the project corridor. Further design and evaluation of compatibility with crossing of culverts would occur during preparation of the Final EIS.

Long-term impacts on vegetation, wildlife, and wildlife habitat could include disturbance due to increased human access. The introduction of public rail transit in the area would have minor reductions in vehicular traffic on the roadways in the project vicinity compared to the No Build Alternative. This would reduce automotive greenhouse gas emissions and contaminated stormwater runoff from roadways. Indirect effects from potential future development that could be induced by the FWLE would be subject to review under applicable federal, state, and local regulations. This review would trigger the implementation of measures and practices aimed at avoiding or minimizing the potential indirect adverse effects on wetlands, aquatic species and habitat, and other natural resources.

4.9.5 Potential Mitigation Measures

Sound Transit's policy on ecosystem mitigation is to avoid impacts on environmentally sensitive resources and provide adequate mitigation for unavoidable impacts to ensure no net loss of ecosystem function and acreage as a result of Sound Transit projects. Mitigation for ecosystem impacts would be based on a prioritized sequence of avoiding, minimizing, and compensating for unavoidable adverse impacts.

4.9.5.1 Avoidance and Minimization Measures

Sound Transit would avoid and minimize adverse operational effects of the FWLE on wetlands through design to the extent practicable.

Design aspects that could be incorporated into the project include elevated guideways, siting support columns and other elevated guideway features to span and avoid direct impacts on wetlands, and using retaining walls to reduce the at-grade footprint of guideway sections, thus reducing the extent of fill in wetlands.

Sound Transit would also design permanent stormwater treatment facilities and flow-control measures to minimize impacts on stream water quality and flow (as described in Section 4.8, Water Resources). The risk of introducing or spreading invasive species would be minimized by replanting and by implementing best management practices (BMPs) to avoid, reduce, and control the spread of invasive weeds.

Existing stream channels and culverts would be largely avoided by the project alternatives, with the exception of the I-5 Alternative at Bingaman Creek. In this location the stream channel would need to be relocated and a portion potentially conveyed within a new culvert. The new stream channel for the relocated portion would be constructed to incorporate habitat structure such as LWD and pools to improve fish habitat from the existing conditions. Sound Transit would design culverts conveying fish-bearing or potentially fish-bearing streams to comply with federal, state, and local permit conditions, and tribal consultation.

Tree removal along the I-5 corridor would be minimized in association with the I-5 and SR 99 to I-5 alternatives and would be mitigated according to the WSDOT *Roadside Policy Manual* (WSDOT, 2014). Tree removal outside of WSDOT right-of-way would be mitigated to comply with local jurisdictions' tree retention requirements. Operational effects on vegetation, wildlife, and wildlife habitat would be minimized to the extent practicable by minimizing the project footprint through forested areas and connected riparian corridors.

4.9.5.2 Compensatory Mitigation

To the extent that impacts cannot be avoided or adequately minimized, Sound Transit would provide compensatory mitigation to achieve no net loss of ecosystem function and acreage.

Long-term impacts on wetlands and wetland buffers would be mitigated by replacing resources through the use of available approved wetland mitigation banks, the King County in-lieu-fee program, advanced mitigation or through project-specific mitigation developed by Sound Transit. Compensatory mitigation would be implemented in accordance with applicable federal, state, and local requirements and guidelines, and to the extent possible, mitigation sites would be identified close to impacts and compensated for lost values in-kind. Potential sites under consideration for project-specific wetland mitigation have not yet been identified; however, publicly owned portions of the McSorley Creek Wetland may provide opportunities for mitigation through enhancement.

Mitigation for unavoidable impacts on other ecosystem resources (e.g., streams, stream buffers, vegetation and wildlife habitat) that are protected under federal, state, and local regulations would also be provided. With the exception of Bingaman Creek, the project design would avoid impacts on existing streams, but some unavoidable impacts on stream riparian areas would be mitigated by improving stream habitat and riparian function by replanting affected areas with native vegetation. The loss of open channel in Bingaman Creek could be mitigated by providing improved habitat in a new channel that could be constructed on private property to the west of the I-5 Alternative, north of S 288th Street. Compensatory mitigation may be required for the stream impacts south of S 288th Street where the stream cannot be relocated. Based on consultation with WDFW and the Muckleshoot Tribe, the most beneficial mitigation opportunities may be downstream, east of I-5.

4.10 Energy Impacts

4.10.1 Summary

Operation of the Federal Way Link Extension (FWLE) would result in a slight reduction of passenger and transit vehicle miles traveled as people shift to the light rail system. Overall, FWLE operation is projected to result in 0.1 percent less energy use than the No Build Alternative.

4.10.2 Introduction to Resources and Regulatory Requirements

Operation of motor vehicles, commuter trains, and light rail in the Puget Sound Region consumes large amounts of energy. This section estimates the amount of energy that would be consumed by vehicles operating within the study area, including FWLE light rail, automobile, and other transit use.

There are no federal, state, or local laws that regulate energy consumption in the transportation sector. Many state, local, and regional transportation plans and policies identify goals for the efficient use of energy and energy conservation.

Sound Transit implemented a Sustainability Plan that encourages car trip reduction, the efficient use of energy in operations and facilities, and the use of construction practices that incorporate recycling, salvage, and greenhouse gas reduction.

4.10.3 Affected Environment

The study area for the energy impacts analysis is the same as the study area for the regional transportation analysis (the Puget Sound Regional Council (PSRC) four-county region, which includes King, Pierce, Snohomish, and Kitsap counties) because the regional travel model for vehicle miles traveled (VMT)/ vehicle hours traveled (VHT) includes all four counties. This section discusses the existing energy use and supply in the study area. Detailed information about energy use in the study area is not available; therefore, Sound Transit used state-level energy data to estimate energy consumption at the local level.

4.10.3.1 Washington State Energy Consumption Trends

According to the Energy Information Administration, over 2,060 trillion British thermal units (Btu) of energy were consumed in Washington in 2010 (U.S. Energy Information Administration, 2012a), enough energy to meet the needs of nearly 23 million households (Clean Technica, 2012). From 1980 to 2000, Washington's per capita energy consumption was approximately 250 million Btu (MMBtu), which is the energy equivalent of approximately 2,000 gallons of gasoline per person (Washington State Department of Commerce, 2012). More recently, the state's per capita energy consumption has been closer to 200 MMBtu as a result of higher fuel prices, the decline of the aluminum manufacturing industry in the state, and a downturn in the national and regional economy (Washington State Department of Commerce, 2012).

In 2010, the transportation sector in the state of Washington consumed approximately 328.6 trillion Btu of gasoline and approximately 114.6 trillion Btu of distillate fuel (U.S. Energy Information Administration, 2012b). This accounts for approximately 22 percent of all energy consumed in the state. Table 4.10-1 presents daily VMT and energy consumption by transportation mode for the region. According to the PSRC traffic model and the Sound Transit ridership model, the existing daily VMT for the study area is approximately 87.6 million. The daily energy use by the different transportation modes is approximately 5.7 x 10^{11} Btu (572,350 MMBtu).

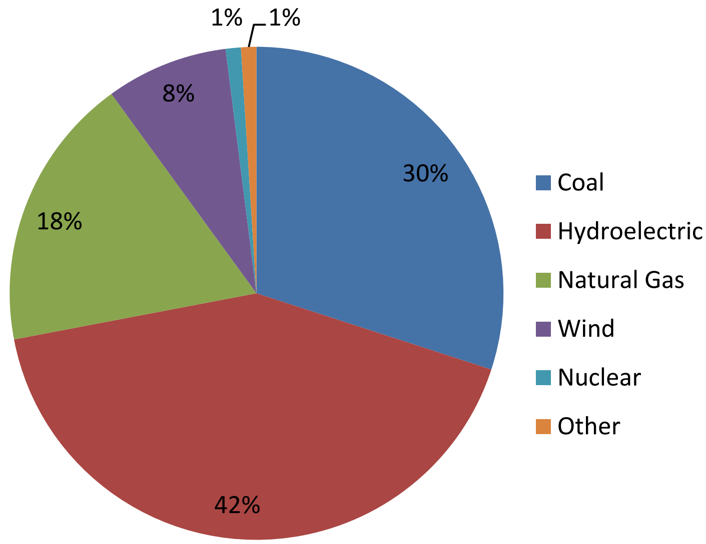
TABLE 4.10-1
Study Area Existing Daily Vehicle Miles Traveled and Energy Consumption (2012)

Vehicle Type	Energy Consumption Rate (Btu per mile)	Existing Conditions	
		Daily VMT[a]	MMBtu
Passenger Vehicle	5,807[b]	83,766,970	486,416
Heavy Duty Truck	21,698[b]	3,759,050	81,564
Transit Bus	37,718[b]	96,000	3,621
Light Rail	33,068[c]	8,800	291
Commuter Rail	95,494[c]	4,800	458
Total		87,635,620	572,350

[a] Sources: PSRC, 2012; Sound Transit, 2012.
[b] Source: Oak Ridge National Laboratory, 2013.
[c] Source: Sound Transit, 2014.

4.10.3.2 Electricity Supply in Study Area

Puget Sound Energy, which provides electricity to the study area, is the largest energy utility in Washington and provides electric power to more than 1 million customers. Its electricity is generated using a number of different resources. In 2012, hydroelectric power accounted for 42 percent of the utility's power generation portfolio. Puget Sound Energy also produces power from thermal power plants, a large coal-fired generating facility in Montana, wind farms, and natural-gas-fired power plants in the Puget Sound Region. Exhibit 4.10-1 illustrates the utility's energy source mix.



Source: Puget Sound Energy, 2014.

EXHIBIT 4.10-1
Puget Sound Energy Source Mix, 2012

In 2013, Puget Sound Energy had peak power resources of approximately 4,800 megawatts (PSE, 2014). Of this total, the utility had about 3,600 megawatts of company-controlled power-generating capacity. The remaining power supply came from a variety of other utilities, independent power producers, and energy marketers across the western United States and Canada (PSE, 2014). Approximately 50 percent of the electricity Puget Sound Energy customers use comes from Puget Sound Energy-owned generation.

4.10.4 Environmental Impacts

The energy analysis evaluates operational energy use by the FWLE and the demand on regional energy supply.

Sound Transit estimated operational impacts from the VMT estimates by mode presented in the PSRC traffic forecast model. The study area total VMT estimates for light rail were modeled based on the projected operations plan for the combined Link system of light rail. The regional VMT was separated into passenger miles and heavy truck miles to account for differences in energy consumption levels. All energy consumed was converted to Btu to provide a common measure among all energy sources. The energy consumption rate (Btu per vehicle mile) for each motor vehicle type (cars, trucks and buses) was obtained from the *Transportation Energy Data Book, Edition 32* (Oak Ridge National Laboratory, 2013). The energy consumption rate for light rail and commuter rail vehicles was obtained from the Sound Transit Sustainability Inventory (Sound Transit, 2014). Energy consumption rates are listed above in Table 4.10-1. The VMT, energy consumption rate (Btu per mile), and total energy consumption for the No Build and Build alternatives are presented in Table 4.10-2. The light rail VMT for the No Build Alternative includes the extension of the light rail system to Lynnwood in the north and Overlake Transit Center in the East.

TABLE 4.10-2
Daily Vehicle Miles Traveled and Energy Consumption

Vehicle Type	Energy Consumption Rate (Btu per mile)	2035 No Build Alternative		2035 Build Alternatives		% Change in Btu from No Build Alternative
		Daily VMT[a,b]	MMBtu	Daily VMT[b]	MMBtu	
Passenger Vehicle	5,807[c]	97,934,180	568,681	97,780,490	567,789	-0.2%
Heavy Duty Truck	21,698[c]	5,826,200	126,417	5,825,700	126,406	0.0%
Transit Bus	37,718[c]	107,500	4,055	107,200	4,043	-0.3%
Light Rail	33,068[d]	32,800	1,085	36,800	1,217	12.2%
Commuter Rail	95,494[d]	7,600	726	7,600	726	0.0%
Total		**103,908,280**	**700,963**	**103,757,790**	**700,181**	**-0.1%**

[a] Source: PSRC, 2012.
[b] Source: Sound Transit, 2012.
[c] Source: Oak Ridge National Laboratory, 2013.
[d] Source: Sound Transit, 2014.

4.10.4.1 No Build Alternative

Under the No Build Alternative, the daily VMT for the study area is projected to increase from approximately 87.6 million in 2012 (see Table 4.10-1) to approximately 103.9 million in 2035. The No Build Alternative would place additional demands on energy in the region as a result of increased passenger trips, greater levels of congestion, and slower speeds and, therefore, increasing greenhouse gas emissions. However, the additional demand on the electric utilities that the light rail system would place on the electric grid would not occur.

4.10.4.2 Build Alternatives

All build alternatives would be of similar length and ridership; therefore, this analysis applies to direct impacts for all alternatives.

No indirect impacts would occur. Construction impacts related to energy are discussed in Chapter 5.

When compared to the No Build Alternative, the FWLE would result in a slight regional reduction of passenger and transit vehicle miles traveled, and therefore less energy consumption, as people shift to the light rail system.

Operation of the light rail system would place a demand on the local electrical utility, Puget Sound Energy. Under the build alternatives, light rail vehicles are expected to travel 4,000 more total rail car miles per day than the No Build Alternative. This additional mileage is expected to result in energy use of approximately 132 MMBtu per day, or 38.7 megawatt hours (MWh) per day. Assuming that the light rail system would operate 365 days per year, the additional annual MWh consumed by the Build alternatives would be nearly 14,000 MWh. This represents less than 0.1 percent of the total Puget Sound Energy 2011 power generation. Overall, energy use during project operation is projected to result in 0.1 percent less energy use than the No Build Alternative.

4.10.5 Potential Mitigation Measures

Operation of the FWLE is expected to consume less energy overall than the No Build Alternative. It is not expected to overburden the electric utilities' power availability; therefore, no mitigation would be required. During final design, Sound Transit would investigate methods of reducing energy use during operations as part of its Sustainability Initiative.

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